

MEMORANDUM

W.P. 803-66

To: Mr. T. J. Kovich,
Regional Materials Engr.,
Materials & Testing Div.,
Room 134-A, Lab. Bldg.

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

DATE: August 18, 1967

OUR FILE REF.

IN REPLY TO

SEP 1 1967

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Unstable Slope Conditions

Hwy. No. 3 at Canboro

District No. 4 (Hamilton)

W.J. 67-F-69 -- W.P. 803-66

Enclosed, please find the results of our detailed foundation investigation at the above mentioned site.

We believe the information contained in the report will be sufficient for your design purposes. Should any points require further clarification, please contact this Office.

AGS/ndef
Attach.

cc: Messrs. T. J. Kovich (2)
H. A. Tregaskes
D. W. Parren
G. K. Hunter (2)
H. Greenland

A. G. Sternac
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Unstable Slope Conditions
Hwy. No. 3 at Canboro
District No. 4 (Hamilton)
W.J. 67-F-69 -- W.P. 803-66

1. INTRODUCTION:

The Foundation Section, in a memo dated July 10, 1967, was requested by Mr. P. F. Weber, Sr. Project Soils Supervisor, to investigate an unstable slope condition on Hwy. 3, approximately a mile East of Canboro, in the Hamilton district. Subsequently, a foundation investigation was carried out by this Section.

The section of road, which has been a maintenance problem for some time, lies between stations 303+41 and 305+43 of the contract drawings of the relocation of Hwy. 3 (see Drawing 67-F-69A).

The roadway is on a fill adjacent to a natural side slope some 15 ft. high, sloping towards the West. The subsidence affects the left lane and half of the right lane of the highway. The subsidence of the pavement and cracks in the pavement have been temporarily patched. At some earlier date, presumably after an earlier subsidence, the toe of the slide has been excavated and braced with 2 feet high, wooden shorings. It was noticed that guardrails along the West shoulder of the highway had been somewhat displaced and that a hydro pole on the fill had become tilted, but trees near the toe of the slide had been left unaffected. This was taken as indications of a relatively shallow slide.

A cone penetration test was performed and one borehole was put down on either side of the road - one above and one in the body of the slide. For a detailed account of the boreholes and locations, see Drawing 67-F-69A and borelog sheets, 1 and 2.

cont'd. /2 ...

2. SUBSOIL CONDITIONS:

The subsoil at the site consists of a silty clay fill overlying a layer of organic silt on a deep deposit of silty clay.

2.1) Fill Material:

This material meets the natural side slope about 25 feet east of the centre-line of Hwy. 3, and about 45 feet west of the centre-line of Hwy. 3 at elevations 589 and 579, respectively, being about $6\frac{1}{2}$ feet deep under the pavement. It consists of stiff silty clay containing traces of sand and gravel and some traces of organic material. Its natural moisture content is about 27%, its liquid limit about 45%, and its plastic limit about 25%. The colour of this material is dark brown to brown.

2.2) Organic Silt:

This layer consists of soft to firm organic silt and is approximately $1\frac{1}{2}$ to 2 feet thick. The layer follows the natural slope line, deepening towards the bottom of the slope. Its natural moisture content is about 27%, its liquid limit about 35%, and its plastic limit about 22%. After oven drying the organic material, the liquid limit is about 29% and the plastic limit about 19%. The colour of this material is black.

2.3) Silty Clay to Clay:

This deposit consists of very stiff to firm silty clay to clay. The upper 2 to 4 feet contains organic material. As well, the top 10 to 15 feet contains varved layers of silt. This tendency persists deeper but to a lesser degree. The natural moisture content of the layer ranges from 27% at the top to 40%, 25 ft. into the layer. The liquid limit ranges from 40% to 63%, and the plastic limit from 22% to 32%. If the organic matter in the top 2 to 4 feet is removed by oven drying, the plastic limit falls about 9%.

cont'd. /3 ...

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

2.3) Silty Clay to Clay: (cont'd.) ...

The unconfined shear strength of this layer is between 1210 to 1350 p.s.f. at elevation 570' and between 744 to 209 p.s.f. at elevation 562'. The bulk density at elevation 570' is about 122.5 lbs./ft.³ and about 113.5 lbs./ft.³ at elevation 562'.

The top 2 to 4 feet of the deposit is grey with pockets of black organic matter. Below that, the material assumes a grey colour with oxidized brown silt layers. Farther below, the colour is grey with mottled red-brown layers.

3. GROUNDWATER:

The water levels in boreholes 1 and 2 were at elevations 583.2' and 581.9', respectively, the day after drilling had ceased.

Water plants, prospering on the fill slope, at the slide only, and a soft consistency of the soil below the wooden bracing after a rainstorm, indicate a seepage of water through the organic silt layer and the silty clay fill material.

4. RECOMMENDATIONS:

A review of the subsoil conditions at this site indicates that the primary causes of subsidence are:

(1) the presence of the soft to firm organic silt layer below the fill material.

(2) seepage of water through the organic silt layer and the fill material.

The above will result in a worsening of the slope stability during and after every heavy rainfall. In order to stabilize the roadway permanently, it will be necessary to:

cont'd. /4 ...

4. RECOMMENDATIONS: (cont'd.) ...

(1) excavate the fill material and remove the black organic silt layer, replacing it with suitable fill material, compacted to optimum density according to the pertinent D.H.O. Standards.

(2) provide a sufficient number of French drains to ensure proper drainage through this section.

5. MISCELLANEOUS:

The field work for this project was carried out during the period August 1 - August 3, 1967. The equipment used was owned and operated by Canadian Longyear Ltd. Borehole locations, elevations, and cross sections were surveyed by District surveyors. The field work was supervised by Mr. K. A. Liljefors, Project Foundation Engineer, who also prepared this report. The report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

August 1967

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 67-F-69 LOCATION Sta. 304 + 37 18' Rt. ORIGINATED BY KAL
W.P. 803-66 BORING DATE August 1, 1967 COMPILED BY KAL
DATUM Geodetic BOREHOLE TYPE Core Drill CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. o Unconfined		WATER CONTENT %			
589.1	Ground Level						400 600 800 1000 1200	20 40 60				
0.0	Silty clay, traces of sand, gravel & org. material (Fill). Stiff											
586.0												
3.1	Silty clay, Seams of silt to Clay. Very stiff to firm.		1	SS	9	585						
			2	SS	20							
			3	SS	15	580						
			4	TW	PM 8"	575						
			5	SS	24							
			6	SS	14	570						
			7	SS	11							
			8	SS	10	565						
			9	TW	PM 18"	560						
559.1												
30.0	End of Borehole											

583.2'
Aug. 3/67

114
113

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

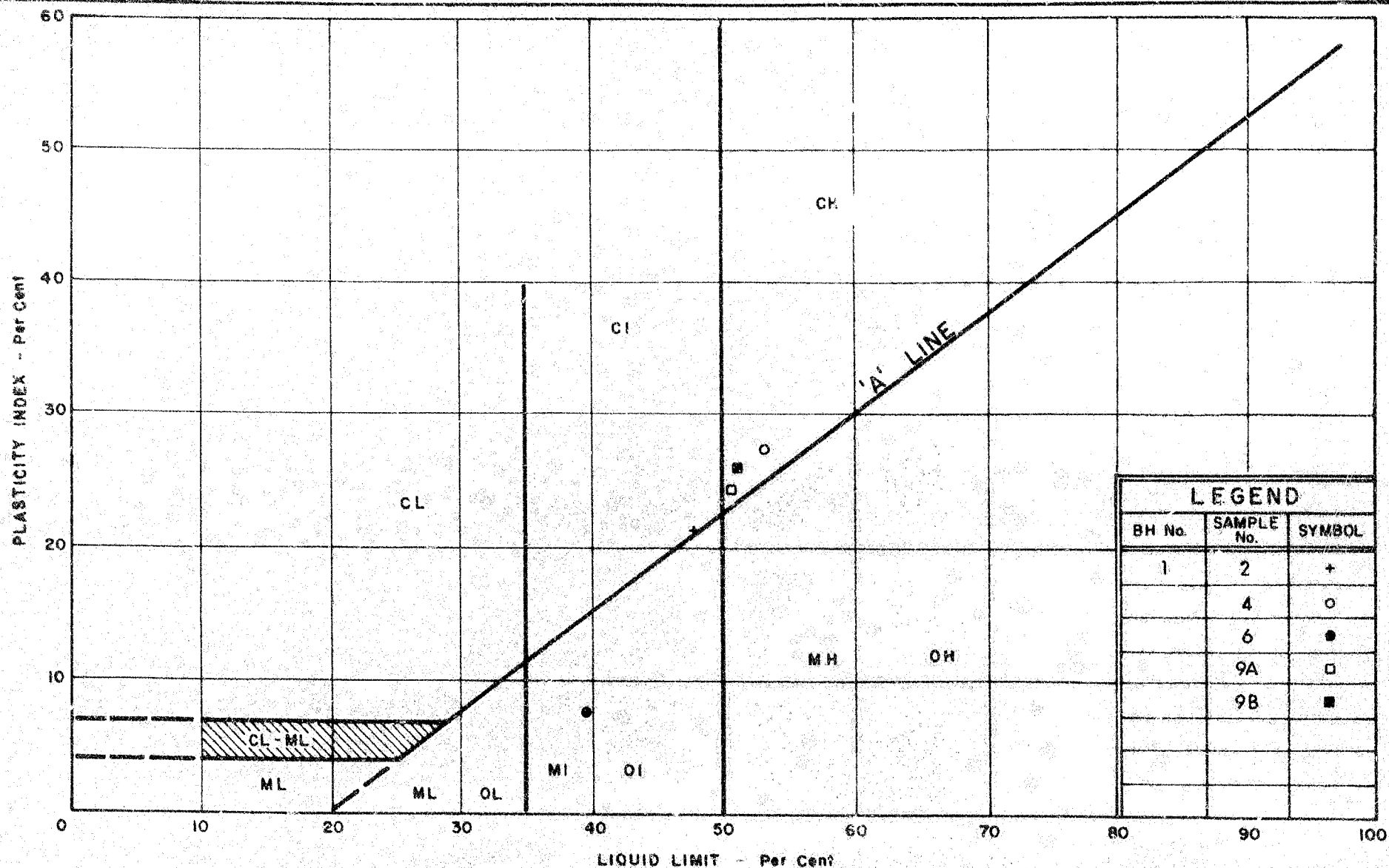
FOUNDATION SECTION

JOB 67-F-69 LOCATION Sta. 304 + 37 24' Rt. ORIGINATED BY KAL
W.P. 803-66 BORING DATE August 2, 1967 COMPILED BY KAL
DATUM Geodetic BOREHOLE TYPE Core Drill CHECKED BY AK

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. o Unconfined						WATER CONTENT % WP — W — WL			
585.0	Ground Level						400	600	800	1000	1200	20	40	60		
0.0	Silty clay, traces of sand, gravel & organic material. Fill Stiff		1	SS	11											
580.5																
4.5	Organic silt. Soft to firm.		2	SS	8	580										
578.7																
6.3	Silty clay with organic material. Stiff		3	TW	PM 18"											
575.0						575										
10.0	Silty clay, seams of silt to clay. Stiff		4	TW	PM 12"											
			5	SS	8	570										
566.5			6	SS	16											
18.5	End of Borehole					565										

581.9
Aug. 3/67

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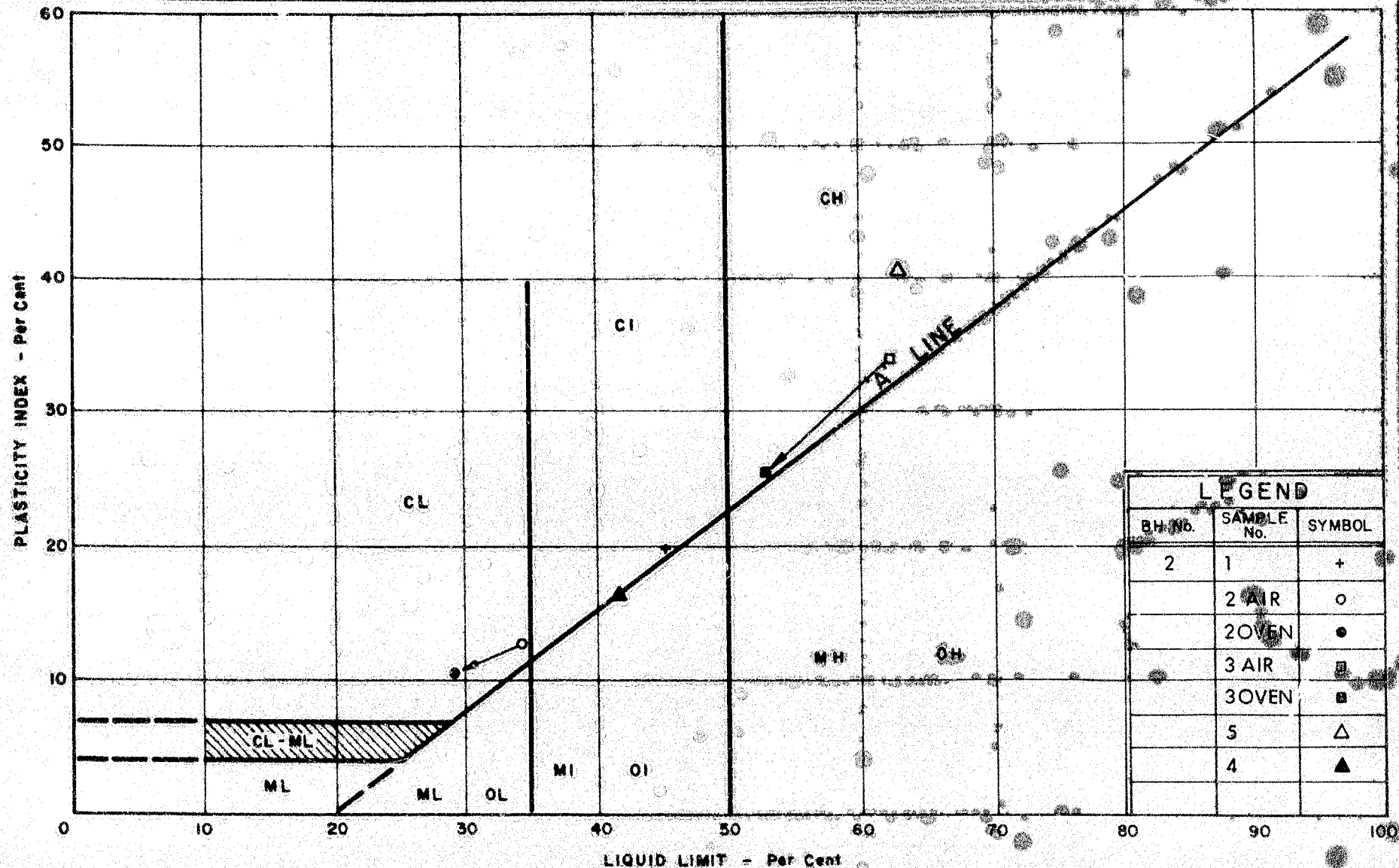


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

WP No. 803-66

JOB No. 67-F-69



LEGEND		
BH No.	SAMPLE No.	SYMBOL
2	1	+
	2 AIR	o
	2 OVEN	•
	3 AIR	□
	3 OVEN	■
	5	△
	4	▲



DEPARTMENT OF HIGHWAYS
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DIVISION

PLASTICITY CHART

W.P. No. 803-66

JOB No. 67-F-69