DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. S. McCombie

From: Foundation Section,
Materials & Research Div.,
Room 107, Lab. Bldg.

Date: June 24, 1964

Our File Ref.

In reply to

Subject:

FOUNDATION INVESTIGATION REPORT

For

Hunt St. and C.P.R. Crossing in the
City of Hamilton, Dist. 4, Hamilton.

W.J. 64-F-33 -- W. P. 118-64

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design work. Should you require additional information, please do not hesitate to contact our Office.

for A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

KYL/MdeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
H. Greenland
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

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FOUNDATION INVESTIGATION REPORT

For

Hunt St. and C.P.R. Crossing in the
City of Hamilton, Dist. 4, Hamilton.
W.J. 64-F-33 -- W.P. 118-64

1. INTRODUCTION:

A request for a foundation investigation at the site of the crossing of Hunt St. and the C.P.R. in Hamilton, was received from Mr. W. Melinyshyn, Bridge Location Engineer.

A field investigation was subsequently carried out by this Section in order to determine the subsoil conditions at the site of the proposed structure. Presented in this report are the results of this investigation, together with recommendations pertaining to the design of structure foundations.

2. DESCRIPTION OF THE SITE:

The site lies within the area covered by the former Lake Iroquois, formed in the Pleistocene Epoch. The red Queenston shale bedrock is covered by a layer of alluvium deposited from the lake waters. When the level of the lake water rose with the retreat of the ice, gravel bars were formed on top of the alluvium. The railway excavation, cut through the exposed well-cemented sand and gravel, is underlain by layers of silty sands and clays containing gravel and fragments of red shale. The bedrock is red and grey Queenston shale. The steep slopes of the cutting are partly covered with topsoil and vegetation.

cont'd. /2 ...

3. FIELD INVESTIGATION AND LABORATORY TESTS:

A total of 6 sampled boreholes and 2 dynamic cone penetration tests was carried out during the course of the field investigation. Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. Samples were recovered by means of a standard 2" O.D. split-spoon sampler. Bedrock core was obtained by means of AXT core barrel.

The locations and elevations of all boreholes are shown on Dwg. No. 64-F-33A which accompanies this report.

The samples were visually examined in the laboratory as well as in the field. Tests were carried out in the laboratory on a selection of samples, for the determination of Atterberg limits, moisture contents and grain size distributions.

The laboratory test results have been summarized and are included in this report in Appendix I.

4. SUBSOIL CONDITIONS:

4.1) General:

The subsoil conditions at the site were found to be generally uniform. Detailed descriptions of various soil types encountered in each boring are given in Appendix I of this report. The estimated stratigraphical profile of Dwg. 64-F-33A is based upon this information.

From ground level downwards, the various soil types encountered are as follows:

cont'd. /3 ...

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

4.2) Silty Clay:

This stratum was found only in the boreholes (B.H. #1 and B.H. #7) drilled from the top of the bank of the railroad cut. The depth to the bottom of the stratum was 15 ft. in B.H. #1 and 16 ft. in B.H. #2. The liquid limit of the soil varies from 36% to 56%, the plastic limit from 20% to 27%, and the moisture content from 19% to 28%.

Standard Penetration test values in the stratum varied from 14 to 33, indicating a consistency of very stiff to hard.

4.3) Sand and Gravel:

Following the silty clay is a stratum of sand and gravel and was found only in the two boreholes (#1 and #7) located on the top of the existing railway cut. The stratum consists of a cemented, heterogeneous mixture of sand and gravel. This deposit was proved only 16 ft. in B.H.'s #1 and #7.

Standard Penetration test values in the stratum vary from 65 blows/ft., to over 100 blows/ft., indicating a relative density of very dense.

4.4) Silty Sand:

A deposit of silty sand was observed immediately below the ground surface in B.H.'s #2, #4, #5 and #6. These boreholes are located approx. at the toe of the existing railway cut. The thickness of the stratum varies from 9 ft. in B.H.'s #5 and #6, to 14 ft. in B.H.'s #2 and #4.

Standard Penetration test results in the stratum varied from 5 to 60, indicating a relative density of loose to very dense.

cont'd. /4 ...

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

4.5) Clayey Silt:

Immediately below the stratum of silty sand in B.H.'s #2, #4, #5 and #6, a deposit of clayey silt was encountered. This deposit was proved down to shale bedrock in B.H.'s #2 and #5, whereas in B.H.'s #4 and #6, this was determined only to a depth of 12 to 18 ft. below the sand layer. The maximum depth of this layer was found to be 33 ft. in B.H. #5.

The physical properties of the stratum as determined in the field and in the laboratory, are as follows:

Liquid Limit	22%	-	32%
Plastic Limit	12%	-	18%
Moisture Content ...	11%	-	27%
'N' values	13 blows/ft.	-	51 blows/ft.

Based on the 'N' values, the consistency of the stratum may be described as stiff to hard.

Within the clayey silt deposit, between elevations 257 and elev. 265 in B.H. #2, a layer of sand and gravel was encountered. The 'N' values measured by the Standard Penetration tests were generally in the order of 60 blows/ft., indicating a very dense relative density.

4.6) Shale Bedrock:

The bedrock of red-grey Queenston shale was proved by drilling 5 ft. of core in B.H. #2. The bedrock was only contacted, but not drilled in B.H. #5. The contact with bedrock was established between elev. 249 and elev. 244.

cont'd. /5 ...

5. GROUND WATER:

During the foundation investigation, water level observations were carried out in the boreholes. These indicate that the ground water elevation varies little over the site, being at approximate elevation 284.

The exact water levels observed during the investigation are shown on Dwg. No. 64-P-33A.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new overhead structure at the crossing of the C.P.R. tracks and Hunt Street. The existing timber trestle is to be removed and replaced by either a single-span structure, incorporating retaining walls, or a three-span structure without retaining walls.

The investigation has revealed that the subsoil conditions are generally favourable for spread footing foundations.

1) Single-Span Structure with Closed End Type Abutments and Retaining Walls:

The existing ground elevation of the railway cut is at approximate elev. 286.0. In order to have adequate frost protection the footings should be located some 5 to 6 ft. below the existing ground. It is recommended that the above-mentioned type of structure should be supported on spread footings located at elev. 281.0 or below, with a net bearing pressure of 3 t.s.f.

The footing excavations for the structure will be carried out in a relatively permeable type of subsoil, below the prevailing ground water level and, therefore, dewatering problems can be anticipated. Also, care should be

cont'd. /6 ...

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

1) Single-Span Structure: (cont'd.) ....

taken to prevent softening of the foundation material by surface water during construction. A granular or concrete working pad should be placed as soon as possible to prevent softening bottom of the excavation.

2) Three-Span Structure with Perched Abutments:

As an alternative, a three-span structure may be adopted at this location. The proposed abutments will be located on the banks of the railway cut and the proposed piers at the toe of the railway cut. The subsoil conditions at both the locations are favourable for spread footing type of foundations. The pier footings can be designed as discussed above for the abutment footings of the single-span structure. From the available information at the time of writing this report, it was understood that the perched abutments will be located at elev. 310.0 or below. The abutments should be supported on spread footings with a safe bearing pressure of 3 t.s.f. A minimum of 6 feet of cover should be provided for frost protection.

No dewatering problems for the abutment footing excavations are anticipated since the water table is at approximate elev. 284.0, some 26 feet below the bottom of the excavations.

3) Approach Cuts:

The proposed grade of Hunt Street is at elev. 324.0 and the C.P.R. track at elev. 286.0. This indicates that the approach cuts will be in the order of 38 ft. No approach cut stability problems are anticipated provided the standard 2:1 cut slopes are adopted.

cont'd. /7 ...

7. SUMMARY:

Subsoil at the site generally consists of silty sand followed by clayey silt at the bottom of the railway cut. The material on the banks of the cut is generally composed of silty clay followed by sand and gravel.

A new overhead structure is proposed to replace the existing timber trestle structure at the crossing of Hunt Street and C.P.R. tracks. The new overhead structure could be either a single-span, open type abutments with retaining walls, or a three-span structure with perched abutments. In either case, the structure can be supported on spread footings with a safe bearing pressure of 3 t.s.f.

Dewatering problems pertaining to each type of structure are discussed under 6.1 and 6.2 of "Discussion and Recommendations".

No stability problems are anticipated.

8. MISCELLANEOUS:

The field work, performed in May 1964, together with the preparation of this report, was undertaken by Mr. R. Magi, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

Equipment was owned and operated by Dominion Soil Investigation Ltd. of Toronto.

June 1964

APPENDIX I.

FORM CE-MLT-63.3(6)

OFFICE REPORT OF SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS, TRANSPORTATION AND
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 64-F-33 LOCATION 30' Rt. Sta. 502 ORIGINATED BY R.M.

W. P. 118-64 BORING DATE May 13, 1964. COMPILED BY R.M.

DATUM 324.4 BOREHOLE TYPE Washboring CHECKED BY M.D.

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
324.4	Groundlevel					
0	Silty clay.		1	SS	16	320
			2	SS	23	
			3	SS	14	
			4	SS	33	
309.4	Stiff to hard.					310
15	Sand and gravel.		5	SS	41 (2")	
						300
			6	SS	65	
292.4	Very dense		7	SS	50 (2")	
32	End of borehole.					290

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT ——

SHEAR STRENGTH P.S.F.

LIQUID LIMIT —— WL
PLASTIC LIMIT —— WP
WATER CONTENT —— W

WP W WL

WATER CONTENT % 20 40 60

BULK DENSITY P.C.F.

REMARKS

Sa1% Si 61%
Cl 38%

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-33 LOCATION 20' Lt. Sta. 5+46 ORIGINATED BY R.M.

W.P. 118-64 BORING DATE May 15, 1964. COMPILED BY R.M.

DATUM 293.5 BORING METHOD Washboring & Cone Penetration CHECKED BY M.D.

ELEV / DEPTH	SOIL DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
293.5	Groundlevel									
0	Silty sand.		1	SS	5	290				
			2	SS	21					
			3	SS	26					W.L. 284.5
			4	SS	34	280				
289.5	Loose to dense									
14	Clayey silt.		5	SS	27					Sa 5% Si 75% Cl 20%
			6	SS	34	270				
			7	SS	13					
265.5	Stiff to hard.									
28	Sand and gravel.		8	SS	67					Sa 25% Gr 68% Cl & Si 7%
						260				
257.5	Compact to v. dense		9	SS	25					
36	Clayey silt.		10	SS	39					
248.5	Very stiff to hard.					250				
45	Shale bedrock.		11	RC	-					
243.5										
50	End of borehole.									

FORM OR[illegible]

[illegible]ICE REPORT OF SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 64-F-33 LOCATION 67' Lt. Sta. 5+37 ORIGINATED BY R.M.

W. P. 118-64 BORING DATE May 21, 1964. COMPILED BY R.M.

DATUM 292.7 METHOD Cone Penetration Test. CHECKED BY M.D.

ELEV. DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY	BLOWS/FT.	ELEV.	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
292.7	Groundlevel									
0						290				
						280				
270.2										
22	End of borehole.					270				

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 64-F-33 LOCATION 40' Rt. Sta. 5+61 ORIGINATED BY R.M.

W.P. 118-64 BORING DATE May 21, 1964. COMPILED BY R.M.

DATUM 294.0 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
294.0	Groundlevel									
0	Silty sand.		1	SS	55	290				
			2	SS	32					
			3	SS	38					W.L. 284.4
280	Dense to v. dense		4	SS	60	280				Sa 59% Si 37% Cl 4%
14	Clayey silt		5	SS	28					
			6	SS	35	270				
			7	SS	44					
262.5	Very stiff to hard.		8	SS	20					
31.5	End of borehole.					260				

FORM OBM

OFFICE REPORT OF SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 64-F-33 LOCATION 42' Rt. Sta. 6/10 ORIGINATED BY R.M.

W.P. 118-64 BORING DATE May 25, 1964. COMPILED BY R.M.

DATUM 287.0 BOREHOLE TYPE Washboring CHECKED BY M.D.

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
287.0	Groundlevel					
0	Silty Sand		1	SS	25	
			2	SS	27	280
278.0	Compact					
9	Clayey silt.		3	SS	34	
			4	SS	25	
			5	SS	51	270
			6	SS	26	
			7	SS	22	260
			8	SS	17	
			9	SS	50	250
			10	SS	45	
245.0	Very stiff to hard					
42.0	Shale Bedrock					
	End of borehole.					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT

SHEAR STRENGTH P.S.F.

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w

w_P w w_L

WATER CONTENT %
20 40 60

BULK DENSITY
γ P.C.F.

REMARKS

W.L. 284.2

FORM CS-ML

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 64-F-33 LOCATION 32' Lt. Sta. 5+88 ORIGINATED BY R.M.

W P 118-64 BORING DATE May 26, 1964. COMPILED BY R.M.

DATUM 288.2 BORING METHOD Washboring CHECKED BY M.D.

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS
288.2	Groundlevel									
0	Silty sand.		1	SS	28					W.L. 283.5
			2	SS	39					Sa 64% Si 29% Cl 7%
279.2	Compact to dense					280				
9	Clayey silt.		3	SS	47					
			4	SS	26					
			5	SS	33					
						270				
266.7	Very stiff to hard.		6	SS	30					
21.5	End of borehole.									

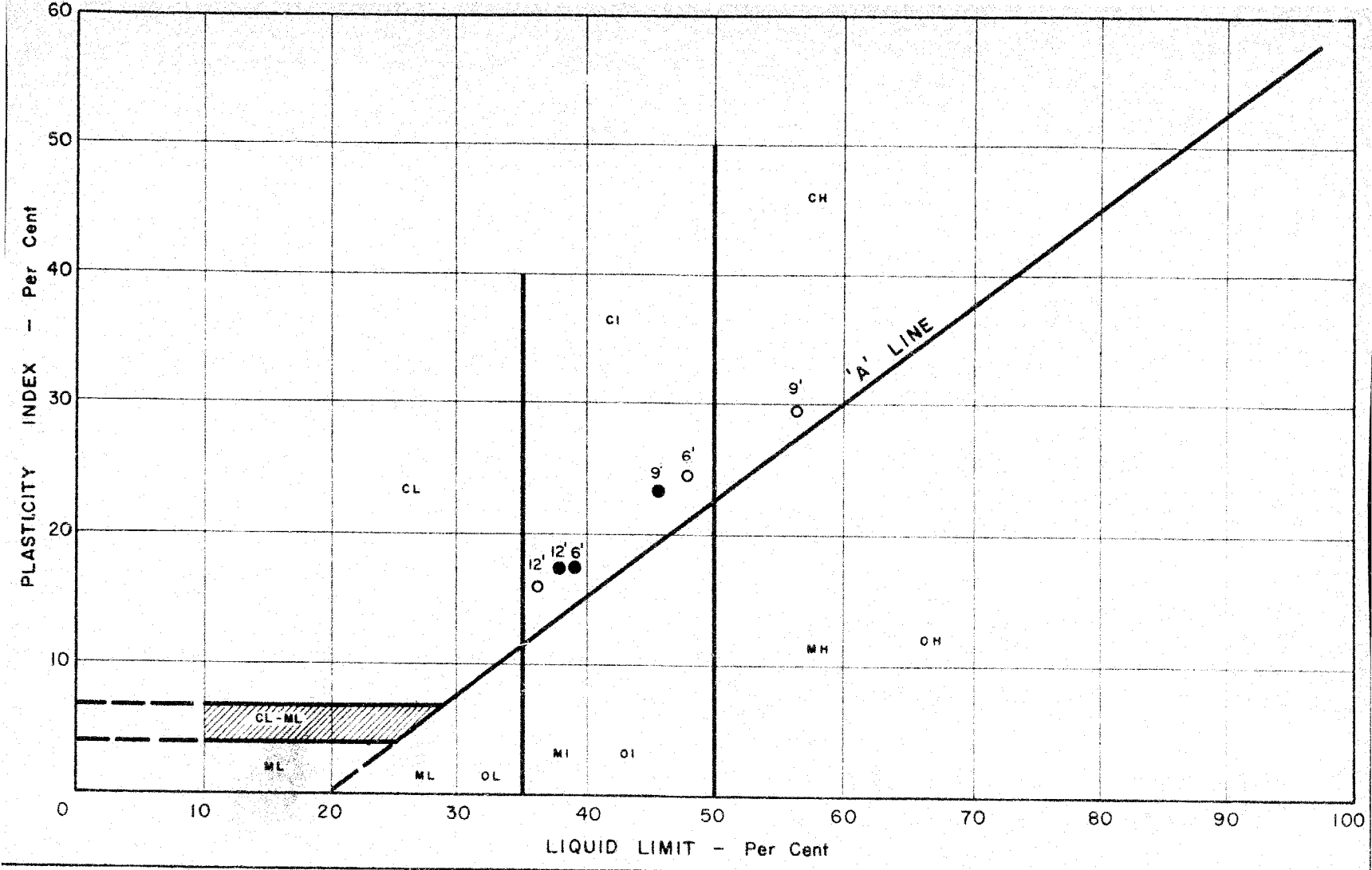
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 64-F-33 LOCATION 25' Lt. Sta. 6+43 ORIGINATED BY R.M.
W.P. 118-64 BORING DATE May 27, 1964. COMPILED BY R.M.
DATUM 324.2 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NO.	TYPE	BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
324.2	Groundlevel									
0	Silty clay.		1	SS	8	320				
			2	SS	14					
			3	SS	15					
			4	SS	17	310				
308.2	Stiff to v. stiff		5	SS	37					
16	Sand and gravel.		6	SS	51					
			7	SS	110 (6")					Gr50% Sa43% Si & Cl 7%
						300				
			8	SS	100 (8")					
292.7	Very dense		9	SS	100 (6")					Gr42% Sa50% Si & Cl 8%
31.5	End of borehole.					290				



NOTES ○ BOREHOLE NO. 1

● BOREHOLE NO. 7

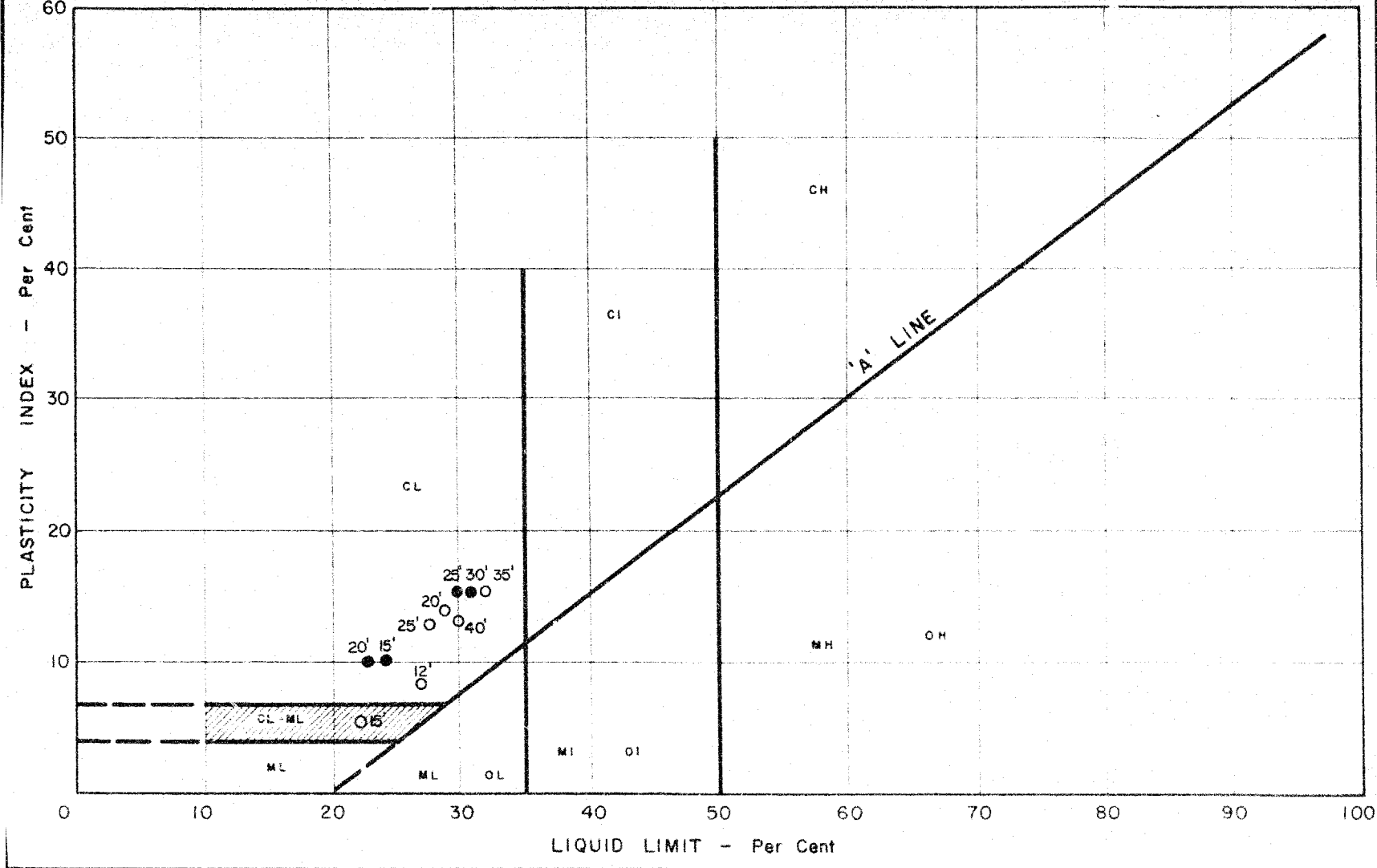
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH DIVISION

PLASTICITY CHART

Job No. 64-F-33 W.P. No. 118-64

Location CPR & HUNT ST. HAMILTON



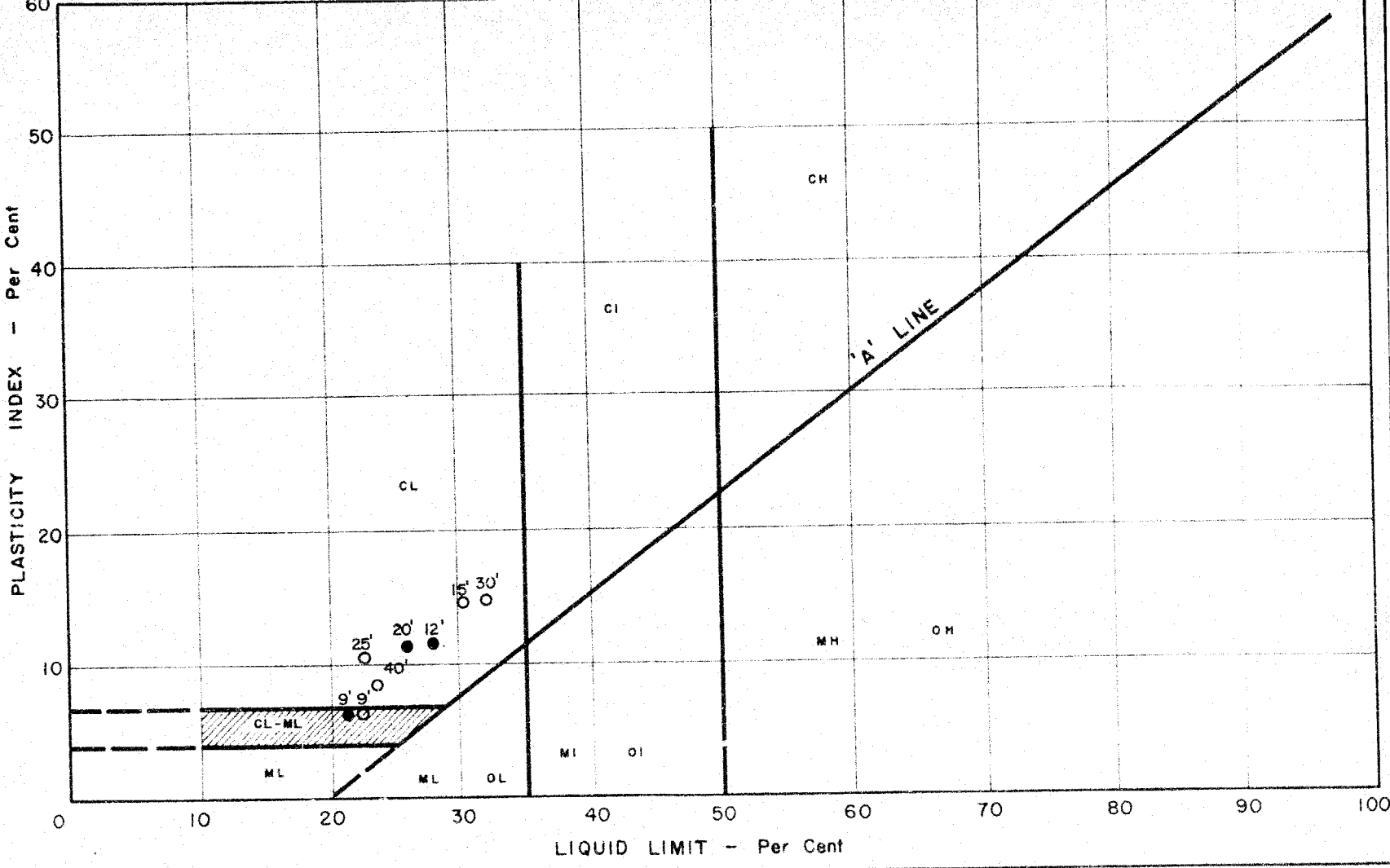
NOTES
- O BOREHOLE NO. 2
- ● BOREHOLE NO. 4

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

PLASTICITY CHART

Job No. 64-F-33 W.P. No. 118-64

Location CPR. & HUNT ST. HAMILTON



NOTES
- O BOREHOLE NO. 5
- ● BOREHOLE NO. 6

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 64-F-33 W.P. No. 118-64
Location CPR. & HUNT ST. HAMILTON

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: Bridge Division,
Downsview, Ontario.

Date: April 29, 1964.

Our File Ref.

In Reply To

Subject: W.P. 118-64
Hunt St. Structure over C.P.R.
City of Hamilton
Dist. #4

Please find attached one print of Plan E-4267-1 with the probable location of footings for the proposed structure marked in red. A possible alternative may be a three span with the probable abutment footing location marked in green.

Would you kindly arrange a foundation investigation at this site, covering both possibilities, in order to provide us with the information necessary to design the new structure.

W. Melinyshyn

WM/sp
cc. R. Fitzgibbon
N. D. Smith

W. Melinyshyn,
Regional Bridge Location Eng.

Informed Regional Materials Engineer by phone that the investigation will be done in May 1964.
Lou Pelc Tyler - Dist Maintenance Engineer on May 12/64.

May 12/64

64-F-33

E

HANN DCA[illegible] MAY 13/64 1116E VR

M GREENLAND DIST ENG-

ATTN A D MAY MTCE ENGR

RE *F116-64 HUNT JCT. STRUCTURE OVER CPR. AT CITY OF HAMILTON

DIST 4 HJ64-F-33

FOUNDATION INVESTIGATION WORK FOR THE ABOVE MENTIONED

STRUCTURE WILL COMMENCE ON MAY 13TH/64 BY THIS SECTION

THIS IS FOR YOUR INFORMATION

R DEVATT JR FOUNDATION ENGR FOR H D STEWART PRINC FOUND ENGR

MAIN & HLG DIV

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: Bridge Division,
Downsview, Ontario.

Date: September 18, 1964.

Our File Ref.

In reply to

Subject: C.P.R. Overhead on Hunt St.
City of Hamilton
District #4 W.P. 118-64

64-F-32

Enclosed please find one print of our preliminary plan D 5544-P1 for the proposed structure.

Would you please inform us if you have any comments or let us have your approval if the preliminary is satisfactory.

Attention is drawn to the 1½:1 cut slopes employed whereas 2:1 slopes were originally anticipated as outlined in the Foundation Report.

WSM/es

W. S. Melinyshyn,
Regional Bridge Location Engineer.

Mr. S. McCombie,
Bridge Planning Engr.,
Bridge Division.

Attn: Mr. W. G. Melinyshyn

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

October 2, 1964

C.P.R. Overhead on Hunt St.,
City of Hamilton, District No. 4,
W.J. 64-F-33 -- W.P. 118-64.

We have reviewed the Preliminary Plan D 5544-P1 for the above-mentioned proposed structure and submit the following comments:

1) 1½:1 cut slopes can be adopted as shown on the preliminary drawing.

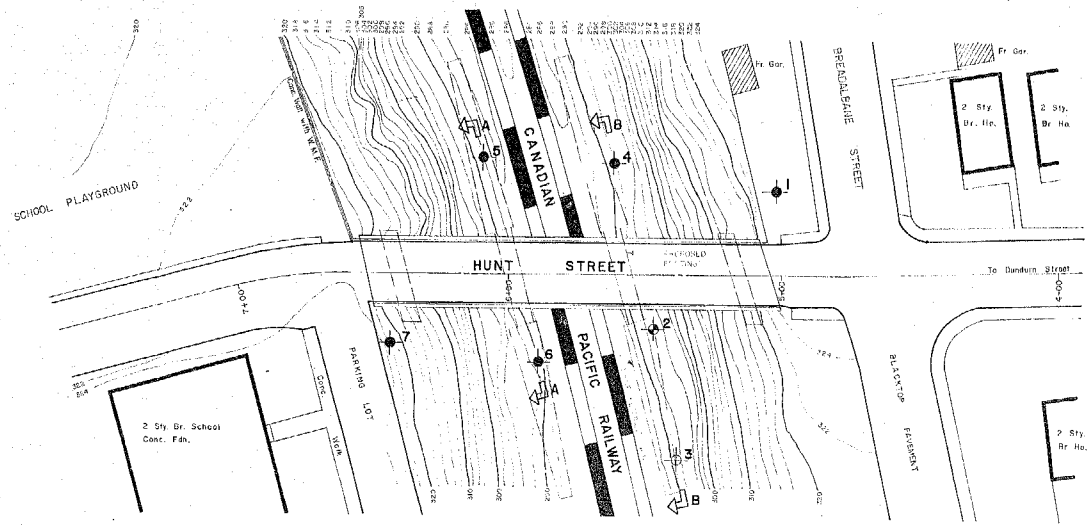
2) Stability of the abutment against overturning and sliding should be checked. The passive resistance of the soil in front of the wall is generally neglected in the stability analyses. A factor of safety of 1.5 should be incorporated using an angle of internal friction $\phi = 35°$.

MD/MdeF

cc: Foundations Office
Gen. Files

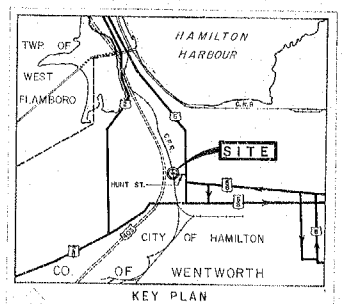
for M. Devata
L. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

#64-F-33
W.P. #118-64
HUNT. ST. &
C.P.R. CROSSING
IN HAMILTON



PLAN

20 10 0 20 40 FT



E 730280
N 479050
EL

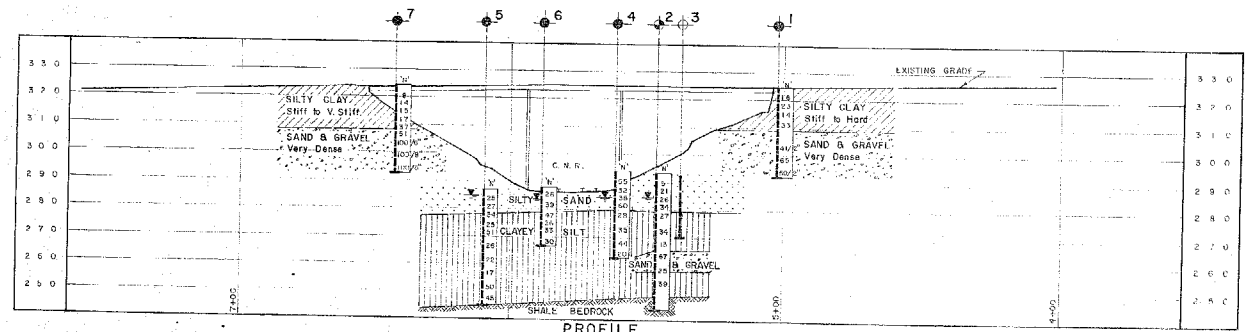
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, (May 1964)

NO.	ELEVATION	STATION	OFFSET
1	324·4	5+02	30' Rt.
2	293·5	5+46	20' Lt.
3	292·7	5+37	67' Lt.
4	294·0	5+61	40' Rt.
5	267·0	6+10	42' Rt.
6	288·2	5+88	32' Lt.
7	324·2	6+43	28' Lt.

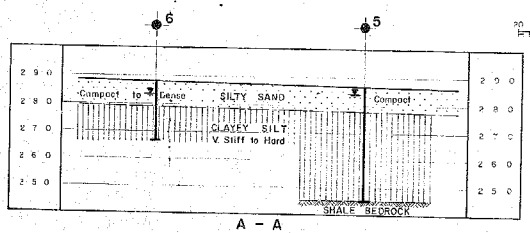
NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are assumed from geological evidence and may be subject to considerable error.

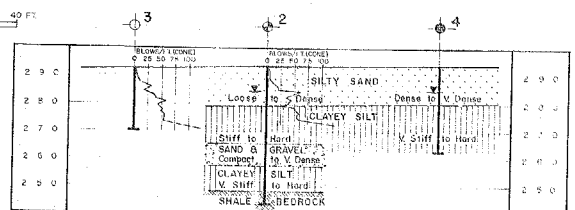


PROFILE

20 10 0 20 40 FT



A – A



B – B

SECTIONS

20 10 0 20 40 FT

REF. NO. E-4267-1

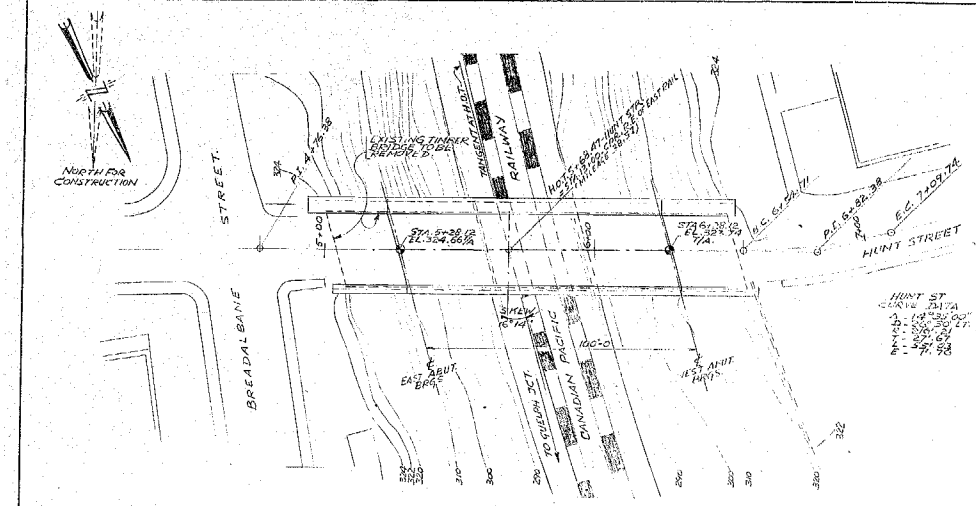
DEPARTMENT OF HIGHWAYS - ONTARIO

CANADIAN PACIFIC RAILWAY

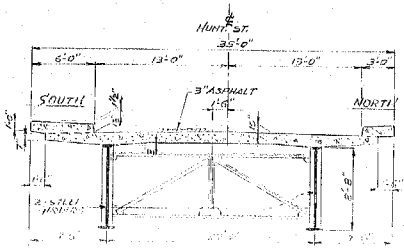
KING'S HIGHWAY NO. HUNT STREET DIST. NO. 4
CO. WENTWORTH CITY OF HAMILTON
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

DES'D R.M.	CHECKED	S.P. NO. 118-64-4	DRAWING NO. 64-F-33A
DRAWN D.M.	CHECKED	DRG. NO. 64-F-33	
DATE 9 JULY 1964	SPEC. NO.		REVISION NO.
APPROVED	DIST. NO.		

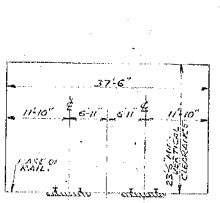


PLAN - SCALE 1" = 20'-0"



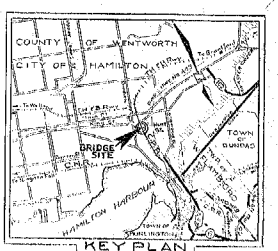
TYPICAL SECTION THROUGH DECK

SCALE 3/4" = 1'-0"



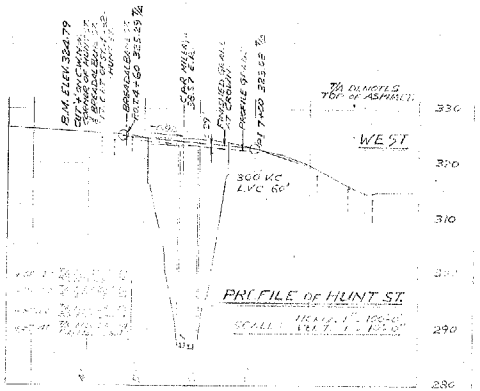
CLEARANCE DIAGRAM OF C.P.R. UNDER HUNT ST.

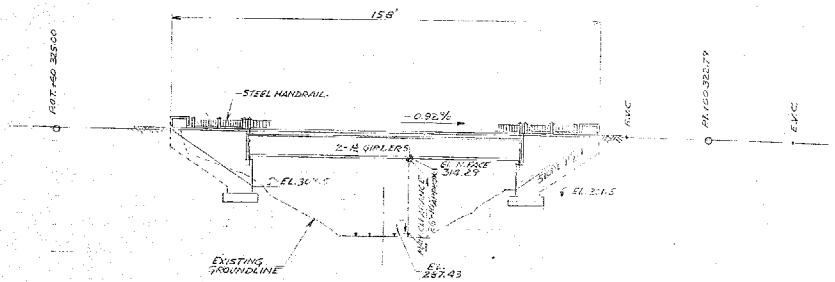
SCALE 1" = 10'-0"



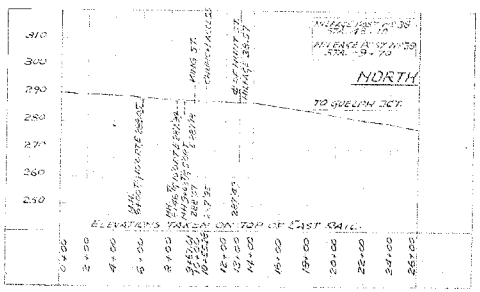
KEY PLAN

SCALE - 1 in = 1 MILE





ELEVATION - SCALE 1"=20'-0"



PROFILE OF CANADIAN PACIFIC RAILWAY

STA. 0+00 C.P.R. CL. OF E.B. & H.O.T. S. 68+87 HUNT ST.

SCALES: HORIZ. 1" = 40'-0"

VERT. 1" = 20'-0"

REFERENCE PLANS:
BRIDGE SITE PLAN E-4267-1
LOCATION PLAN D-151-10
LOCATION PROFILE C-151-22
RAILWAY PLAN G-2932

REVISIONS		
DATE	BY	DESCRIPTION

PRINT RECORD		
No.	FOR	DATE

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

C.P.R. OVERHEAD
OFF HUNT STREET

KING'S HIGHWAY No. — DIST. No. 4

S.S. ST WENTWORTH — Mileage 58.57 Hamilton Subdivision

TWP. CITY OF HAMILTON LOT — CON.

PRELIMINARY PLAN

APPROVED — BRIDGE ENGINEER

SPEC. No. 37-195 — W.P. No. 118-64

CONTRACT Nos.

DESIGN	F.G.	CHECK	
DRAWING	D.SCH	CHECK	F.G.&W.E.
DATE	AUG. 84	LOADING	H20-S16

DRAWING No. D.5544-P1

P. GORMEK