BA 1395

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105 PINE STREET
ANCASTER - ONTARIO

REPORT ON SUBSOIL INVESTIGATION FOR VAN NORMAN BRIDGE - OVER THE COX CREEK IN THE COUNTY OF WELLINGTON

OWNER: PILKINGTON TOWNSHIP

Submitted by

DOMINION SOIL INVESTIGATION LIMITED
77 Crockford Boulevard
SCARBOROUGH - ONTARIO

OUR REFERENCE: 2-3-26

April 1 9 6 2

C O N T E N T S

E N C L O S U R E S

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INTRODUCTION

A letter of authorization dated March 19th, 1962 was received from Mr. V. R. Astrop, Consulting Engineer, to conduct a foundation investigation at the site of a proposed bridge over the Cox Creek in Pilkington Township, County of Wellington.

The proposed project will replace the existing one, which is in a bad condition and does not meet the requirements of modern traffic.

The purpose of the investigation was to reveal the subsurface conditions and determine the necessary soil properties for the design and construction of foundations.

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S U M M A R Y

(1) THE TWO BOREHOLES DRILLED AT THE SITE REVEALED THE PRESENCE OF GLACIAL, DENSE DEPOSITS BELOW ELEVATION 89 FT. AVERAGE.

(2) THE GROUND WATER TABLE WAS AT AN AVERAGE ELEVATION OF 92 FT. THIS IS CONSIDERED TO BE THE HIGH GROUND WATER LEVEL.

(3) SPREAD FOOTINGS WILL BE CAPABLE OF SUPPORTING THE STRUCTURE PLACED AT OR BELOW ELEVATION 87 FT.

(4) NO SPECIAL DEWATERING MEASURES ARE REQUIRED PROVIDED THE FOOTING GRADE IS NOT MUCH BELOW ELEVATION 87 FT.

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I. DESCRIPTION OF SITE AND GEOLOGY

The site lies about 8 miles south of Elora. The existing bridge carries a gravel road over the Cox Creek, between Concessions II and III in Pilkington Township, Wellington County. The road runs parallel to and immediately west of the Canadian National Railway line. The farmland north of the site belongs to Mr. E. Van Norman and the elevation of the valley in which Cox Creek is running is about 1150 ft. above sea level.

The region is glaciated. It is a gently rolling "till plain" transected by an irregular network of spillways. These latter are broad valleys, which served as drainage paths for the meltwaters which spilled out at the edge of the ice shield and deposited debris carried by the ice. Later, they were occupied by a secondary stream. (Cox Creek is such a secondary creek).

Drumlins (i.e. oval shaped glacial hills, consisting of boulder-clay mostly) are the outstanding features of the landscape.

The area has been covered by ice several times during the Pleistocene Age. This geological event has important consequences from the point of view of engineering properties of the subsurface materials. The subsoil has undergone a tremendous loading thousands of years ago (i.e. the strata are highly preconsolidated).

II. FIELD AND LABORATORY WORK

Field work was carried out March 28th to 30th, 1962 and comprised two boreholes and two dynamic cone penetration tests at the locations shown on Enclosure #1. The positions of the test holes were set out on the site with the assistance of a drawing (Site Plan, Drawing No.1)

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provided to us. The locations of the boreholes were slightly changed to enable better set-up conditions. Elevations were measured relative to a spike in a telephone pole northeast from the bridge (=El.100.0).

The boreholes were of varying diameter. Nx casing was advanced first (3½" diameter) to a depth of 5 ft., then Bx casing (2 7/8" diameter) was driven telescopically to deeper strata. Boulders, cobbles slowed the advancement of casing in the boreholes. In the event such an obstacle was encountered, the holes were continued with a hawthorne bit. The cleaning was done either with an auger (the upper strata) or by washing.

Standard penetration tests were made at frequent intervals using a 2 in. outside diameter split spoon driven into the bottom of the clean borehole by a constant driving energy (140 pound hammer dropping 30 ins.). The dynamic cone penetration test is one type of deep sounding in which the Bx rods with a 2 in. diameter 60 degree apex cone driving point are driven into the subsoil without casing and applying the same driving energy as above. The former test provided disturbed samples of the substrata indicating their relative density and consistency and the latter a continuous record of soil density.

An approximate value of the unconfined compressive strength was obtained in the field using a pocket penetrometer.

The samples were shipped to our laboratory where they were thoroughly examined and classified. The results of this analysis together with the field penetration test data comprise the basis on which the geotechnical properties of the subsoil are being evaluated.

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The stratification of the subsoil, sampling depths, the results of the penetration and pocket penetrometer tests are recorded on geotechnical data sheets comprising Enclosures #2 and #3.

III. SUBSURFACE CONDITIONS

The stratigraphy of the subsoil can be the easiest visualized with the aid of a subsurface profile presented on Enclosure #1. The engineering properties of the individual strata are further discussed below. (The color representing the layer on the said profile stands in brackets after the name).

(a) Road fill (yellow). Borehole #1 was drilled through the approach embankment, hence the first material encountered consisted of silty gravel-sand, that is the building material of the fill.

(b) Organic, sandy soil (brown). Both boreholes were drilled in the immediate proximity of Cox Creek, which occupies the lowest portion of the valley. This soil is partly a flood deposit, partly sediment carried by the run-off from the sides of the valley. It has a high water content and it is in a loose or soft state.

(c) Silty sand with gravel, cobbles and boulders (orange). This non-uniform material was probably deposited by the spillway referred to in Paragraph I - Description of Site and Geology. A clayey silt layer was found in it around elevation 87 ft. and gravel and cobble pockets were encountered at other locations. These variations, of course, indicate the varying permeability of the deposit. Seepage of water will be negligible through the silty-clayey material; on the other hand, more water can enter the excavation through granular beds. The stratum is compact at the top and its density increases with depth.

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(d) Grey, hard, varved clay (indigo blue). Deposits such as this were formed during an inter-glacial period. They usually consist of alternating layers of two materials: in the present case, the one is a hard, dark grey silty clay (the thickness of beds is about 1/4" to ½") and the other is a very dense, slightly or non-cohesive clayey silt in a damp condition. The material is characteristically anisotropic; its properties vary with direction. It is an excellent foundation material.

(e) Grey, hard, clayey sandy silt (lavender). This is a typical glacial till - i.e. a nonsorted mass of all soil types: clay, silt, sand and embedded angular gravel, cobbles and boulders. In the present case, it is mostly silt with a considerable amount of sand and clay.

Ground water was encountered in both boreholes. They represent probably the highest position of the water table owing to the spring thaw season.

IV. DISCUSSION AND RECOMMENDATIONS

Design

The two main factors influence the selection of a suitable base level:

(i) the subsoil must be capable of supporting the foundations without detrimental settlements - and

(ii) no danger of erosion must exist.

Elevation 87 ft. is the recommendable highest footing grade. The bearing capacity depends on depth.

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Footing Grade		Gross Allowable Bearing Pressure
Elev. 87 to 85 ft.	-	4,000 psf
" 85 to 82 ft.	-	6,000 "
" 82 ft. or lower	-	8,000 " plus

The above values are based on the criterion that the settlements should not exceed one inch.

Construction

The suggested highest footing grade of 87 ft. means a minimum of seven ft. deep excavation, much of this below ground water table. Hence, consideration should be given to the dewatering. Owing to the relatively high density of the material and the presence of silt and clayey silt therein, no special dewatering may be required if the footing grade is close to the highest recommended elevation. Pumping should be done from a deep well dug in the corner of the excavation. (The success of this operation depends on the speed with which the excavations are carried out. They should be kept open for as short a period as possible and immediately after the footing grade has been reached, a lean concrete blanket should ascertain its watertightness).

If the footing grade is deeper and the water tends to loosen the base level, the best method of dewatering would be by enclosing the excavation by sheet piles driven into the varved clay. Thereafter, pumping can be done from the enclosed pit and the impermeable stratum below would limit the inflow of water through the bottom.

The removal of all organic, soft material from below approach fills is advisable. The embankments should be founded on the silty-gravelly sand.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

L. R. Szalatkay

L. R. Szalatkay, P.Eng.,
Senior Soils Engineer.

LRS/oed

Encls.

V. REFERENCES

(1) Procedures for Testing Soils - ASTM April 1958, pp 186 to 198. (Unified Soil Classification System - by A. A. Wagner).

(2) Terzaghi and Peck: Soil Mechanics in Engineering Practice. John Wiley and Sons, New York 1948.

(3) The Physiography of Southern Ontario by L.J.Chapman and D.F.Putnam of the Ontario Research Foundation - University of Toronto Press 1951.

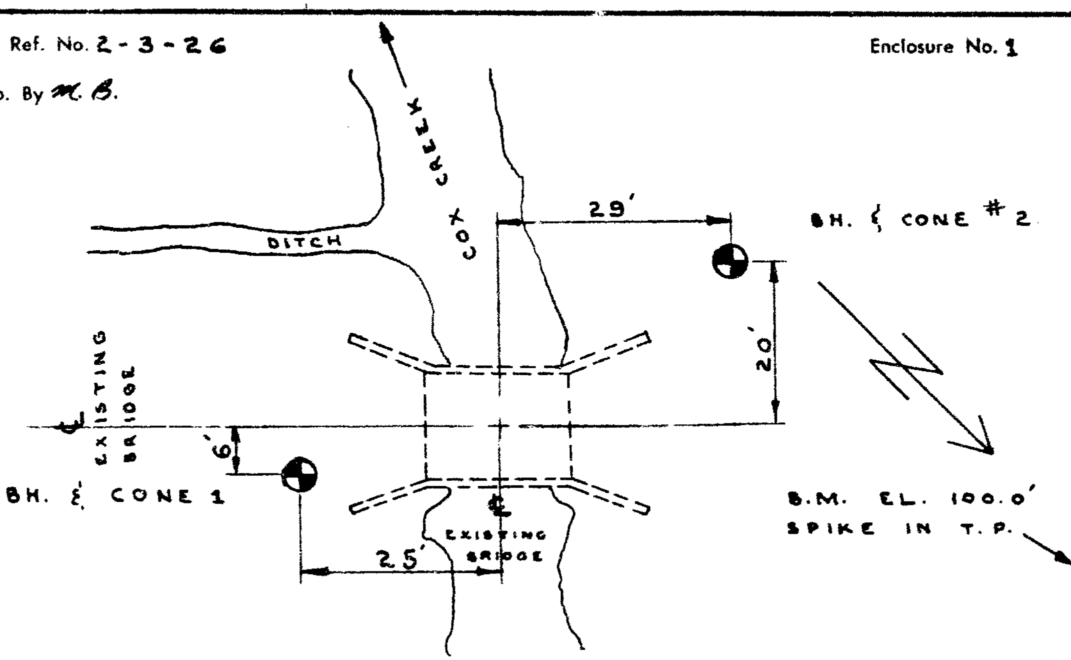
(4) Taschenbuch fuer Bauingenieure (Handbook for Civil Engineers - in German) by F. Schleicher, Berlin, 1955.

E n c l o s u r e s

Our Ref. No. 2-3-26

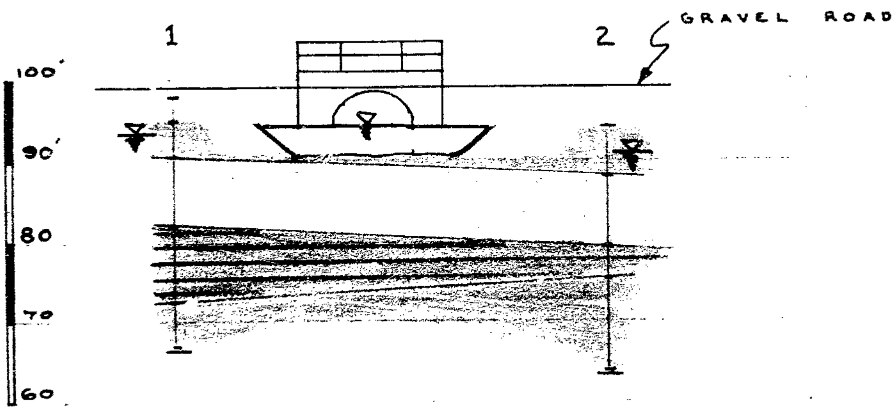
Prep. By M. B.

Enclosure No. 1



LOCATION OF BOREHOLES

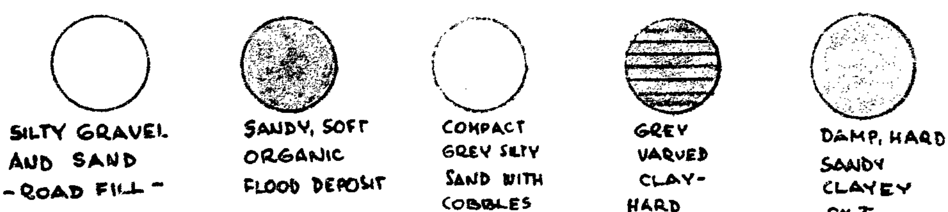
SCALE 1" = 20'



SUBSURFACE PROFILE

VERT. SCALE 1" = 20'

LEGEND



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GEOTECHNICAL DATA SHEET FOR BOREHOLE 1

OUR REFERENCE NO 2-3-26

CLIENT: V. R. ASTROP
PROJECT: VAN NORMAN BRIDGE
LOCATION: WELLINGTON COUNTY, ONTARIO
DATUM ELEVATION: 98.16

METHODE OF BORING WASHBORING
DIAMETER OF BOREHOLE 2 7/8"
DATE MAR. 30. 1962.

ENCLOSURE NO 2

ELEVATION	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	N or Advancement of Sampler	PENETRATION RESISTANCE (blows per foot) / SHEAR STRENGTH (lbs/sq ft)	CONSISTENCY water content %	REMARKS
98.16	0	ROAD FILL		1	SS	18			⟩ DENOTES DYNAMIC CONE PENETRATION RESISTANCE
95	5	SOFT, BROWN ORGANIC FLOOD DEPOSIT, HUMUS, SAND AND COBBLES (boulder)		2	SS	5			○ STANDARD PENETRATION RESISTANCE
90	10	COMPACT GREY SILTY SAND WITH GRAVEL & COBBLES (clayey silt layer)		3	SS	19			+ SHEAR STRENGTH AS MEASURED BY POCKET PENETROMETER
85	15			4	SS	28			
80	20	ALTERNATING, GREY LAYERS OF HARD CLAY AND VERY DENSE SILT - varved structure -		5	SS	43			NO CASING WAS USED BEYOND 20' DEPTH
75	25			6	SS	33			DENOTES WATER LEVEL
70	30	GREY, DAMP TO MOIST, HARD SANDY SILT WITH GRAVEL		7	SS	100/4"			DENOTES WHERE BOREHOLE CAVED IN UPON WITHRAWAL OF CASING
									SS DENOTES SPLIT SPOON SAMPLE

Penetration resistance scale: 0, 20, 40, 60, 80, 100. Shear strength scale: 1000, 2000, 3000, 4000, 5000. Consistency: PL, W, LL.

VERTICAL SCALE: 1 IN. TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE M. B. CH'D

GEOTECHNICAL DATA SHEET FOR BOREHOLE 2

OUR REFERENCE NO. 2-3-26

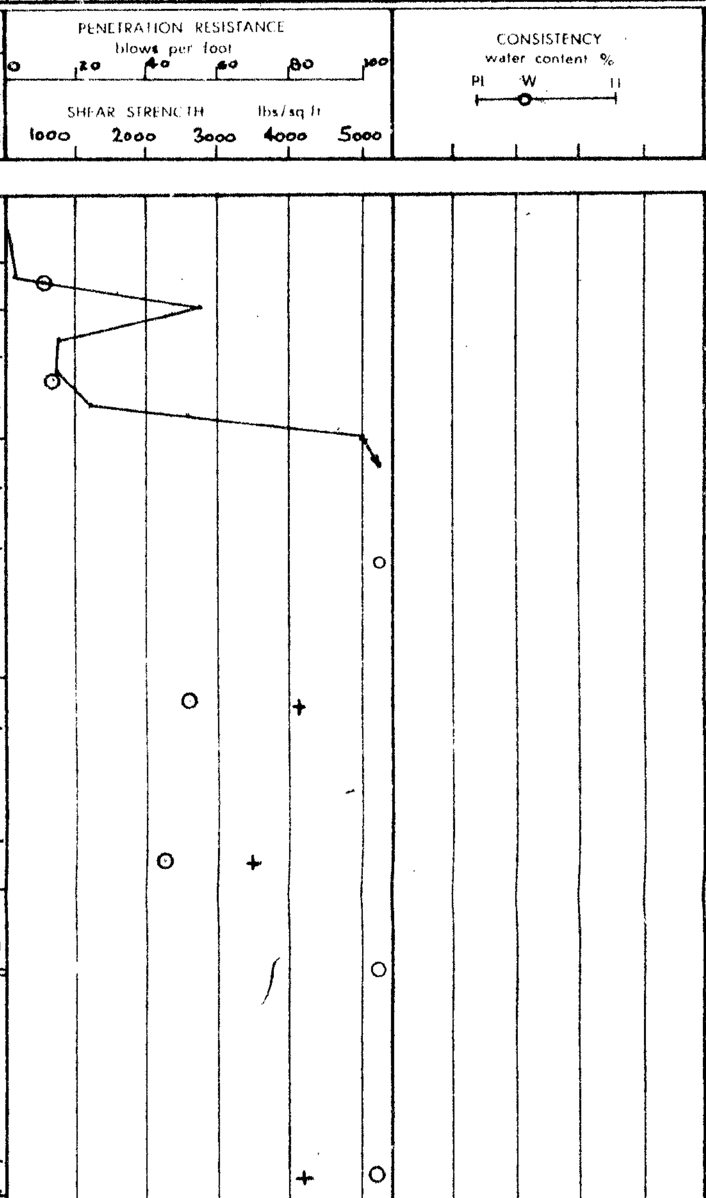
CLIENT: V. R. ASTROP
PROJECT: VAN NORMAN BRIDGE
LOCATION: WELLINGTON COUNTY, ONTARIO
DATUM ELEVATION: 94.35

METHODE OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 7/8"
DATE: MAR. 28 & 29, 1962.

ENCLOSURE NO. 3

Elevation ft.	Depth ft.	Stratification Description	Sample Number	Type	N or Advancement of Sampler
94.35	0	SOFT, BROWN ORGANIC FLOOD DEPOSIT, HUMUS, SAND AND COBBLES	1	SS	11
			2	SS	14
		clayey silt layer	3	CS	–
		COMPACT TO VERY DENSE GREY SILTY SAND WITH GRAVEL AND COBBLES	4	CS	–
			5	WS	–
			6	SS	23/2"
			7	WS	–
	15	GREY VARVED CLAY AND SILT	8	SS	53
		GREY, DAMP TO MOIST, HARD SANDY SILT WITH GRAVEL	9	SS	45
			10	SS	½" 100/½"
			11	WS	–
	30		12	SS	100/4"

Elevation scale: 94.35, 90, 85, 80, 75, 70, 65. Depth scale: 0, 5, 10, 15, 20, 25, 30.



REMARKS:

FOR NOTATIONS SEE ENC. 2.

NO CASING WAS USED BELOW 15 FT DEPTH

HAWTHORNE BIT WAS USED TO ADVANCE THE BOREHOLE THROUGH COBBLES AND BOULDERS

CS DENOTES SAMPLE OBTAINED FROM WITHDRAWN CASING

WS DENOTES WASH SAMPLE

VERTICAL SCALE: 1 IN. TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE: M.B. CH'D: [signature]