

46-F-279 M

TROOPS BRIDGE

LOTS 21/22, CON. 2

CARADOC TWP.

B.A. 2360
Site 19-335

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LONDON ONTARIO.

Report on
SOIL INVESTIGATION
for
TRCOPS BRIDGE
LOTS 21 & 22, CONCESSION 2
TOWNSHIP OF CARADOC

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No. 6-5-L2
June 2nd, 1966

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I INTRODUCTION

In accordance with a letter of authorization, dated May 12, 1966, a soil investigation has been carried out in the Township of Caradoc where it is proposed to construct a new bridge across the C.N.R. railway.

The structure will be located on Lots 21 and 22, Concession 2 of the Township and is named Troops Bridge.

It is understood that the proposed structure is a 3 span precast concrete girder type with an overall span of about 120 feet. The requirements of the project were discussed with Mr. N. M. Warner, 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 during the period May 11 to 13, 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 the top of rail at the centre line of the bridge, El. 810.63 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 encountered loose sandy and clayey silt deposits which extend from the ground surface to a depth of 4.5 feet. These deposits are probably fill material which was excavated during construction of the railway cut at this section of the track.

Natural subsoil was encountered at El. 814⁺ in both boreholes and consists of sandy silt soil down to the limit of the boreholes at a depth of 35 feet. Grain size analyses of this stratum, which are plotted on Enclosures 5 and 6, indicate that the soil consists of 75% medium to coarse silt and 25% fine sand. The relative density of the stratum is estimated to be 'dense' to 'very dense' based on standard penetration test results ranging from 26 blows per foot to refusal values of 100 blows for less than 1 foot penetration of the sampler.

The colour of the silt stratum changes from brown to grey at El. 790⁺, and indicates that the low summer water table is at about this elevation. The water levels observed in the boreholes can be attributed partly to washwater used in the boring operation and partly to the excessive rainfall prior to commencement of the drilling.

IV DISCUSSION

It is understood that the bridge will have three spans of about 40 feet supported by piers on spread footings at each side of the track and abutments supported on either piles or spread footing foundations.

Piers

The top of the rail is at El. 810.63, therefore the pier footings will be supported at about El. 805 to provide sufficient cover for frost protection. This elevation lies within the stratum of dense sandy silt and on the basis of the borehole results, a maximum allowable soil pressure of 8000 p.s.f. may be used in the design of footings. Total settlement of footings mobilizing the above soil pressure is estimated to be less than 1/2 inch.

Abutments

The abutments may be supported on spread footings at or below El. 813 using a maximum allowable soil pressure of 8000 p.s.f. Total settlement of footings mobilizing the above soil pressure is estimated to be less than 3/4 inch.

Alternatively stub abutments may be supported on piles driven into the very dense sandy silt stratum. It is estimated that concrete filled steel tube piles will develop their full working load when driven into the very dense sandy silt material, therefore the depth of penetration will depend on the length of embedment required for lateral support. Also, due to the

very dense nature of the subsoil, it may be necessary to use jetting or pre-augering to achieve the required depth of penetration.

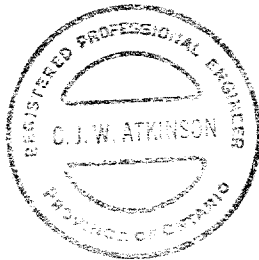
For preliminary design purposes, it is estimated that 10-inch and 12-inch diameter steel tube piles will develop working loads of 40 and 50 tons respectively. In practice the piles should be driven to a satisfactory set in accordance with a recognised dynamic pile driving formula.

Construction

The sandy silt subsoil is susceptible to disturbance by the 'pumping' action of heavy equipment. It is therefore recommended that excavations be carried out by a back-hoe type of machine in order to keep disturbance to a minimum. The footing grade should be inspected to confirm that no loose or disturbed soil is present.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



A handwritten signature in dark ink, appearing to read "C.J.W. Atkinson".

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

CJWA:jms

DOMINION SOIL INVESTIGATION LIMITED

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
$\phi > 8"$	$3"$	$3/4"$	4.75mm	2.0	0.42	0.075	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
 " 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 :



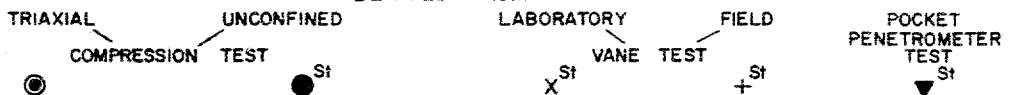
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SOIL PROPERTIES.

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 total stress
PL % Plastic limit	RD Relative density	ϕ Angle of int. friction in terms of effective stress
PI % Plasticity index	C_v Coeff. of consolidation	ϕ' Cohesion
LI Liquidity index	m_v Coeff. of volume compressibility	ϕ' Angle of int. friction

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

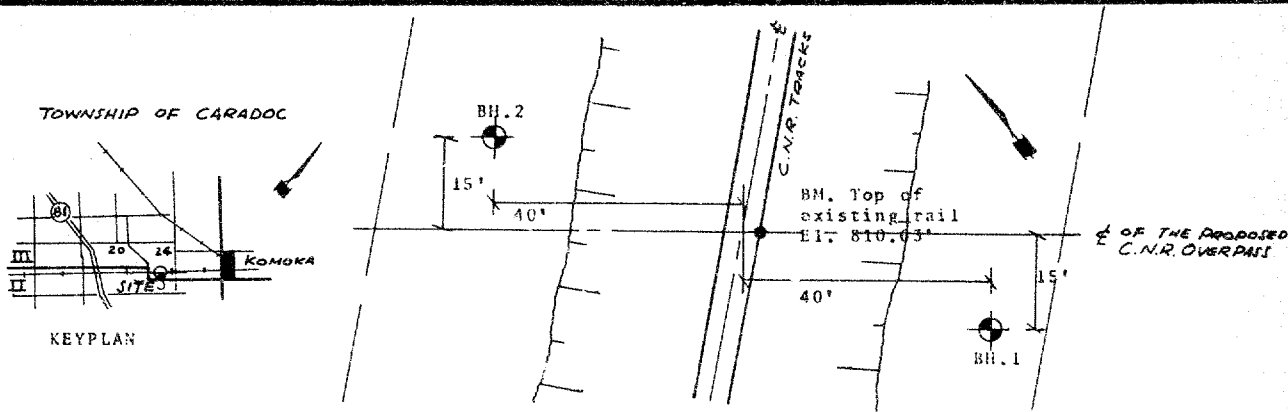


Strain at failure is represented by direction of stem
 20%
 15%
 10%
 5%

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

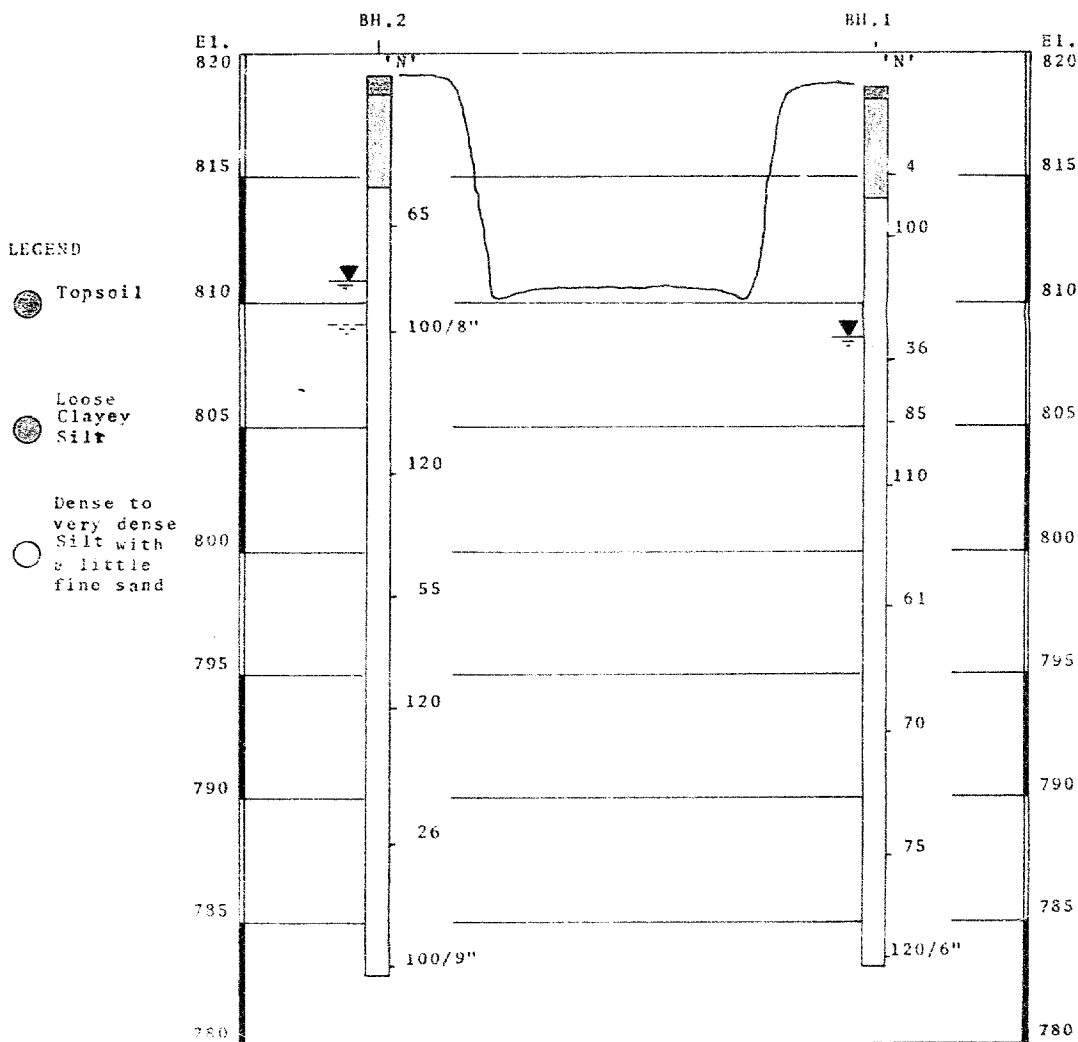
SOIL DESCRIPTION.

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 20 feet



SUBSURFACE PROFILE
Vert. Scale 1-inch to 5 feet

GEOTECHNICAL DATA SHEET FOR BOREHOLE

OUR REFERENCE NO 6-5-12

CLIENT: R. C. Dunn & Associates
PROJECT Troops Bridge
LOCATION Township of Caradoc
DATUM ELEVATION:

METHOD OF BORING Washboring
DIAMETER OF BOREHOLE Bx (3-inch)
DATE May 13, 1966

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	N ₆₀ or Adjustment of Sampler	20	40	60	80	100	PL	W	LI	
818.2	0.0	Ground Surface													
	0.5	Topsoil													
815	4.5	Loose brown clayey sandy silt.		1	SS	4									
				2	SS	100									
810		Dense to very dense		3	SS	36									
805		brown medium to coarse		4	SS	85									
800		silt, with a little fine sand.		5	SS	110									
795				6	SS	61									
790				7	SS	70									
785				8	SS	75									
35.8		grey End of borehole		9	SS	120	6"								

W. L.
El. 808.2
May 13,
1966

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 2 . . .

OUR REFERENCE NO 6-5-L2

CLIENT: R. C. Dunn & Associates
PROJECT: Troops Bridge
LOCATION: Township of Caradoc
DATUM ELEVATION:

METHOD OF BORING Washboring
DIAMETER OF BOREHOLE Bx (3-inch)
DATE May 11 & 12, 1966

ENCLOSURE NO. 4

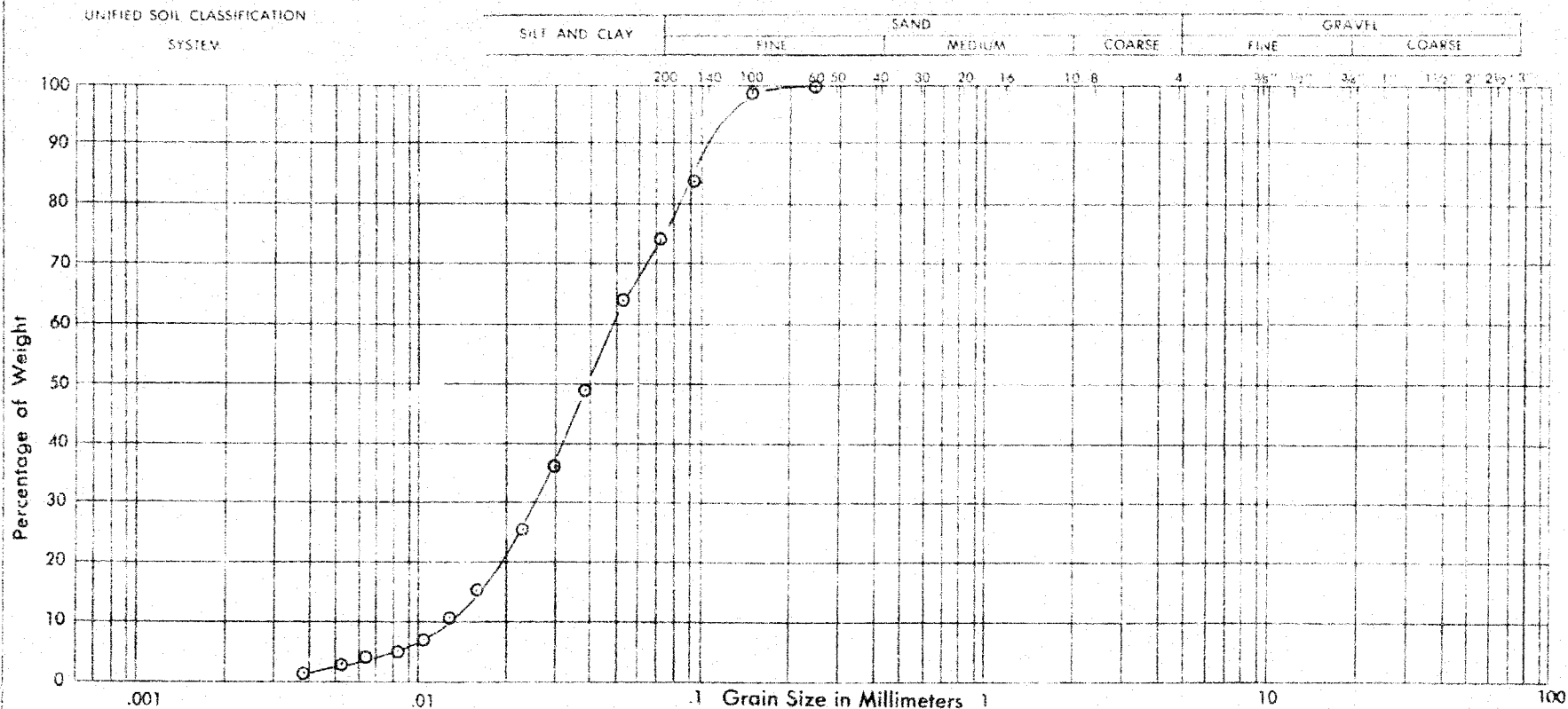
ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	Advancement of Sampler	20	40	60	80	100	PL	W	LI	
819.1	0.0	Ground Surface													
	0.8	Topsoil													
		Brown clayey silt, trace of organics													
815	4.5														
		Dense		1	SS	65									
		to													
810		very		2	SS	100/									
		dense													
		brown													
805		medium		3	SS	120									
		to													
800		coarse													
		silt,		4	SS	55									
		with													
795		a													
		little		5	SS	120									
		fine													
790		sand.													
		grey		6	SS	26									
785															
36.3				7	SS	100/									
		End of Borehole													

W. L.
El. 810.9
Cave-in
El. 809.1
May 13,
1966

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GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 6-5-L2



PROJECT: Troops Bridge
 LOCATION: Twp. of Caradoc
 BOREHOLE NO.: 1
 SAMPLE NO.: 2
 DEPTH OF SAMPLE: 5 feet
 ELEVATION OF SAMPLE: 813

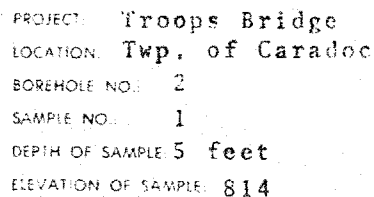
COEFFICIENT OF UNIFORMITY 3.5
 COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:
 MEDIUM TO COARSE SILT WITH A LITTLE
 FINE SAND

PLASTIC PROPERTIES:

LIQUID LIMIT % 11
 PLASTIC LIMIT % 11
 PLASTICITY INDEX % 11
 MOISTURE CONTENT % 1
 ACTIVITY =

OUR REFERENCE NO. 6-5-L2



Classification of Sample and Group Symbol:
MEDIUM TO COARSE SALT WITH A LITTLE
FINE SAND.

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