60-F-327m

WEIR BRIDGE

NORTH

DORCHESTER

TWP.

TOWNSHIP OF NORTH DORCHESTER

R. C. DUNN & ASSOCIATES LTD.
CONSULTING ENGINEERS
410 THIRD ST. LONDON, ONT.

REPORT ON FOUNDATION INVESTIGATION FOR WEIR BRIDGE LOCATED AT LOT 4 ON ROAD BETWEEN CON. I & II TOWNSHIP OF NORTH DORCHESTER

Submitted by
Dominion Soil Investigation Ltd.
88 Eglinton Ave. East
Toronto 12 Ontario

Our Ref: No. O-11-2
Nov. 1960.

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ENCLOSURES

HUdson 7-3633

88 Eglinton Ave. East
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DOMINION SOIL INVESTIGATION LTD.

SOIL MECHANICS • FOUNDATION ENGINEERING

TORONTO 12, ONTARIO

INTRODUCTION:

Authorization was received from Messrs. R.C. Dunn and Associates Ltd., Consulting Engineers, London, Ontario in a letter dated November 1st, 1960, to conduct a soil investigation at the site of a proposed bridge, referred to as the Weir Bridge.

The proposed bridge will be of reinforced concrete, a rigid frame of approximately 70 ft. span. The new structure will also be wider than the existing one. A preliminary plan of the project (No. 60-118/1) was supplied by the Consulting Engineers.

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

I. DESCRIPTION OF SITE AND GEOLOGY

The proposed bridge site lies about 3 miles east from the City of London. It will carry a widened road running parallel to Highway No. 2 and south of it, above the Waubuno Creek, in the Township of North Dorchester, Concession I and II, N.T.R. at Lot 4.

The surrounding area is an agricultural, cattle raising, fruit and vegetables being the main branches cultivated. Scattered farms lie along the roads and small-wooded areas and grassed meadows comprise the general picture of the land.

Topographically, the whole surrounding is flat lying. Waubuno Creek has cut a wide valley about 30' deep with steep walls into the plain. This shows that in flood periods, the Creek delivers substantial amount of water southwards, into the Thames River.

The construction of the new bridge will be not only a part of a general modernization of the present road, but also part of the regulating of the Creek. The proposed delineation will set a straight course for the Waubuno Creek, together with widening and regulating the grade, etc.

The bridge site lies within a triangular sand plain, referred to in "The Physiography of Southern Ontario" (Chapman & Putnam, 1951) as the London Annex, similar to the Caradoc Sand Plains lying west of London, and about three times the size. The deposits in these areas are silt and fine sand, overlain by alluvial gravel and sand.

II. FIELD AND LABORATORY WORK

The subsoil investigation comprised two boreholes and two dynamic cone penetration tests at the locations shown in Enclosure No.1. Samples were taken at regular intervals with a 2" outside diameter split spoon. The driving energy for the cone and the split spoon was obtained from a 140 lbs. hammer falling 30 inches. The numerical values of these tests are plotted on the Engineering Data Sheets. (Encls. #2 and 3).

Field exploration started on November 2nd and was finished November 9th, 1960. The high Relative Density of the soil and the presence of cobbles and boulders caused slow progress. It was necessary to use a diamond bit to advance the casing and to core the hole to clean it out. The surface elevations at the boreholes were referred to a BM given by Messrs. R.C. Dunn & Associates (nail in Hydro Pole, EL. 500.00).

Several laboratory tests were performed in order to classify the soil and predict its behaviour during construction. Samples 2/2, 1/2 end 2/3, 1/3 and 2/4 were subjected to sieve analyses, and the fraction smaller than U.S. standard sieve size No.40 was classified according to its plasticity (i.e. Liquid Limits and Plastic Limits). Two pairs of these samples were combined due to the similarity of the material. For the laboratory test results, see Encls. #4, 5 and 6.

III. SUBSOIL AND WATER CONDITIONS

The subsoil at the site of the proposed bridge consists of three layers, with slightly different characteristics, but these small variations may have importance with regard to dewatering problems during construction. In Borehole #2, a fourth layer was observed at the top, a yellow fine to medium sand with gravels and cobbles. This hole is located in the flood-area of Waubuno Creek. The deposit is saturated with water, in medium dense condition, very permeable, and moving water would tend to wash out the finer particles, thus further reducing its Relative Density.

Between elevation 476 and 473 ft. a grey dry sandy silt with traces of fine gravel was encountered. It is a very hard, compressed deposit. Its dryness is a proof that the coefficient of permeability is low. This fact is not as much due to its grain size distribution, but more to its great degree of compactness.

Below this layer, down to elevation 470 or 471 ft., there is a grey dry sandy clay of very hard consistency, with traces of fine gravel. This layer has a very low permeability because of the clay content and hardness.

At lower depths a damp, grey silt-clay mixture of low plasticity, with traces of gravel and sand was encountered. Cobbles, boulders at random elevations are present in the main material. To best visualize this deposit, we refer to the Engineering Data Sheets or Subsurface Profile. This stratum has been classified by visual methods, due to its lesser importance. The high relative density has been proven with Standard Penetration Tests, thus adequate bearing capacity is at hand.

Water level in the holes corresponded to that in the Creek.

IV. DISCUSSION AND RECOMMENDATIONS

The bearing capacity of the subsoil is high. For frost and scourprotection, Elevation 470 appears to be a reasonable level for footings. From information obtained from the Consulting Engineers, this elevation was anticipated on the preliminary plans also. The recommended allowable bearing

pressure at this or lower levels is 8000 p.s.f. Settlements at this pressure are not expected to exceed 1", and what is more important, no appreciable differential settlements are to be expected, thus a statically indeterminate structure may be used.

With a carefully planned organization, most dewatering problems during construction can be solved. The proposed diversion of the Creek should be coordinated with excavation and construction of the substructure for the bridge. The saturated top layers (see BH #2) should be stripped, and the excavation pit surrounded with temporary ditches to intercept surface water. It should be possible to keep the excavation pit reasonably dry by collecting any seepage water or precipitation in a sump at the bottom and pumping it out. Before pouring lean concrete for the footings, the grade should be checked for loose pockets which should be removed for at least a depth of 2 ft. and recompacted with vibrating equipment. Light timber shoring will be required to stop the soil spilling into the excavation. Rip-rap protection at the footings is recommended as a measure for protecting the bridge from scour. Weeping tile drainage of the foundations is also advisable because the subsoil is inherently frost susceptible.

V. SUMMARY

1. The subsoil at the bridge site consists of loose fine to medium sand, grey, dry, hard sandy silt, grey, dry, hard sandy clay and a silt clay mixture. The top sand deposit was washed out in the riverbed (BH #1).

2. Ground water level corresponds to that in the Creek. Ground water movement in the soil below the sand layer is very slow owing to its density and hardness.

3. Footings may be placed at elevation 470 ft. or lower, with an allowable bearing pressure of 8000 p.s.f. Settlements should be less than 1" and no differential settlement is expected.

4. Dewatering problems could be solved by coordination of riverbed diversion and substructure construction for the bridge. Surface waters can be intercepted in a protective trench network, trenches and sumps in the excavation pits will assist the dewatering there. Light timber shoring in the excavation pit will prevent spalling.

5. Loose pockets should be removed from the grade recompacted.

6. Rip-rap protection and weeping tile drainage of the footings is recommended.

DOMINION SOIL INVESTIGATION LTD.

L. R. Szalatkay, P.Eng.

Toronto, Ontario
November, 1960

E n c l o s u r e s

Order No. 0-11-2 Enclosure No. 2.

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 1

Date: NOV. 2-4. 1960.

Project: WEIR BRIDGE
Location: N. DORCHESTER TOWNSHIP
Hole Location: WEST ABUTMENT
Hole Elevation and Datum: 477.4
Field Supervisor: H.O'D Prep.: LRS
Driller: M'D Checked:

LEGEND
Shear Strength (C)
Unconfined compression
Vane test and sensitivity (S) ⊕ +S
Penetration Resistance (P)
2" Split tube
2" Dia. Cone
Casing
Sampling Method
2" Dia. split tube
2" Shelby tube

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	WATER LEVEL ▽	477.4	0
	GREY DRY SANDY SILT WITH TRACES OF FINE GRAVEL.		
	DRY GREY SANDY CLAY TRACES OF FINE GRAVEL.		5
		470	
	DAMP GREY SILT - CLAY MIXTURE OF LOW PLASTICITY TRACES OF GRAVEL AND SAND.		10
	LIMESTONE BOULDER		15
	LAYERS OF COBBLES & GRAVEL IN SAND-SILT MATRIX. TRACES OF CLAY.	460	
		457.4	20
	END OF BOREHOLE		

STRENGTH AND PENETRATION RESISTANCE
C P.S.F.
P BLOWS/FT.
20 40 60 80 100

1.
2. >100
3. >100
>100
>100
4. >100
5. >100

DIAMOND DRILLING

Order No. O-11-2 Enclosure No. 3.

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 2.

Project: WEIR BRIDGE
Location: N. DORCHESTER TOWNSHIP
Hole Location: EAST ABUTMENT
Hole Elevation and Datum: 479.4
Field Supervisor: H. O'D Prep.: LRS
Driller: B.R Checked:

Date: Nov. 7-9. 1960.

LEGEND
Shear Strength (C)
Unconfined compression ⊕
Vane test and sensitivity (S) +S
Penetration Resistance (P)
2" Split tube
2" Dia. Cone
Casing
Sampling Method
2" Dia. split tube
2" Shelby tube

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	GROUND LEVEL	479.4	0
	TOPSOIL YELLOW FINE TO MEDIUM SAND WITH GRAVEL & COBBLES. ▽ W.L.		
	GREY DRY SANDY SILT WITH TRACES OF FINE GRAVEL		5
	GREY DRY SANDY CLAY OF LOW PLASTICITY, TRACES OF FINE GRAVEL.	470	
	DAMP GREY SILT - CLAY MIXTURE OF LOW PLASTICITY TRACES OF GRAVEL & SAND.		10
	COBBLES	460	15
			20
			25
	COBBLES		30
	END OF BOREHOLE	448.8	

STRENGTH AND PENETRATION RESISTANCE
C P.S.F.
P BLOWS/FT. 20 40 60 80 100

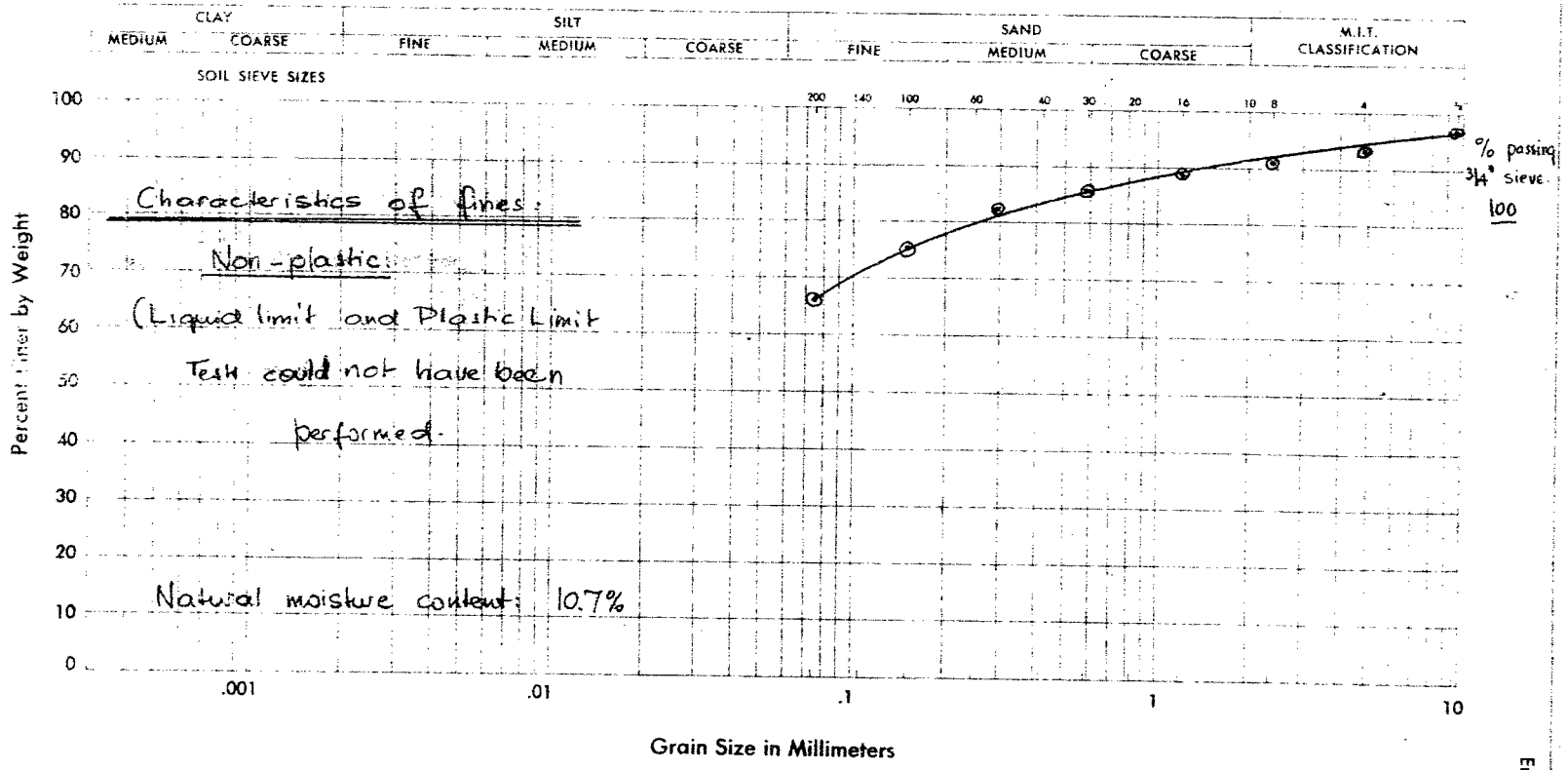
1.
2.
3.
4.
>100
5.
6.
7. >100
8. >100

DIAMOND DRILLING

Dominion Soil Investigation Ltd.

GRAIN SIZE DISTRIBUTION

BH # 2
Sa # 2
El. 473.7 ft



Project WEIR BRIDGE

Order No. O-11-2

Soil classification: Sandy silt - with traces of fine gravel, in dry condition.

Enclosure No. 4

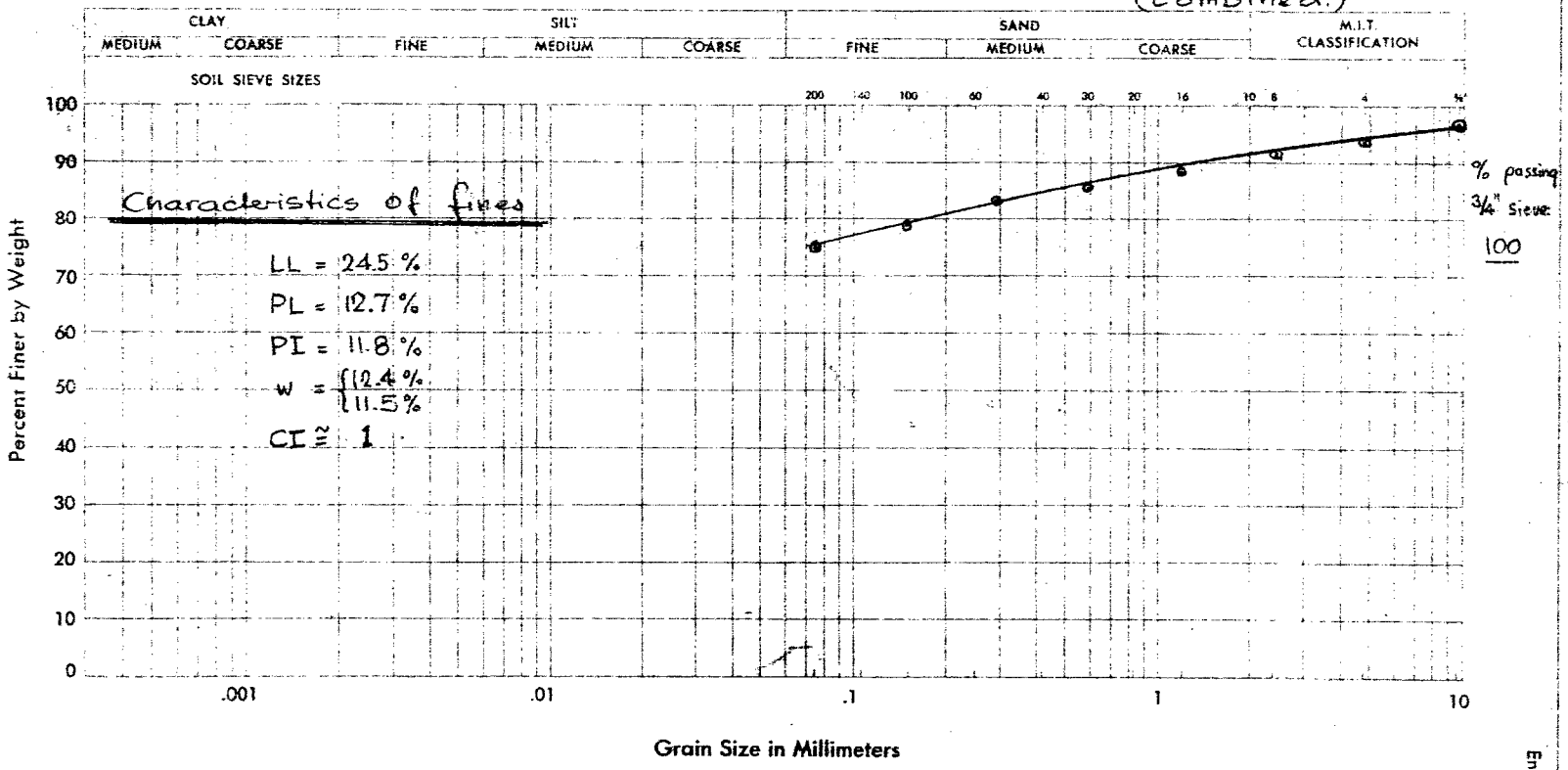
Dominion Soil Investigation Ltd.

GRAIN SIZE DISTRIBUTION

BH # 1 Sa # 2 El. 471.4 ft

BH # 2 Sa # 3 El. 471.4 ft

(combined.)



Characteristics of fines

LL = 24.5 %

PL = 12.7 %

PI = 11.8 %

w = {12.4 %, 11.5 %}

CI ≅ 1

Project WEIR BRIDGE

Order No. O-11-2

Soil classification: Sandy clay of low plasticity, in dry condition. Traces of fine gravel.

Enclosure No. 11

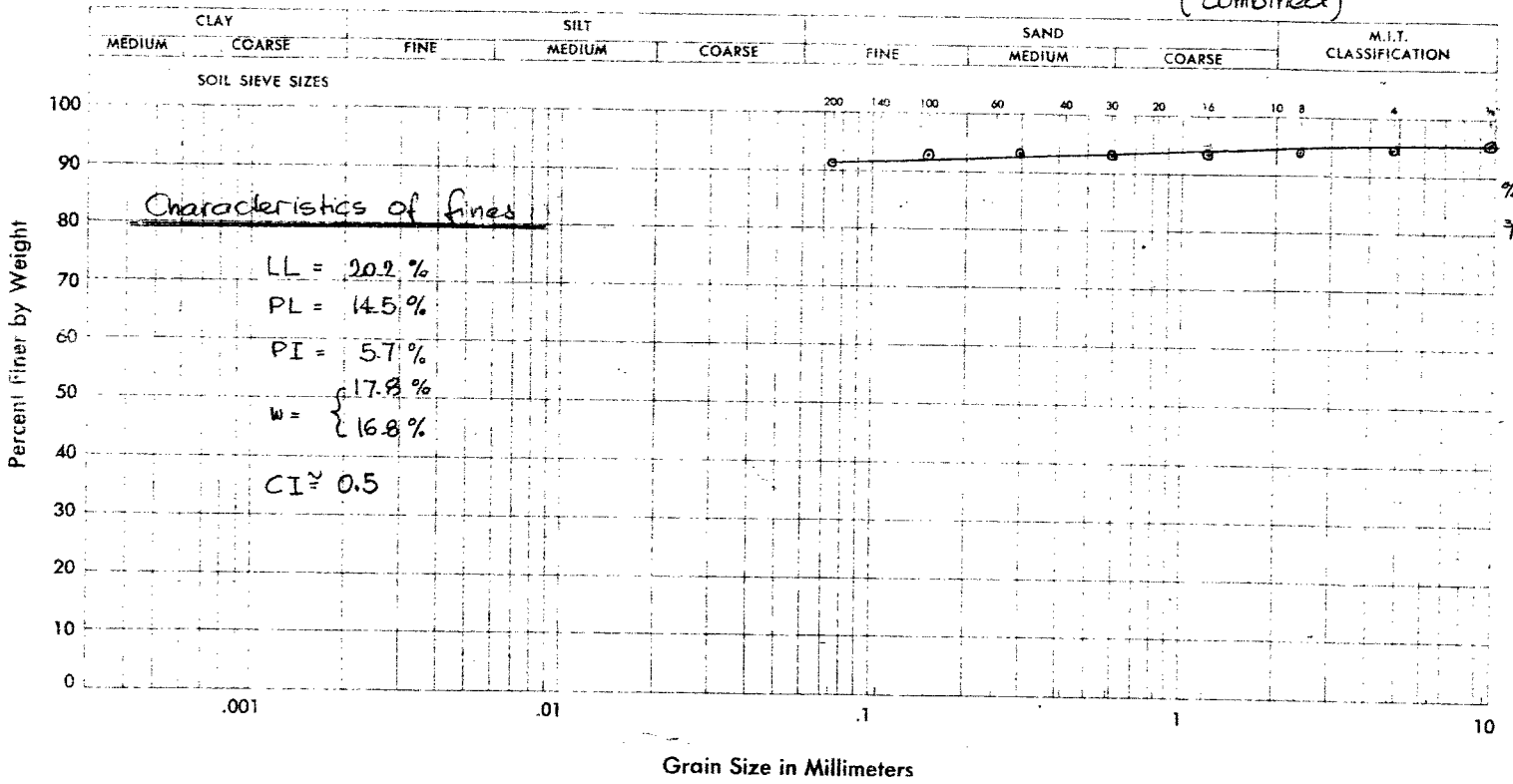
Dominion Soil Investigation Ltd.

GRAIN SIZE DISTRIBUTION

BH # 1 Sa # 3 El. 469.5

BH # 2 Sa # 4 El. 468.7

(combined)



Characteristics of fines

LL = 20.2 %

PL = 14.5 %

PI = 5.7 %

w = { 17.8 %
{ 16.8 %

CI ≈ 0.5

% passing ¾" Sieve: 100

Project WEIR BRIDGE

Soil classification. Silt - clay mixture, of low plasticity in damp condition. Traces of gravel and sand.

Order No. O-11-2

Enclosure No. 9.

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT