

62-F-127

W.P. # 185-62

Hwy. # 99

CROSSING

FAIRCHILD CR.

EAST BRANCH

Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie.

Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.

December 11, 1962.

D.H.O. FOUNDATION INVESTIGATION REPORT -
East Crossing of Fairchild Creek & Hwy. #99,
District No. 4, Hamilton, Ontario.
W.J. 62-F-127 -- W.P. 185-62.

Attached, we are forwarding to you, our detailed
report on the subsoil conditions existing at the above
structure location.

We believe you will find the factual data and
recommendations contained therein, adequate for your future
design work. If we can be of further assistance, please
feel free to contact our Office.

KYL/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
H. Greenland
T. J. Kovich
J. Roy
J. E. Gruspier
E. R. Saint
F. Norman
A. Watt
Foundations Office✓
Gen. Files.

KYL
K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER.

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF SITE.
 3. GROUND WATER CONDITIONS.
 4. FIELD & LABORATORY PROCEDURE.
 5. SUBSOIL CONDITIONS:
 - 5.1) General.
 - 5.2) Clayey-silt & Organic Matter.
 - 5.3) Silt.
 - 5.4) Silt with Seams of Clayey-silt to Silty-clay.
 - 5.5) Silt with Fine Sand.
 - 5.6) Limestone Bedrock.
 6. DISCUSSION & RECOMMENDATIONS.
 7. SUMMARY.
 8. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION

For

East Crossing of Fairchild Creek & Hwy. #99,
District No. 4, Hamilton, Ontario.
W.J. 62-F-127 -- W. P. 185-62.

1. INTRODUCTION:

A memo dated October 25, 1962, requesting a subsoil investigation at the site, was received from the Bridge Location Section.

This report contains the findings of the requested investigation, the laboratory results, their interpretation and discussion, as well as the necessary recommendations for the foundations of the proposed new structure.

2. DESCRIPTION OF SITE:

The site is located in one of the numerous valleys of the area which is composed of undulating to hilly terrain, mainly under cultivation.

The present structure is a single span steel truss, reinforced by a Bailey Bridge.

There is evidence of flooding at this location and local information confirmed that at least once, the water came up to bridge grade.

At the time of this investigation, the creek was some 75 feet in width with water 4 to 5 feet deep and flowing rapidly.

cont'd. /2 ...

3. GROUND WATER CONDITIONS:

A relatively high water table was encountered over the area with the ground water table coinciding with the creek water level at elevation 660.0. In general, the water level is about 2 feet below the ground surface.

In borehole #2, artesian water was encountered while coring bedrock. The water level rose to 4.7 feet above ground, to elevation 666.7. No artesian water was observed in any of the other boreholes.

4. FIELD & LABORATORY PROCEDURE:

Four sampled boreholes, supplemented by two dynamic cone penetration tests, were bored at the site, utilizing a diamond drill rig adapted for soil sampling procedures.

Both undisturbed thin-wall piston Shelby tube, and disturbed split-spoon samples were taken. The former was pushed manually, the latter driven into the soil with a 140-lb. hammer falling 30 inches.

Rock samples were recovered by means of an AXT, five-foot long, core barrel.

The locations and elevations of all boreholes are shown on the attached Drawing No. 62-F-127A and were established at the time of the borings by a D.H.O. survey crew. A geodetic datum was used for all elevations.

Soil samples were visually classified in the field before transportation to the laboratory where a further classification was performed. In addition, Atterberg limits, moisture content,

4. FIELD & LABORATORY PROCEDURE: (cont'd.) ...

unconfined tests, grain size distribution analyses and organic content determinations were carried out, where applicable.

The results of these tests, together with the soil stratigraphy derived therefrom, are plotted on the attached borehole logs.

5. SUBSOIL CONDITIONS:

5.1) General:

Subsoil stratification was found to be generally uniform with small local variations only. From ground level downwards, the various soil types are as follows:

5.2) Clayey-silt & Organic Matter:

In all boreholes, a brown clayey-silt deposit was found from ground level to a depth of about 13 feet. The thickness varied slightly over the site from 11 feet at borehole #1 to 15 feet at borehole #4.

The following table summarizes the physical properties of this deposit:

Liquid Limit %	Plastic Limit %	M. C. %	Field Vane p.s.f.	Unconfined Compression Tests.	Density p.c.f.
25.6 - 37.0	17.0 - 25.8	26.2 - 37.3	400 - 1840	334 - 1155	119 - 124
Avg. = 31.6	21.5	30.5	1145	740	121

From the above results, it can be concluded that this is a soft to firm stratum with widely varying strengths generally increasing with depth.

cont'd. /4 ...

5. SUBSOIL CONDITIONS: (cont'd.) ...

5.3) Silt:

In boreholes #2 and #4, a 7-foot thick layer of brown silt was found, at a depth of 13 and 15 feet, respectively.

Standard penetration resistance ranged from 16 to 28 blows per foot, indicating the relative density to be compact.

The moisture content ranged from 20.6 to 31.1%, with an average of 24%.

This silt layer was not encountered in the other two boreholes, and its extremities are not known.

5.4) Silt with Seams of Clayey-silt to Silty-clay:

Below the clayey-silt in boreholes #1 and #3, and the brown silt in boreholes #2 and #4, a grey silt, irregularly stratified with thin seams of clayey-silt to silty clay was found.

The thickness of this deposit varies from 33 to 60 feet and the stratum terminates approximately 55 feet below the ground surface at elevation 606.

Laboratory tests carried out on representative samples gave the following results:

Soil Type	W _L %	W _p %	M. C. %	Undrained Shear Strength p.s.f.	δ (Avg.) p.c.f.
Clayey-silt	20.7 - 30.1	16.8 - 19.4	20.5 - 30.2	565 to 2115 Avg. = 1025	125
Silty-clay	37.6 - 46.6	19.4 - 25.1	18.4 - 27.8		
Silt			17.0 - 30.1		

cont'd. /5 ...

5. SUBSOIL CONDITIONS: (cont'd.) ...

5.4) Silt with Seams of Clayey-silt to Silty-clay: (cont'd.) ...

Standard penetration resistance ranged from 6 to 10 blows per foot, indicating the relative density to be loose.

A typical gradation curve in this deposit, as well as a plasticity chart for the cohesive seams, is included in the appendix of this report.

5.5) Silt with Fine Sand:

Below the stratified silt deposit and extending down to bedrock, a grey non-cohesive silt with traces of fine sand was found. It ranged in thickness from 17 to 24 feet.

Standard penetration resistance ranged from 11 to 47 blows per foot, indicating a compact to dense, relative density. The moisture content was 20.6 to 31.1%, with an average of 24%.

5.6) Limestone Bedrock:

At elevation 589.0 in boreholes #1 and #2, and elevations 582.0 and 585.5 in boreholes #3 and #4, respectively, a grey, massive and small grained limestone was found.

The bedrock was established at the refusal depth of the chopping bit in boreholes #1 and #4, whereas in the other two boreholes, rock core was taken with an AXT core barrel; 100% recovery was achieved in both cases.

In borehole #2, artesian water was encountered within the rock, rising 4'.7 above ground level to elevation 666.7. No artesian conditions were observed in any of the other borings.

cont'd. /6 ...

6. DISCUSSION & RECOMMENDATIONS:

Subsoil at the site consists of soft to firm clayey-silt with some organic matter, followed by a loose silt, stratified irregularly with thin seams of clayey-silt to silty-clay, except in boreholes #2 and #4, where a 7-foot layer of compact brown silt separated the two deposits. Below the silt, a compact silt with some sand, extends from a depth of 55 feet, down to bedrock approximately 77 feet below the ground.

Due to the soft consistency and the organic content of the upper stratum of the clayey-silt, and the relatively loose density of the silt below it, adequate bearing capacity for a spread footing foundation cannot be found at an economical depth.

End-bearing H-piles, driven down to bedrock, are recommended. For example, 12 BP 53, steel H-piles, driven down to the limestone bedrock, can support a safe design load of 60 tons per pile.

A dewatering scheme will be necessary, as the upper stratum of the clayey-silt, within which the piles will be capped, is quite pervious. It is further suggested that construction be scheduled during the dry season, as flooding is prevalent throughout the area.

No embankment stability problems are anticipated; however, minor settlements are likely to occur, and paving operations should be delayed as long as possible after completion of the approach fills.

It is also recommended, that the excavation for the pile cap be taken slightly below the footing grade, and the removed material replaced with a suitable granular borrow, or else sealed with lean concrete. This will prevent the footing from resting

cont'd. /7 ...

6. DISCUSSION & RECOMMENDATIONS: (cont'd.) ...

directly on any organic matter present at that level.

7. SUMMARY:

Subsoil at the site consists of the following:

- 0' - 13' ± - Soft to firm clayey-silt with organics.
- 13' - 55' ± - Loose silt stratified irregularly with thin seams of clayey-silt to silty-clay, except in boreholes #2 and #4, where a 7-foot layer of compact brown silt was found.
- 55' - 77' ± - compact silt with traces of fine sand.
- 77' ± - Limestone bedrock.

The following recommendations are made:-

- Footings based on steel H-piles driven to bedrock.
A safe design load of 60 tons per pile may be used for 12 BP 53 H-pile.
- A dewatering scheme will be necessary and construction should be scheduled during the dry season as flooding is prevalent in this location.
- Excavation for pile cap should be taken below the footing grade and the removed material replaced with suitable granular borrow or sealed with lean concrete.
- Paving operations be postponed as long as possible after completion of approach fills as minor settlements are likely to occur.
- No embankment fill stability problems are anticipated.

8. MISCELLANEOUS:

The field work, performed during the period November 14 - 23, 1962, together with the preparation of this report, was carried out by Mr. G. Mierzynski, under the general supervision of Mr. M. Devata of the Foundation Section.

Equipment was owned and operated by the D.H.O.

December 1962.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

JOB 62-F-127 LOCATION 45' Rt. of Sta. 37+80 - Line "A" ORIGINATED BY G.M.
W.P. 185-62 BORING DATE Nov. 13 & 14, 1962. COMPILED BY G.M.
DATUM D.H.O. BOREHOLE TYPE Washboring - NX Casing. CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit — WL Plastic Limit — WP Water Content — W	Bulk Density	Remarks
Elev. Depth	Description	Strat. Plot	Number	Type	Blows / Foot		% 15 30 45	P.C.F.	
						SHEAR STRENGTH P.S.F. + Field Vane & Sensitivity Unconfined Shear Strength 500 1000 1500 2000 2500			
666.0	ground level								WL from observation in borehole
0.0	Clayey-silt to silt. Stiff-Brown.		1	TW	P	660		120.0	= 660.0 6.0
655.0			2	TW	P		+ 3.5	122.0	
11.0			3	TW	P		+ 4.2	115.0	
			4	SS	6		+ 4.2		
	Silt with clayey-silt seams. Irregularly. Stratified. Loose-Grey.		5	SS	9	640			
			6	SS	9				
			7	SS	8	620	Penetration ends @ 45.0'		
606.0			8	SS	25	600			
60.0	Silt with traces of fine sand. Compact - Grey.		9	SS	19				
589.0		No. 10							
77.0	End of borehole. (Bedrock)					580			

JOB 62-F-127

LOCATION E Sta. 37+48 - Line "A"

ORIGINATED BY G.M.

W. P. 185-62

BORING DATE Nov. 15 & 16, 1962.

COMPILED BY G.M.

DATUM D.H.O.

BOREHOLE TYPE Washboring - NX Casing.

CHECKED BY _____

[illegible]

FOUNDATION SECTION

ORIGINATED BY G.M.

COMPILED BY G.M.

CHECKED BY

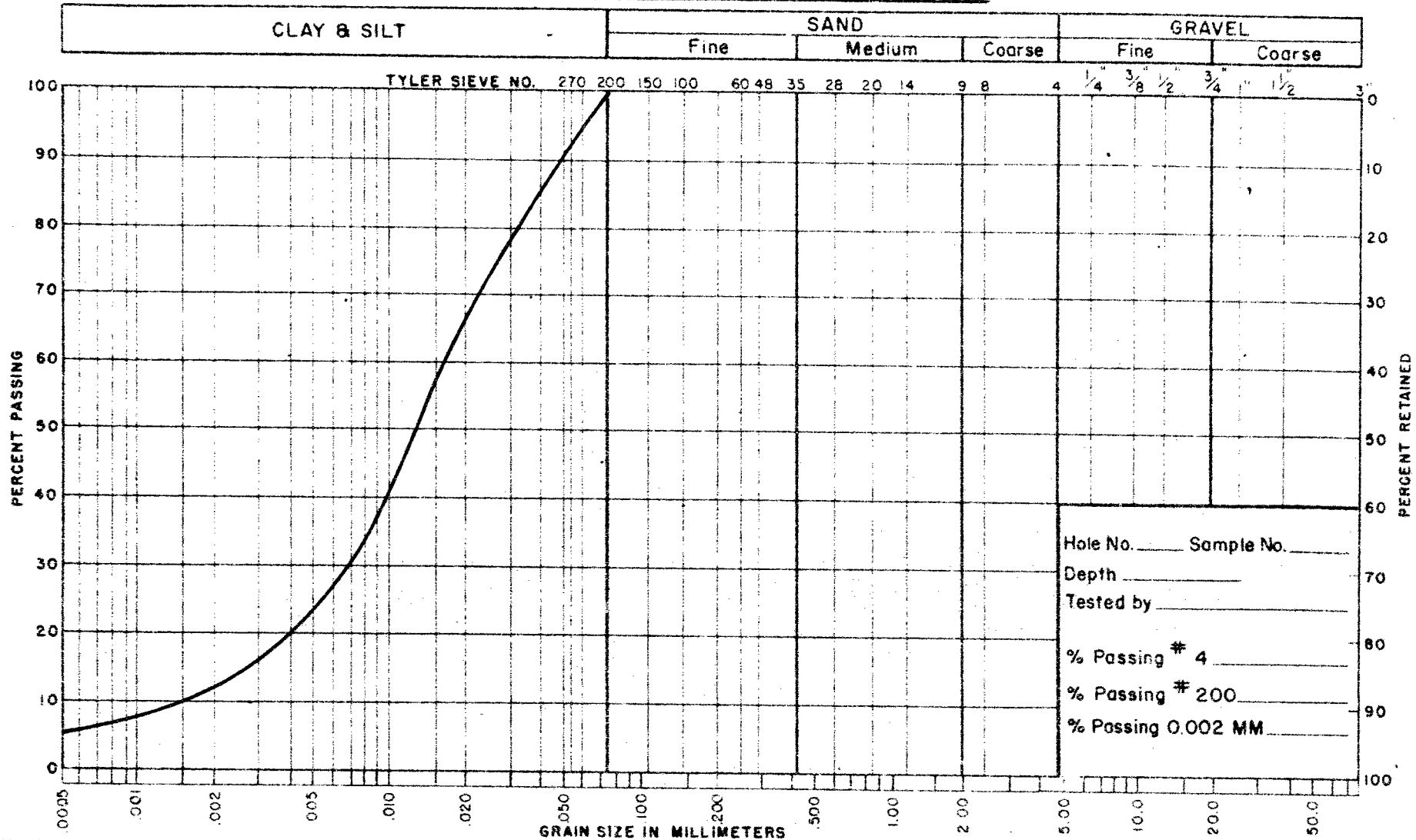
SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT ——— WL PLASTIC LIMIT ——— wp WATER CONTENT ——— w			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. + Field Vane & Sensitivity o Unconfined Shear Strength 500 1000 1500 2000 2500					WATER CONTENT % 15 30 45				
660.0	Groundlevel					660										WL = G.L.
0.0	Clayey-silt and organic matter.															
	Soft and spongy		1	TW	P											
	- Brown.		2	TW	P											
647.7																
13.0	Silt with clayey-silt to silty-clay seams.		3	TW	P											
	Irregularly stratified.		4	TW	P											
	Loose-grey.		5	TW	P											
606.0						620										
54.0	Silt with traces of fine sand.		7	SS	'47											
	Dense to compact.		8	SS	16											
	- Grey.					600										
582.0	Limestone Bedrock.		9	RC	-	580										
577.0	Grey - Massive															
83.0	End of borehole.															100% Recovery

FOUNDATION SECTION

CHECKED BY _____

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT _____ WL PLASTIC LIMIT _____ WP WATER CONTENT _____ W			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.						WP	WL	P.C.F.	
							+ Field Vane & Sensitivity Unconfined Shear Strength									
							500 1000 1500 2000 2500						15 30 45			
662.0 0.0	Groundlevel					660										WL from observation in borehole
	Clayey-silt and organic matter. Soft and spongy - Brown.		1	SS	2											y = 660.0 2.0
			2	TN	P											0.21% Organic
647.0 15.0	Silt - compact		3	SS	20											124.0 0.29% Organic
	Brown and grey.		4	SS	16	640										Silt ~85% Clay = 5%
640.0 22.0	Silt with clayey-silt to silty-clay seams.		5	SS	9											
	Irregularly Stratified.		6	SS	6											Silt ~83% Clay = 17%
	Loose-Grey.		7	SS	7	620										
607.0 55.0	Silt with traces of fine-sand.		8	SS	27	600										
	Compact - Grey.		9	SS	24											
585.5 76.5	End of borehole. (Bedrock)					580										

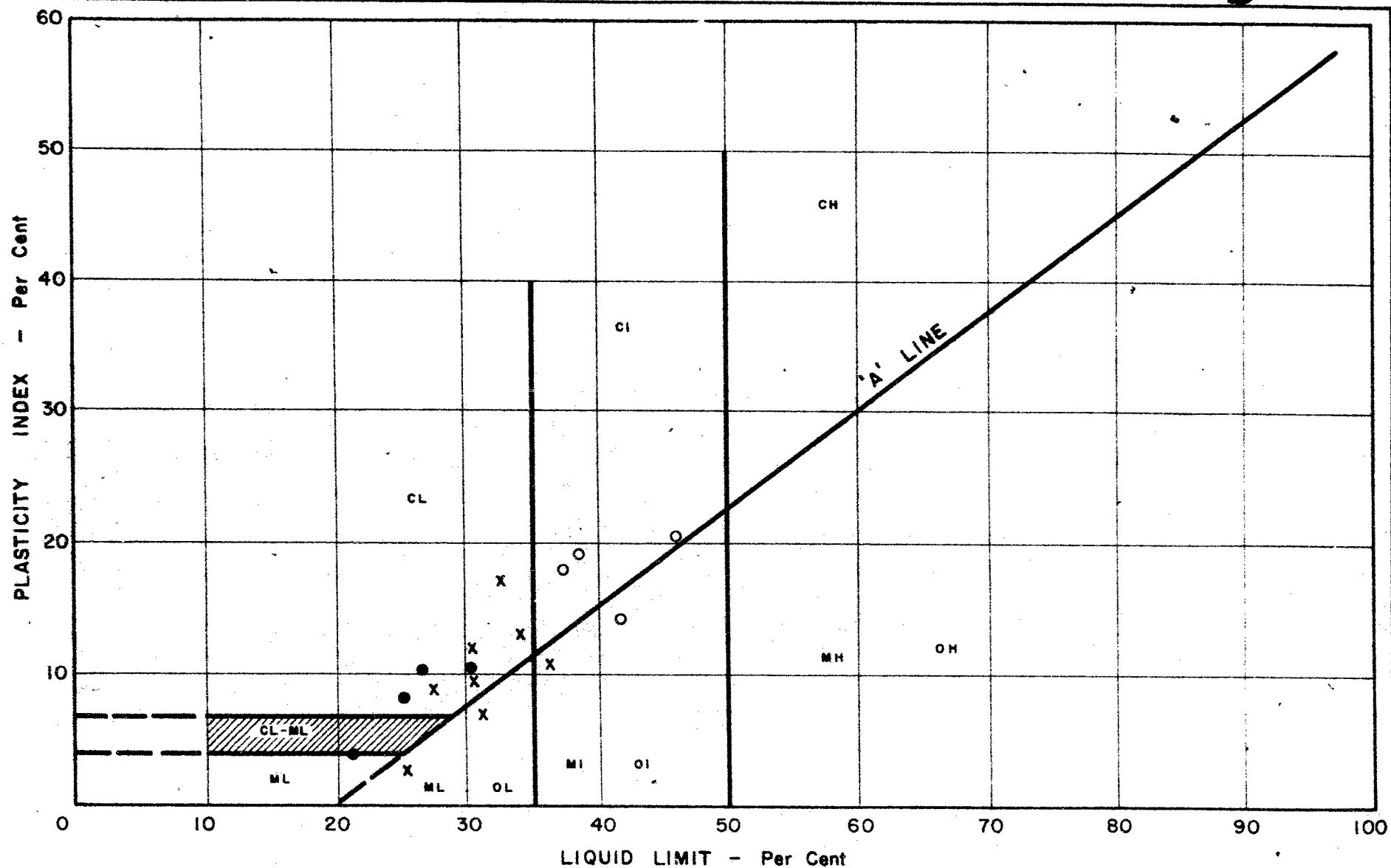
UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES Typical gradation curve in the Stratified Silt Stratum

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 62-F-127 W.P. No. 185-62
Location East Branch of Fairchild Creek & Hwy. No. 99



NOTES

x	Clayey Silt with organics	Depth	0 - 13'
•	Clayey Silt	Tests on cohesive seams	Depth
o	Silty Clay	of stratified silt deposit	13' - 55'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 62-F-127

W.P. No. 185-62

Location East Branch of Fairchild Creek & Hwy. No. 99

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Eng.,
Room 107,
Lab. Bldg

FROM: F. DeVisser

DATE: September 20, 1963.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 184-62 Site 1-31
Fairchild Cr. Br. West Branch
W.P. 185-62
Fairchild Creek Br. East Branch.
Hwy. 99 District #4

Enclosed is one print of the preliminary drawing for each of the subject structures.

If you have any comments, please let me know.

F. DeVisser

FDeV/es

F. DeVisser,
Bridge Location Engineer.

Contacted Mr. Devisser and mentioned no comments regarding above two structures.

*M. Devata
Sept 20/63*