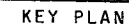


67-F-4
W.P. # 642-64
KITCHENER -
WATERLOO
EXPRESSWAY
UNIVERSITY
AVENUE
UNDERPASS



20 10 0 20 40 F

SCALE



KEY PLAN

LEGEND

- | NO. | ELEVATION | CO-ORDINATES | |
|-----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 1029.0 | 210,820 | 202,770 |
| 2 | 1029.6 | 210,840 | 202,770 |
| 3 | 1029.3 | 210,783 | 202,844 |
| 4 | 1029.9 | 210,863 | 202,811 |
| 5 | 1030.3 | 210,894 | 202,866 |
| 6 | 1031.4 | 210,931 | 202,933 |
| 7 | 1031.9 | 210,949 | 202,960 |
| 8 | 1030.7 | 210,819 | 202,910 |
| 9 | 1034.5 | 210,873 | 202,000 |
| 10 | 1031.9 | 210,859 | 202,970 |

- NOTE -

[illegible]

UNIVERSITY AVENUE UNDERPASS

BORE HOLE LOCATIONS & SOIL STRATA

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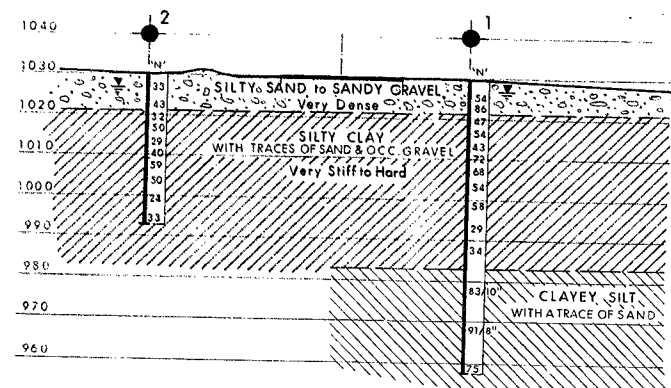
DRAWN M.D.	CHECKED <i>[initials]</i>	JOB NO. 67-F-4	67-F-4A
DATE 28 FEB 1947			BRIDGE DRAWING NO.

DATE 28 FEB 1967	SITE NO	BRIDGE DRAWING NO.
APPROVED <i>A. J. Thomas</i>	CONT NO	

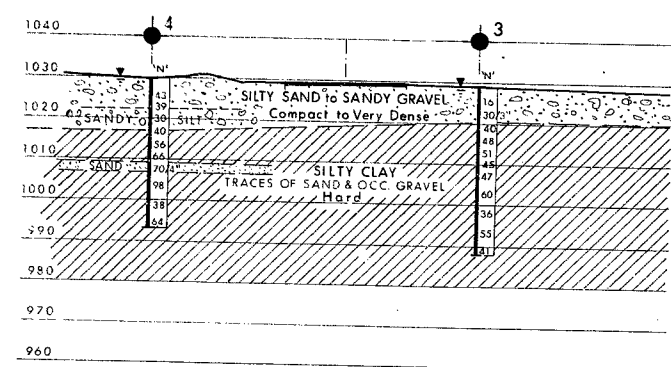
PRINCIPAL FOUNDATION ENGINEER	
-------------------------------	--

[illegible]

67-F-4
W.P. # 642-64
KITCHENER -
WATERLOO
EXPRESSWAY
UNIVERSITY
AVENUE
UNDERPASS

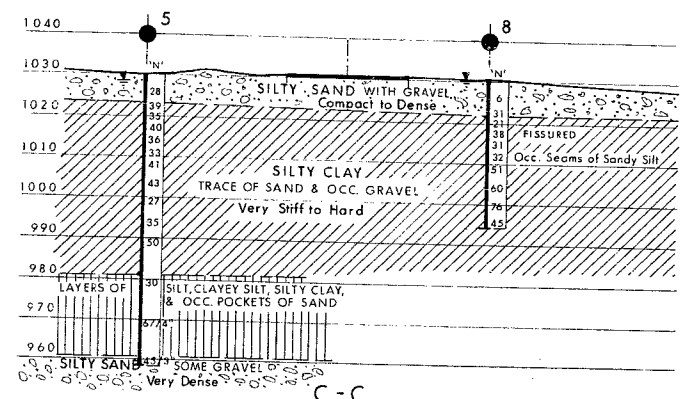


A-A

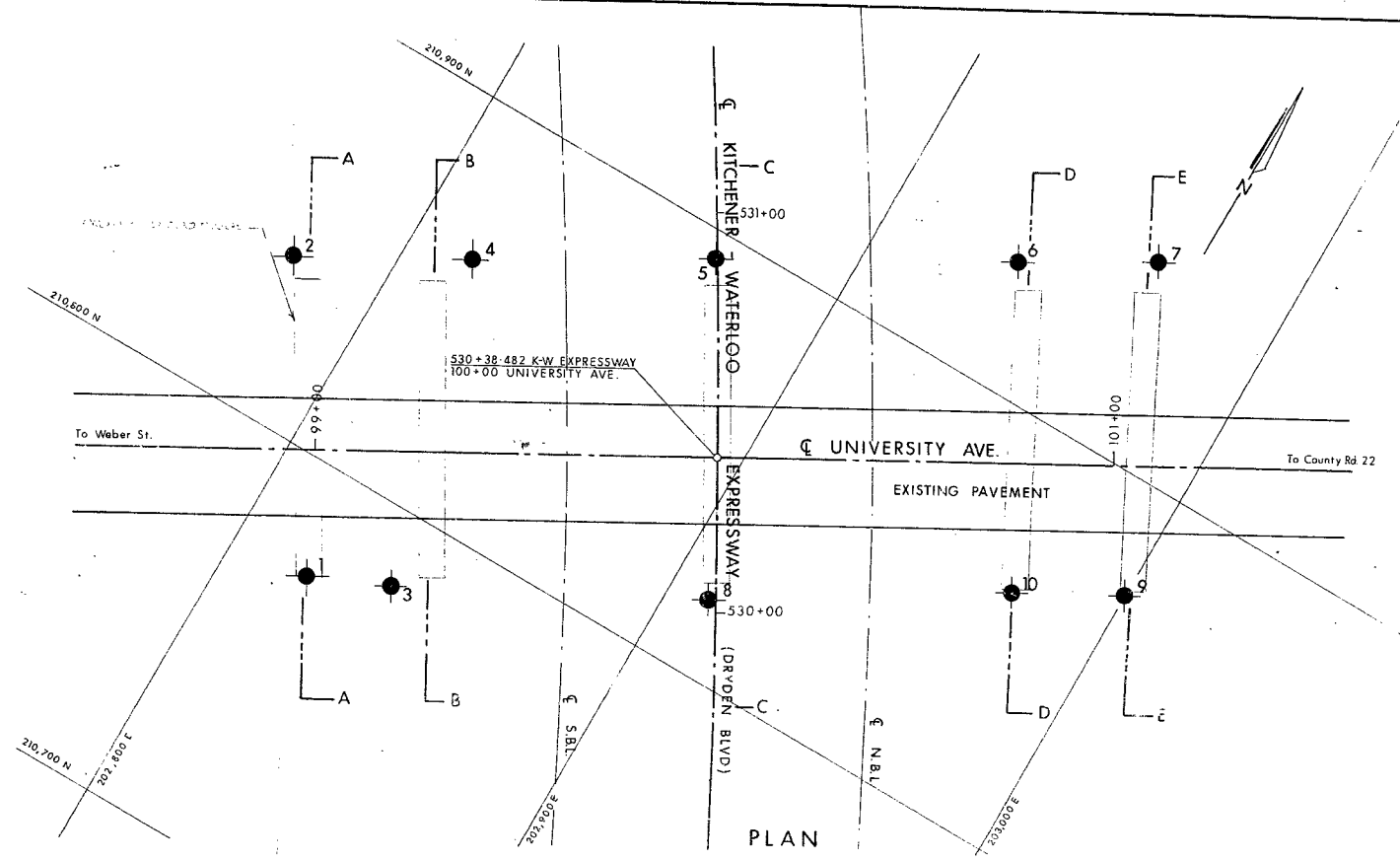


B-B

SECTIONS
SCALE
20 10 0 20 40 FT

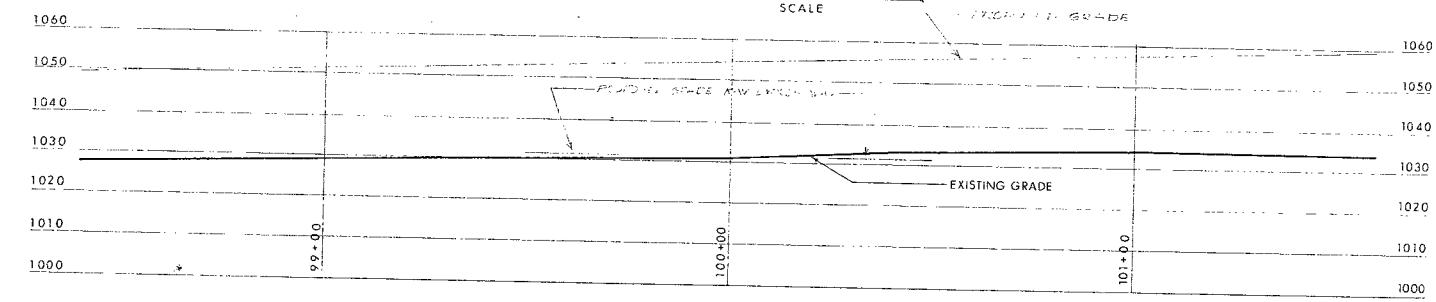


C-C



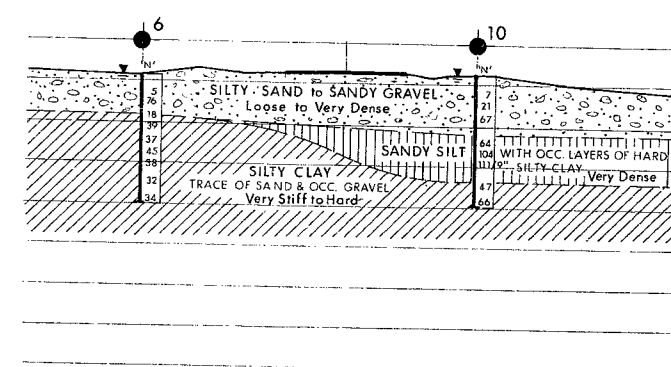
PLAN

SCALE
20 10 0 20 40 FT

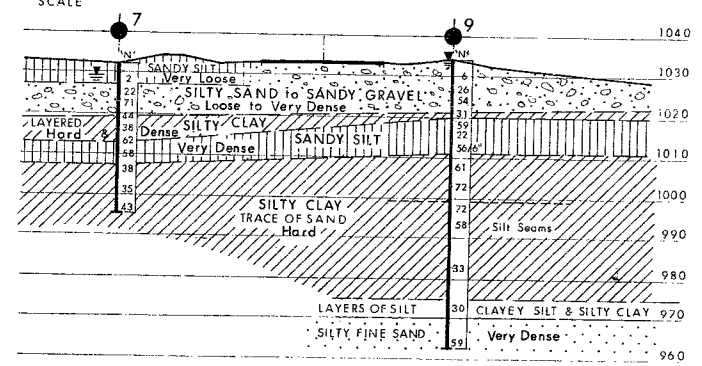


PROFILE UNIVERSITY AVE.

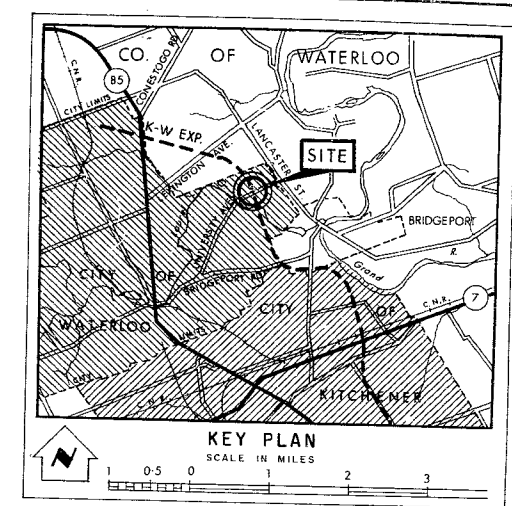
SCALE
20 10 0 20 40 FT



D-D



E-E



KEY PLAN
SCALE IN MILES

LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation. JAN. 1967		

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	1029.0	210,820	202,774
2	1029.6	210,840	202,777
3	1029.3	210,783	202,840
4	1029.9	210,863	202,817
5	1030.3	210,894	202,868
6	1031.4	210,931	202,935
7	1031.9	210,949	202,966
8	1030.7	210,819	202,910
9	1034.5	210,873	202,001
10	1031.9	210,859	202,975

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.

PRINT RECORD		
NO.	FOR	DATE

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

UNIVERSITY AVENUE UNDERPASS

KING'S HIGHWAY NO. KITCHENER-WATERLOO EXPR. DIST. NO. 4
CO. WATERLOO CITY OF WATERLOO
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. P.P.	CHECKED <i>AC</i>	W.P. NO. 642-64	M.B.S. DRAWING NO.
DRAWN M.D.	CHECKED <i>AC</i>	JOB NO. 67-F-4	67-F-4A
DATE 28 FEB. 1967	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A.B. Thomas</i>	CONT. NO.		

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division, Admin. Bldg.
Attention: Mr. S. McCombie

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

DATE: February 20, 1967

OUR FILE REF.

IN REPLY TO:

MAR - 9 1967

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed University Ave. Underpass
Kitchener-Waterloo Expressway
District #4 (Hamilton)

W.J. 67-F-4 -- W.P. 642-64

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/WdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
A. Gater
H. Greenland
S. Melinyshyn

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

W. J. 67-F-4
H. A. Tregaskes & Assoc.
City of Waterloo

Foundation Files
Gen. Files

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 - 4.3) Silty Clay with a trace of Sand and occasional Gravel.
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 - 4.5) Silty Fine Sand.
 - 4.6) Clayey Silt with a trace of Sand.
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FOUNDATION INVESTIGATION REPORT
For
Proposed University Ave. Underpass
Kitchener-Waterloo Expressway
District #4 (Hamilton)
W.J. 67-F-4 -- W.P. 642-64

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed new underpass at University Avenue and the Kitchener-Waterloo Expressway, was received from Mr. W. S. Melinyshyn, Regional Bridge Location Engineer, in a memo dated December 9, 1966.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed bridge.

This report contains the results of our field and laboratory investigation, together with our recommendations for the foundations of the new structure.

2. DESCRIPTION OF SITE:

The site is located about 0.2 mile east of the junction of University Ave. and Lincoln Rd. in the City of Waterloo.

The immediate surrounding area is partially built up and the topography is flat to undulating.

Physiographically, this area is referred to as the "Waterloo Hills". The region is made up of sandy hills, some of them ridges of sandy till and other kames with outwash sand occupying the intervening hollows.

3. FIELD AND LABORATORY WORK:

Ten sampled boreholes were carried out during the course of the field work. Boring was achieved using a Pennsylvania continuous flight auger and a conventional diamond drill adapted

3. FIELD AND LABORATORY WORK: (cont'd.) ...

for soil sampling purposes.

Samples were recovered using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test. They were visually examined in the field and subsequently in the laboratory.

Laboratory tests were carried out on selected samples to determine Atterberg limits, grain-size distribution, and natural moisture contents, where applicable.

The results of the laboratory and field tests are summarized in the Record of Borehole sheets which are contained in the appendix to this report.

The locations and elevations of the boreholes were determined by A. D. Margison and Associates Limited, and are given on Dwg. No. 67-F-4A, which is also contained in the report appendix.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at this site consists of stratified glacio-fluvial deposits, mostly of fine-grained composition. The surficial layer is sandy silt and silty sand with varying proportions of gravel. The thickness of this layer ranges from 7' - 25', but is generally 7' - 13' thick. The relative density is very loose at the surface to very dense with depth.

The next layer is silty clay with traces of sand and occasional gravel. It is generally of hard consistency. This deposit varies in thickness from 26' to 43'.

This deposit gradates into a hard deposit of thin layers of silt, clayey silt, silty clay and clay with occasional pockets of fine sand.

This deposit in turn, is underlain by a deposit of very dense silty fine sand.

cont'd. /3 ...

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

4.1) General:

The latter two deposits were not intersected in borehole No. 1. At this location, the silty clay layer was underlain by a deposit of clayey silt.

From ground level downwards, the deposits are described as follows:

4.2) Sandy Silt and Silty Sand with varying proportions of Gravel:

This deposit consists of sandy silt and silty sand with varying proportions of gravel. Reference should be made to the Record of Borehole sheets for details of the physical properties of this deposit. The very loose to loose soil only occurs within a depth of 6 feet below the ground surface. The deposit increases in thickness from 7 feet in the west to 25 feet thick in the east. The sudden increase in depth of this deposit between the boreholes for the East pier and the East abutment, suggests the presence of an old river channel at this location.

4.3) Silty Clay with a trace of Sand and occasional Gravel:

Only three deep boreholes intersected the lower boundary of this deposit. Based on the findings from these holes, the deposit varies in thickness from 35 to 43 feet. It is generally of hard consistency. In the upper portion of the deposit, it is fissured. In the lower portion, it is laminated with occasional thin seams of silt.

Occasionally, a small percentage of gravel was present.

The 'N' values (No. of blows per foot in the Standard Penetration Test), ranged from 21 - 98.

The average moisture content was about 21%. The range of liquid limits and plastic limits was between 39% to 50% and 18.0% to 24.8%, respectively.

cont'd. /4 ...

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

4.4) Layers of Silt, Clayey Silt, Silty Clay and Clay with occasional pockets of Fine Sand:

In boreholes No's 5 and 9, the previously described deposit gradates into thin layers of silt, clayey silt and silty clay with occasional pockets of fine sand. Reference should be made to the Record of Borehole sheets for details of the physical properties of this deposit. The 'N' values for this deposit range from 30 to 67/4", indicating a hard consistency. It ranged in thickness from 4 to 18 feet.

4.5) Silty Fine Sand:

This deposit occurred in boreholes No's 5 and 9, and was found to be of very dense relative density, having 'N' values ranging from 59 to 45/3".

4.6) Clayey Silt with a trace of Sand:

This deposit was found only in borehole No. 1 where it was intersected for 25 feet depth at the bottom of the borehole. It was of hard consistency, having 'N' values ranging from 75 to 91/8".

The average moisture content was about 14%. The range of liquid limits and plastic limits was between 23.5% to 29.7% and 14.6% to 16.2%, respectively.

5. GROUNDWATER CONDITIONS:

Groundwater levels observed during the foundation investigation, varied from ground level to three feet below it. The exact water levels are recorded on the appropriate borelog sheets as well as on Dwg. No. 67-F-4A.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an underpass structure at the crossing of University Avenue and the Kitchener-Waterloo Expressway. Present proposals call for a four-span (30'-71'-76'-30') structure having approach fills generally 25 feet higher than existing ground level.

cont'd. /5 ...

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

6.1) General: (cont'd.)

The subsoil conditions at this site consist essentially of a very loose to very dense granular deposit overlying a hard deposit of silty clay. The granular deposit is only loose to a depth less than six feet below ground level. It then rapidly becomes dense to very dense and thereby attains sufficient strength to support spread footings.

Spread footings are therefore recommended for the piers whilst the abutments may either be supported on spread footings or can be constructed within the approach fills and supported on piles. Detailed recommendations are made as follows:

6.2) Piers and Abutments supported on Spread Footings:

The piers and abutments may be supported on spread footings founded at or below the following elevations:

West Abutment	:	El. 1,025.0
West Pier	:	El. 1,023.0
Centre Pier	:	El. 1,023.5
East Pier	:	El. 1,024.0
East Abutment	:	El. 1,024.0

A safe bearing pressure of 2.5 ton/ft.² may be used for design purposes.

As excavation below the high groundwater level will be required in material which is highly susceptible to boiling, a dewatering scheme is essential. This problem can most easily be overcome by driving temporary steel sheet piling 2 feet into the silty clay deposit which lies below the footings.

The necessary sheeting lengths can be determined from Dwg. No. 67-F-4A.

In the case of the East pier and East abutments, where the silty clay deposit lies at a greater depth than elsewhere, the

cont'd. /6 ...

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

6.2) Piers and Abutments supported on Spread Footings: (cont'd.)...
sheeting need only be driven to a depth below the bottom of the excavation equal to the hydraulic head above it to prevent boiling.

Provided these recommendations are carried out, only small differential settlements are anticipated.

6.3) Abutments supported on Piles:

Alternatively, the abutments may be constructed within the approach fills and supported on 12-3/4" O.D. steel tube piles. The piles for the East abutment should be driven to (but not below) El. 1,013.0. For the West abutment, the piles should be driven to El. 980. It is anticipated that hard driving will be required to drive the piles to this elevation. However, this will be necessary to develop the recommended design load for these piles. A design load of 45 ton/pile may be used for the piles of both abutments.

Granular type fill should be placed up to the level of the underside of the pile caps. This fill need only be placed over an area about twice as large as the area covered by the footings and should be well compacted.

Difficulties have arisen in the past when tube piles have been driven through compacted fill. It is believed that most of these difficulties have been due to the presence of cobbles or small boulders. For this reason, it is strongly recommended that all grain sizes larger than 3 inches, be screened out prior to placing this fill.

6.4) Approach Embankments:

No stability problems are anticipated for the construction of the approach fills if standard 2:1 side slopes are adopted.

cont'd. /7 ...

7. SUMMARY:

A foundation investigation at the site of the University Avenue and Kitchener-Waterloo Expressway crossing is reported.

Subsoil at the site consists of a very loose to very dense granular deposit overlying a hard deposit of silty clay.

It is recommended that the piers and abutments of the proposed structure be supported entirely on spread footings or, alternatively, the abutments may be constructed within the approach fills and supported on steel tube piles. Only small differential settlements are expected. Procedures for construction and dewatering have been outlined in this report.

No stability problems are anticipated for the construction of the approach fills.

8. MISCELLANEOUS:

The field work for this project was carried out during the period January 16 - 25, 1967, under the supervision of Mr. P. Payer, Project Foundation Engineer.

Equipment used was owned and operated by Canadian Longyear Limited.

This report was prepared by Mr. A. Calder, Project Foundation Engineer, and reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

February 1967

APPENDIX I.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO			RECORD OF BOREHOLE NO. 2				FOUNDATION SECTION					
MATERIALS & TESTING DIVISION												
JOB 67-F-4			LOCATION Co-ordinates 210, 840 N, 202, 777 E				ORIGINATED BY PP					
W.P. 642-64			BORING DATE January 17, 1967				COMPILED BY HS & ACC					
DATUM Geodetic			BOREHOLE TYPE Pen Drill				CHECKED BY [Signature]					
SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT		
1029.6	GROUND LEVEL											
0.0	Silty sand to sandy gravel with occ. seams of silt. Dense.	0.0	1	SS	33							
		0.0	2	SS	43							
1020.1		0.0	3	SS	32	1020						
9.5	Silty clay with traces of sand and occasional gravel. Very stiff to hard.		4	SS	50							
			5	SS	29							
			6	SS	40	1010						
			7	SS	59							
			8	SS	50							
			9	SS	24	1000						
993.1			10	SS	33							
36.5	End of Borehole					990						

FOUNDATION SECTION

CHECKED BY

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.			WATER CONTENT % 25 50 75			
1029.3	GROUND LEVEL												
0.0	Silty sand to sandy gravel.		1	SS	16								NL.1029.3 Gr.27, Sa.44 Si.&Cl.29 Gr.38, Sa.58 Si.&Cl.4 Gr.9, Sa.33 Si.24, Cl.34
	Compact to very dense		2	SS	30/3"								
1020.3			3	SS	40	1020							
9.0	Silty clay with traces of sand and occasional gravel.		4	SS	48								
			5	SS	51								
			6	SS	45	1010							
			7	SS	47								
			8	SS	60								
			9	SS	36	1000							
			10	SS	55								
987.8			11	SS	41	990							
41.5	End of Borehole					980							

FOUNDATION SECTION

CHECKED BY

[illegible]

FOUNDATION SECTION

JOB 67-F-4 LOCATION Co-ordinates 210, 949 N 202, 966 E ORIGINATED BY P.P.
W.P. 642-64 BORING DATE January 20, 1967 COMPILED BY HS. & ACC.
DATUM Geodetic BOREHOLE TYPE Pen Drill CHECKED BY AK

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.	WATER CONTENT % 25 50 75				
1031.9	GROUND LEVEL											
0.0	Sandy silt with trace of organics. Very loose.		1	SS	2	1030						WL1028. Gr.0,Sa.47 Si.51,C1.2
1027.4			2	SS	22							
4.5	Sandy gravel to silty sand with a trace of gravel. Compact to very dense		3	SS	71							Gr.4,Sa.64 Si.30,C1.2
1019.1			4	SS	44	1020						
12.8	Layers of silty clay, Clayey silt and Sandy silt. Hard & dense.		5	SS	38							Gr.0,Sa.33 Si.46,C1.21
1013.4			6	SS	62							
18.5	Sandy Silt		7	SS	58	1010						Gr.0,Sa.22 Si.74,C1.4
1007.9	Very dense.		8	SS	38							
24.0	Silty Clay with a trace of sand. Hard		9	SS	35	1000						
995.4			10	SS	43							
36.5	End of Borehole					990						

FOUNDATION SECTION

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit — WL	Plastic Limit — WP	Water Content — W	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					
1034.5	GROUND LEVEL											
0.0	Silty Sand to sandy gravel. Loose to very dense.		1	SS	6	1030						
			2	SS	26							
			3	SS	54							
			4	SS	31	1020						
1021.0	Silty clay with trace of gravel. Hard.		5	SS	59							
1020.0			6	SS	22							
14.5	Sandy silt. Very Dense.		7	SS	56/6"	1010						
1010.5			8	SS	61							
24.0	Silty clay with trace of sand. Hard.		9	SS	72							
999.5			10	SS	72	1000						
35.0	Silty clay laminated with thin seams of silt.		11	SS	58							
			12	SS	33	990						
						980						
974.5			13	SS	30							
60.0	Layers of silt, clayey silt & silty clay. Hard.					970						
970.5												
64.0	Silty Fine Sand. Very dense.											
963.0			14	SS	59							
71.5	End of Borehole					960						

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-4 LOCATION Co-ordinates 210, 859 N 202, 975 E ORIGINATED BY PP
W.P. 642-64 BORING DATE January 24, 1967 COMPILED BY HS & ACC
DATUM Geodetic BOREHOLE TYPE Pen Drill CHECKED BY SR

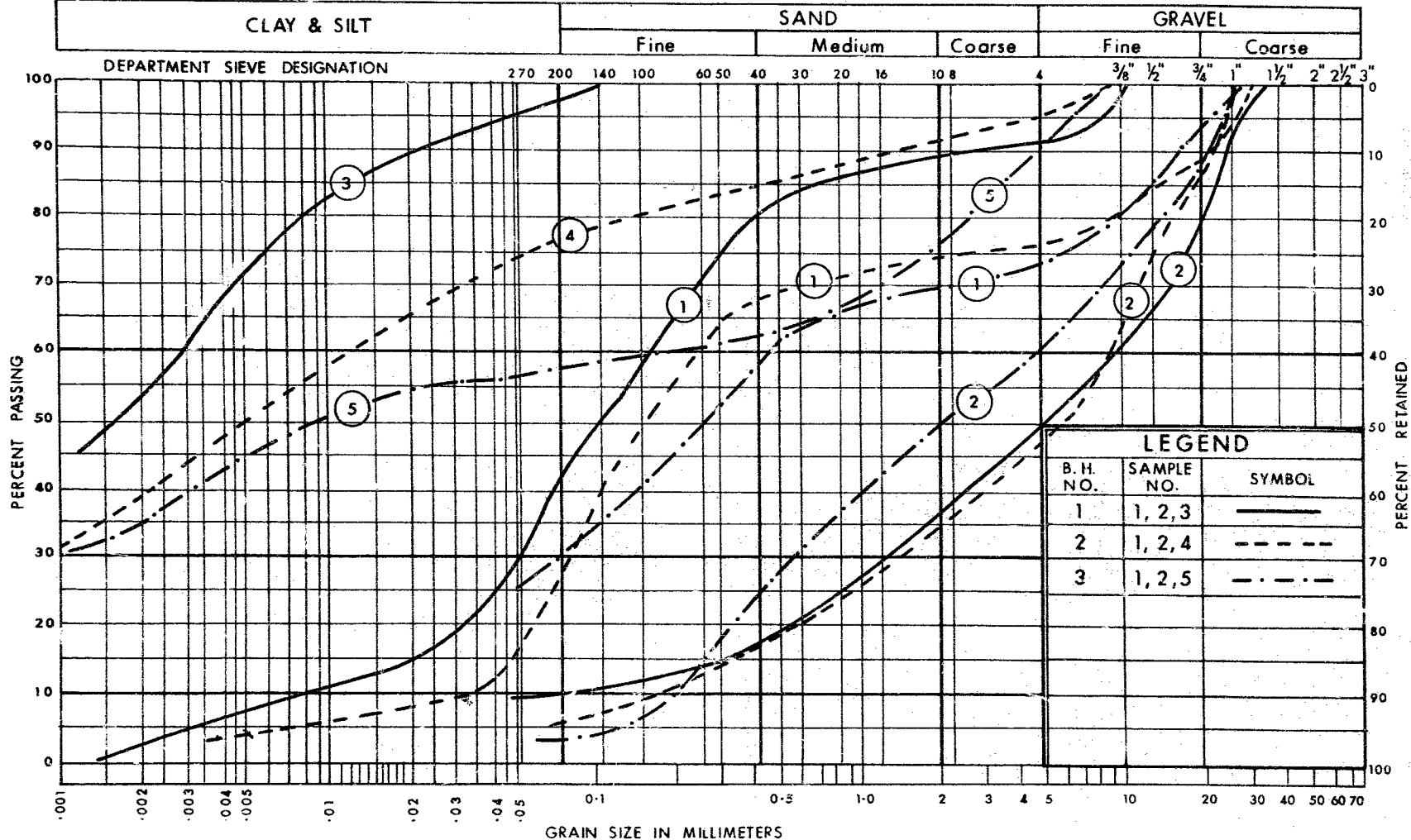
ORIGINATED BY PP

COMPILED BY HS & ACC

CHECKED BY SK

[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM



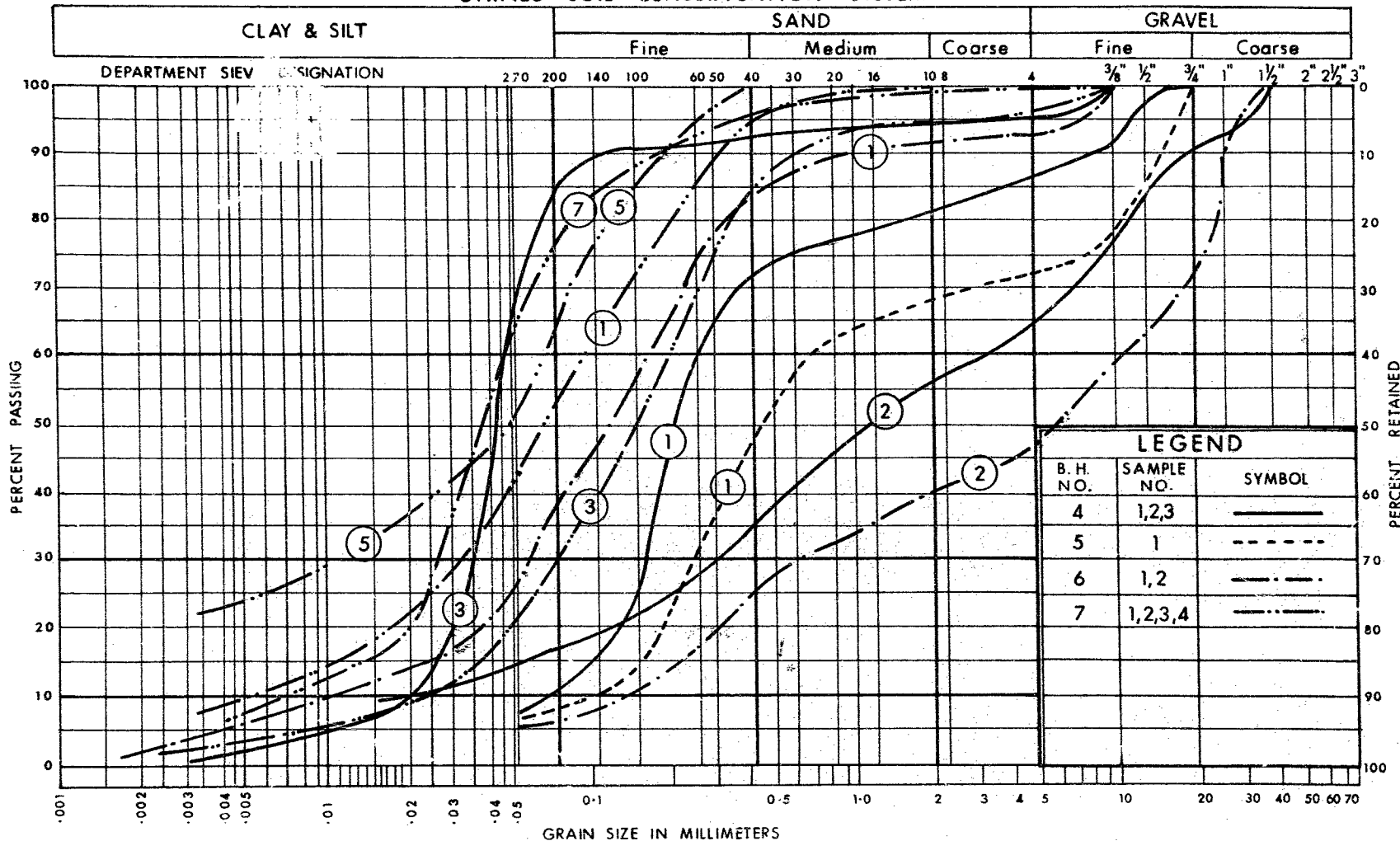
DEPARTMENT OF HIGHWAYS
**MATERIALS and
TESTING
DIVISION**

GRAIN SIZE DISTRIBUTION

W.P. No. 642-64

JOB No. 67-F-4

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

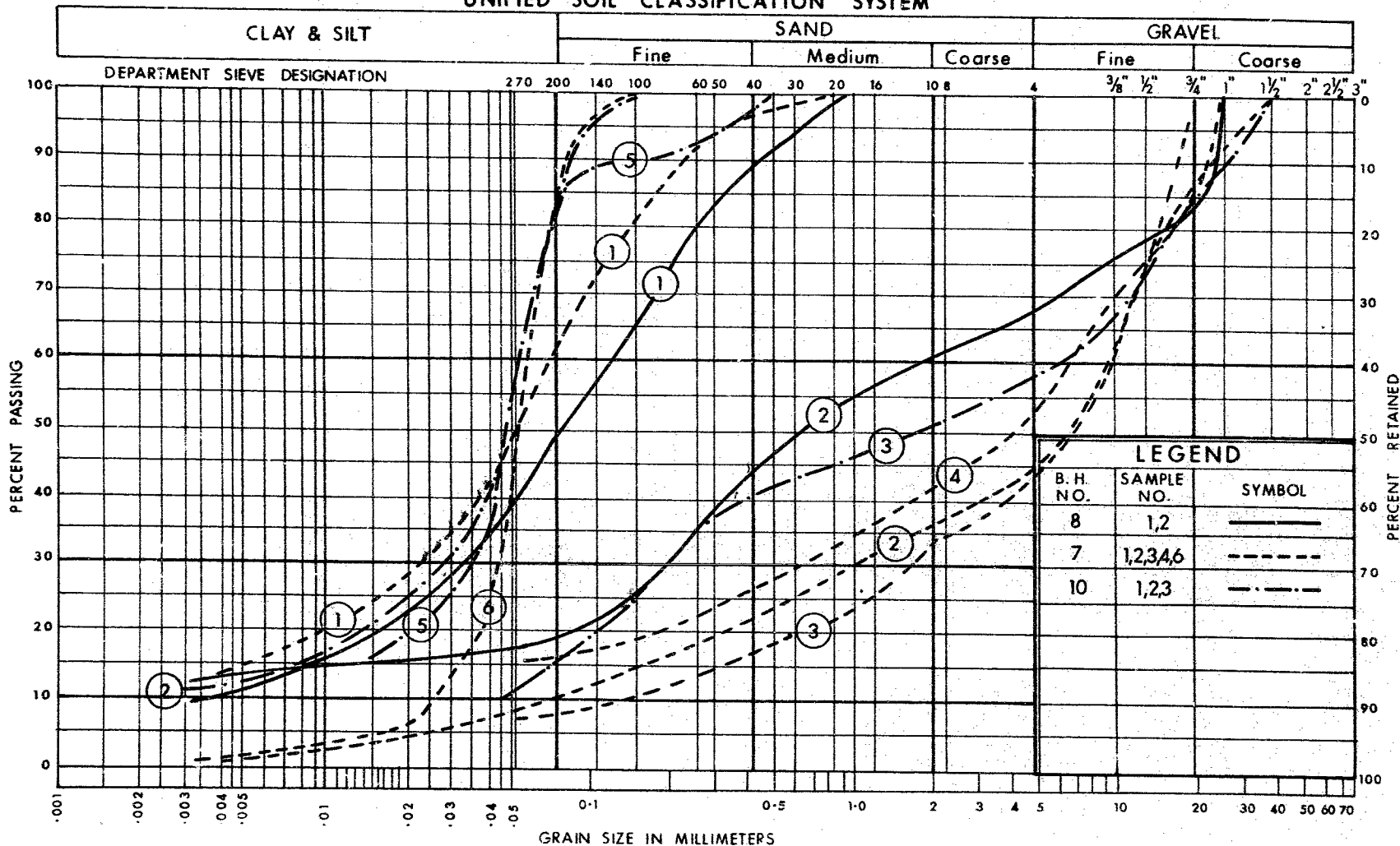


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

W.P. No. 642-64

JOB No. 67-F-4

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

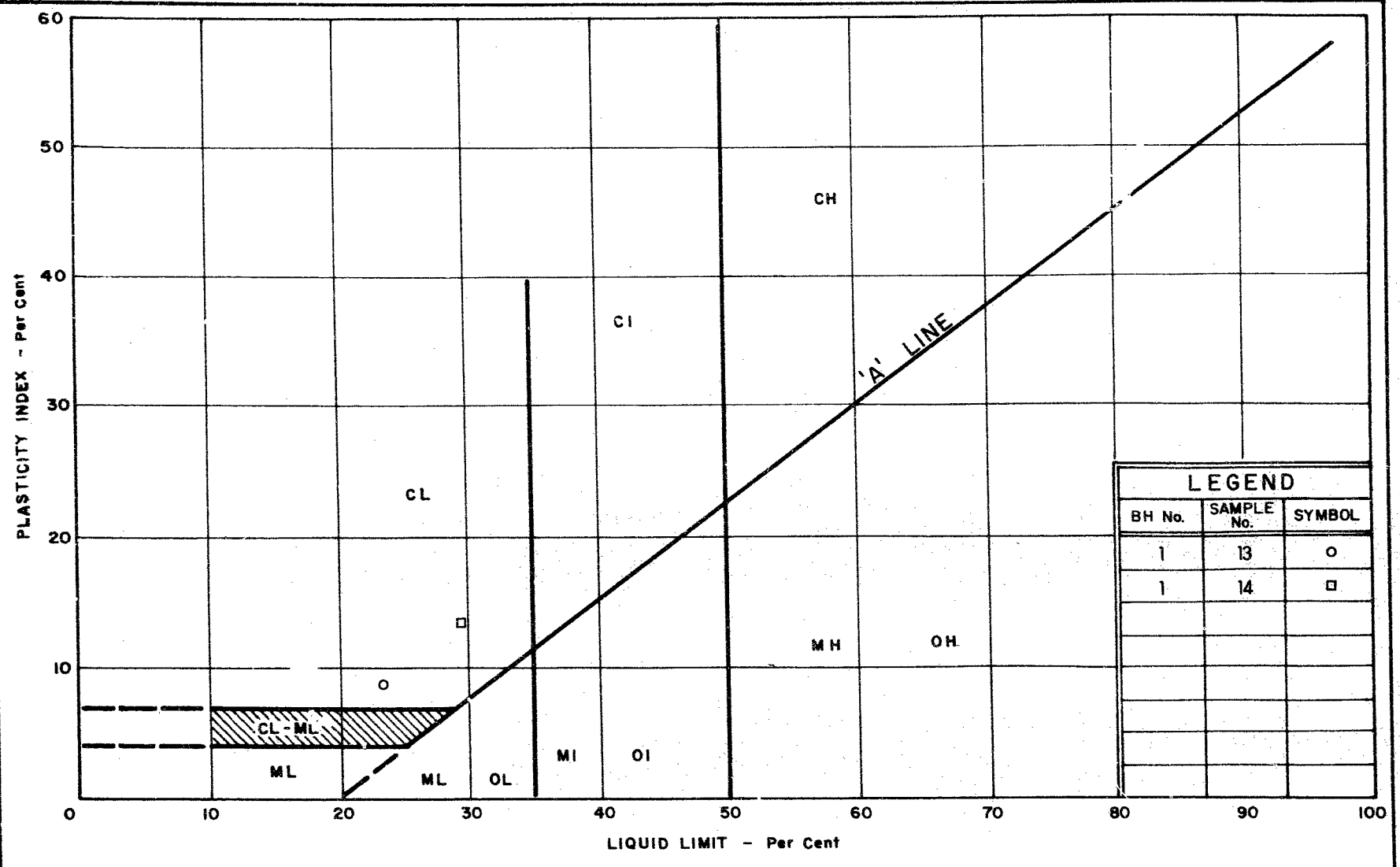


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

ONTARIO

W.P. No. 642-64

JOB No. 67-F-4



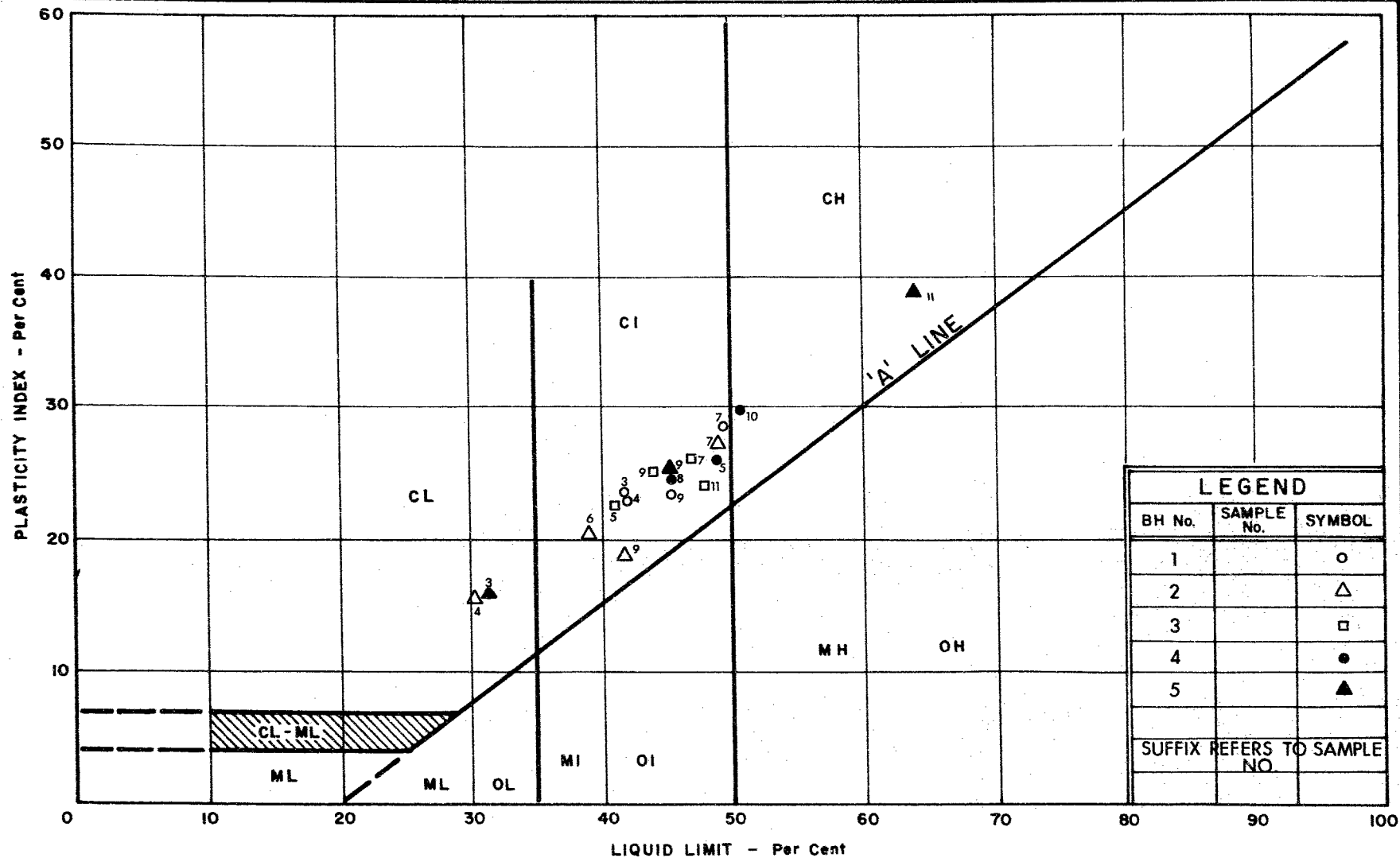
LEGEND		
BH No.	SAMPLE No.	SYMBOL
1	13	○
1	14	□



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART
CLAYEY SILT with a trace of sand

W.P. No. 642-64
JOB No. 67-F-4



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1		○
2		△
3		□
4		●
5		▲
SUFFIX REFERS TO SAMPLE NO.		

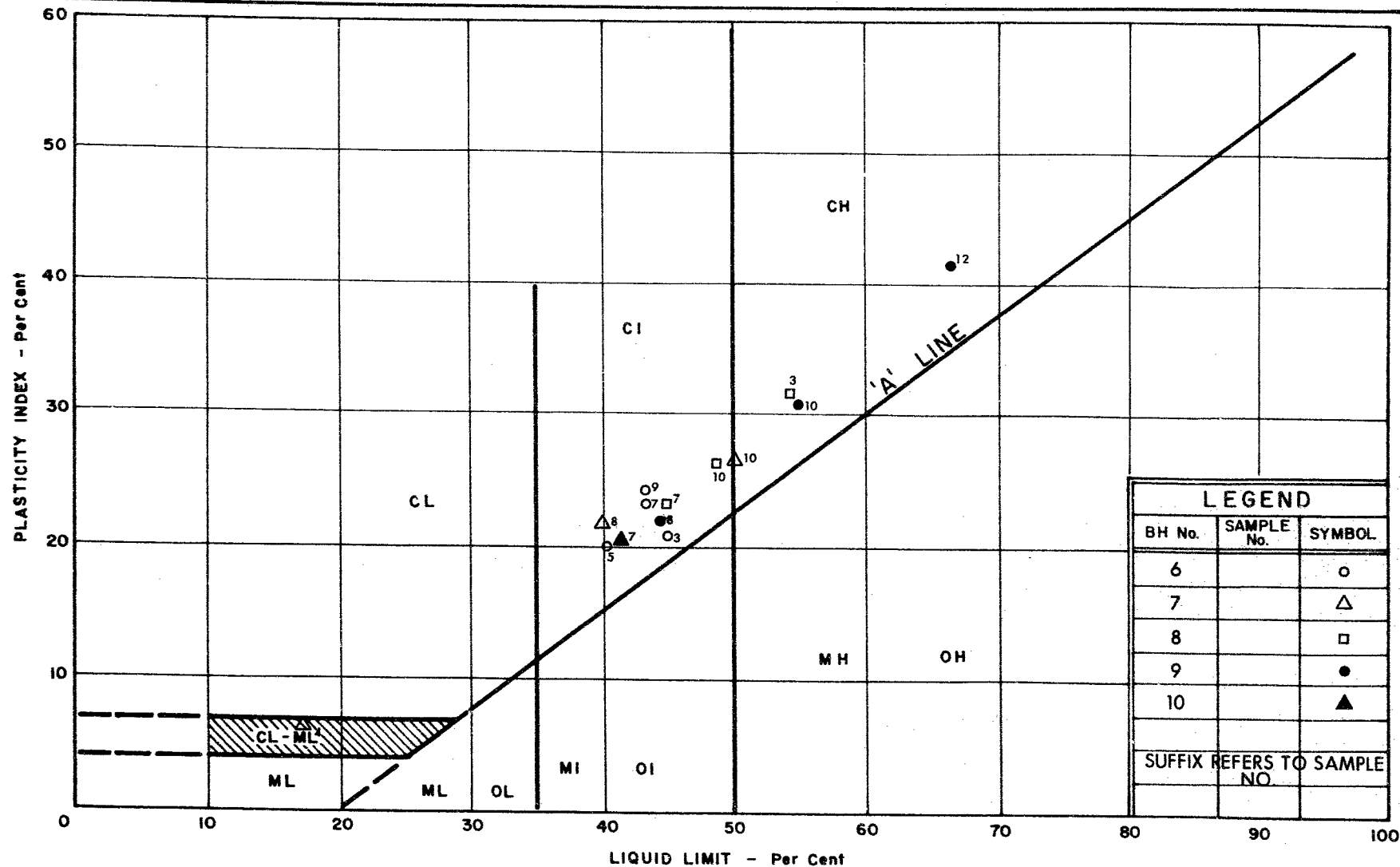


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART
SILTY CLAY with a trace of sand and occasional gravel

W.P. No. 624-64

JOB No. 67-F-4



DEPARTMENT OF HIGHWAYS
**MATERIALS and
TESTING
DIVISION**

PLASTICITY CHART SILTY CLAY with a trace of sand and occasional gravel

W.P. No. 642-64

JOB No. 67-F-4

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 :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
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
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a 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 (YOUNG'S 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_0	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 FORMUL 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

Hwy. 401 & Keele St.,
Downsview, Ontario.

67F4

Materials and Testing Division

January 9, 1967

Canadian Longyear Limited,
35 Brydon Drive,
Rexdale, Ontario.

Attention: Mr. C. Mason

Dear Sir:

This is to confirm our request of January 5, 1967, for the supply of one Diamond Drill, together with all necessary equipment, as specified under the terms of our Contract Agreement, at Kitchener, Ontario, at 10:00 a.m., Monday, January 9, 1967.

This project bears Job Number 67-F-3.

Yours truly,

KGS/mieP

cc: Messrs. H. Konings
H. Szymanski
Foundations Office
Gen. Files

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

MEMORANDUM

67-F-4

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

FROM: Bridge Division,
Downsview, Ontario.

DATE: December 9th, 1966.

Our File Ref.

IN REPLY TO *Revd Ltr 12/166*

SUBJECT: W.P. 642-64 Site 33-242,
University Ave. Underpass,
Kitchener-Waterloo Expressway,
District 4.

Herewith is one print of drawing #2146-SK1, showing in red the probable location of footings for the above structure. Please arrange for a foundation investigation of sufficient scope to enable us to proceed with the design. Attached also is a copy of the preliminary structure site report.

JFW/wm
Encls.

W. S. Melinyshyn
W. S. Melinyshyn,
Regional Branch Location Engineer.

cc: Mr. R. Forrest
Mr. A. Crowley

P.S.

Mr. G. Solty of A.D. Margison and Associates (Tel.No.447-9171) should be contacted to establish the exact location of the alignment and also co-ordinate the location of the boreholes in accordance with the established co-ordinate system.

The deadline for design of the above is becoming rather critical and we would appreciate the results of your investigation at your earliest convenience.

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

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

July 5, 1967

Attention: Mr. J. L. Keen,
Reg. Bridge Project
Engr.

University Avenue Underpass -
Kitchener-Waterloo Expressway,
(Dryden Blvd.) - Site #33-242,
W.P. 642-64 -- W.J. 67-F-4
District #4 (Hamilton)

Following your memo of June 16, 1967, we have reviewed our recommendations regarding pile driving at the west abutment of the above mentioned structure. Above el. 983.0 + the subsoil consists of very stiff to hard silty clay: past experience has shown that

- (1) such material does not provide high end bearing for piles;
- (2) the support provided by friction is not easy to predict; and
- (3) the capacity of piles within such a layer cannot be predicted by means of a dynamic pile driving formula and, in fact, is usually grossly overestimated.

We are of the opinion that the piles should be driven into the much coarser-grained and less plastic clayey silt layer which occurs below el. 983.0 +. It is believed that satisfactory end-bearing support will be achieved in this case.

KGS/hdeF

cc: Foundations Files ✓
Gen. Files

K. G. Selby
K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

MEMORANDUM

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

FROM: Bridge Division,
Downsview, Ontario

DATE: June 16, 1967

OUR FILE REF.

IN REPLY TO

SUBJECT: University Avenue Underpass
Kitchener-Waterloo Expressway (Dryden Blvd.)
W.P. 642-64, Site No. 33-242
W.J. 67-F-4, District No. 4

Would you please review the recommended tube pile tip elevation given in the Soils Report for the above structure, i.e. elevation 980.0 for the West Abutment. There is considerable doubt in my mind that the elevation of 980.0 will be reached. I would expect that the west abutment piles could be terminated well above this for a 45 ton design load, possibly at elevation 1005.0 considering the relatively high values for "N" between elevations 1000 and 1010.

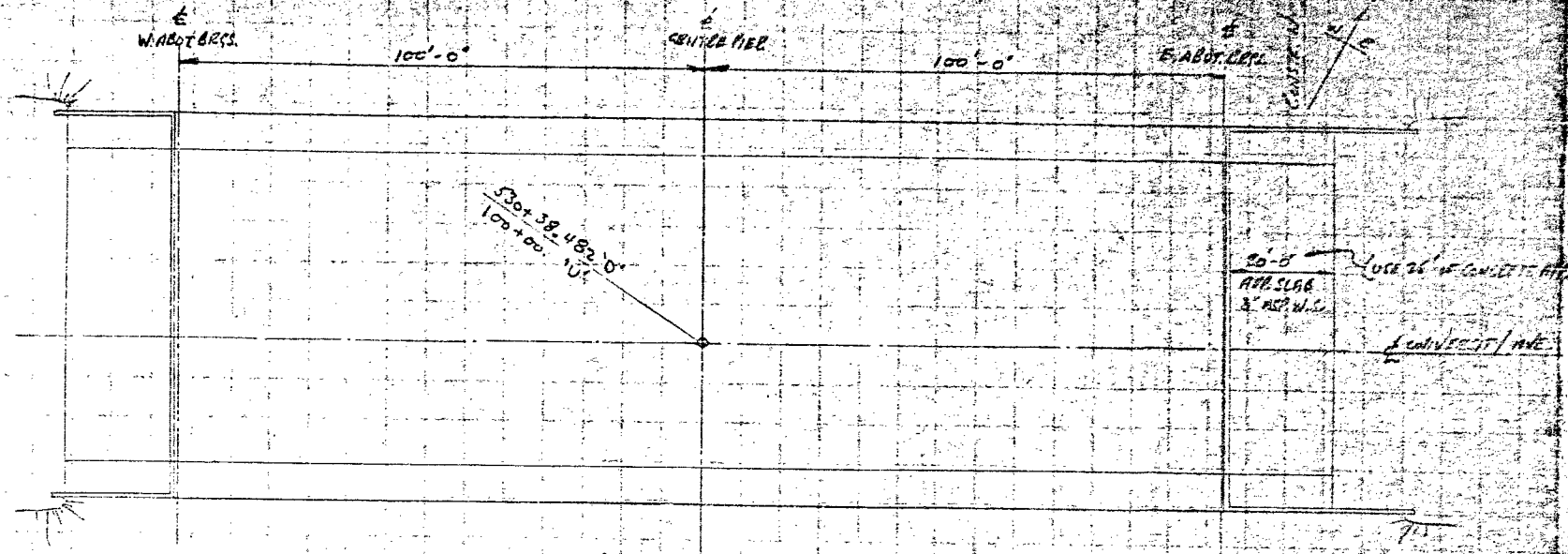
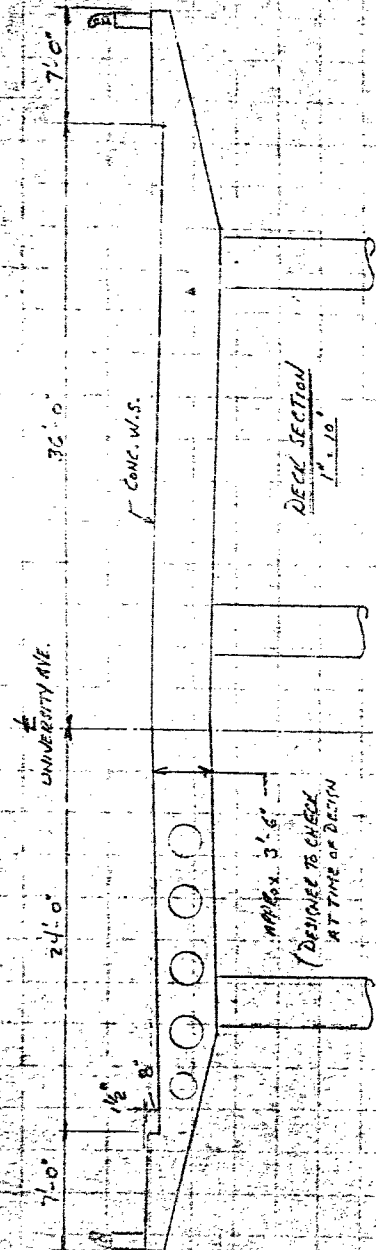
Our proposed structure arrangement is shown on the enclosed sketch.



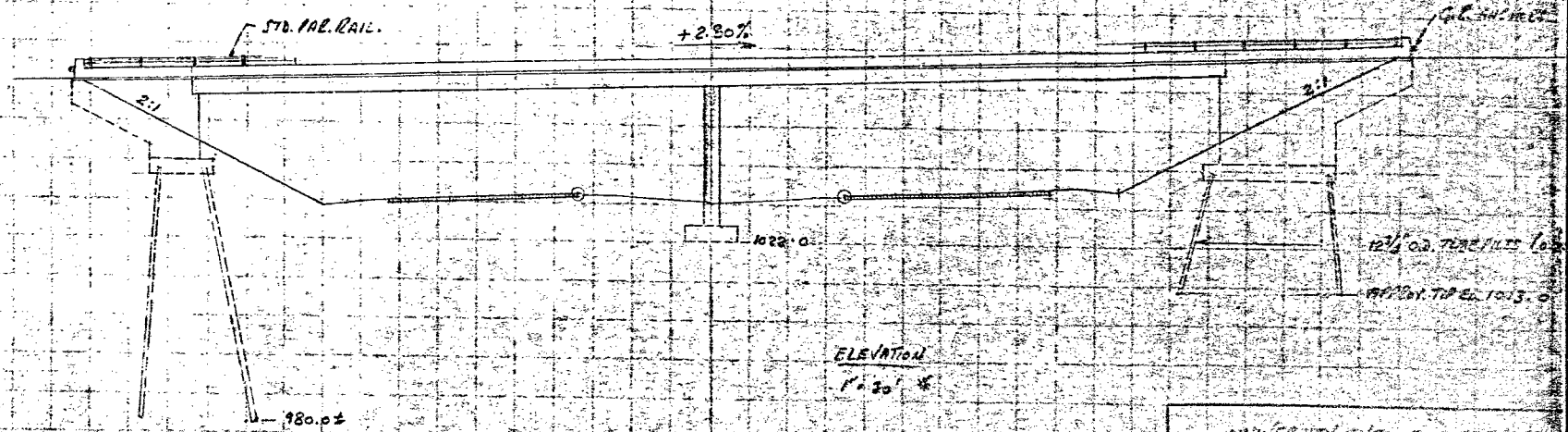
J.L. Keen,
Regional Bridge Project Engineer

JLK:rd

Encl.



PLAN
1" = 20' *

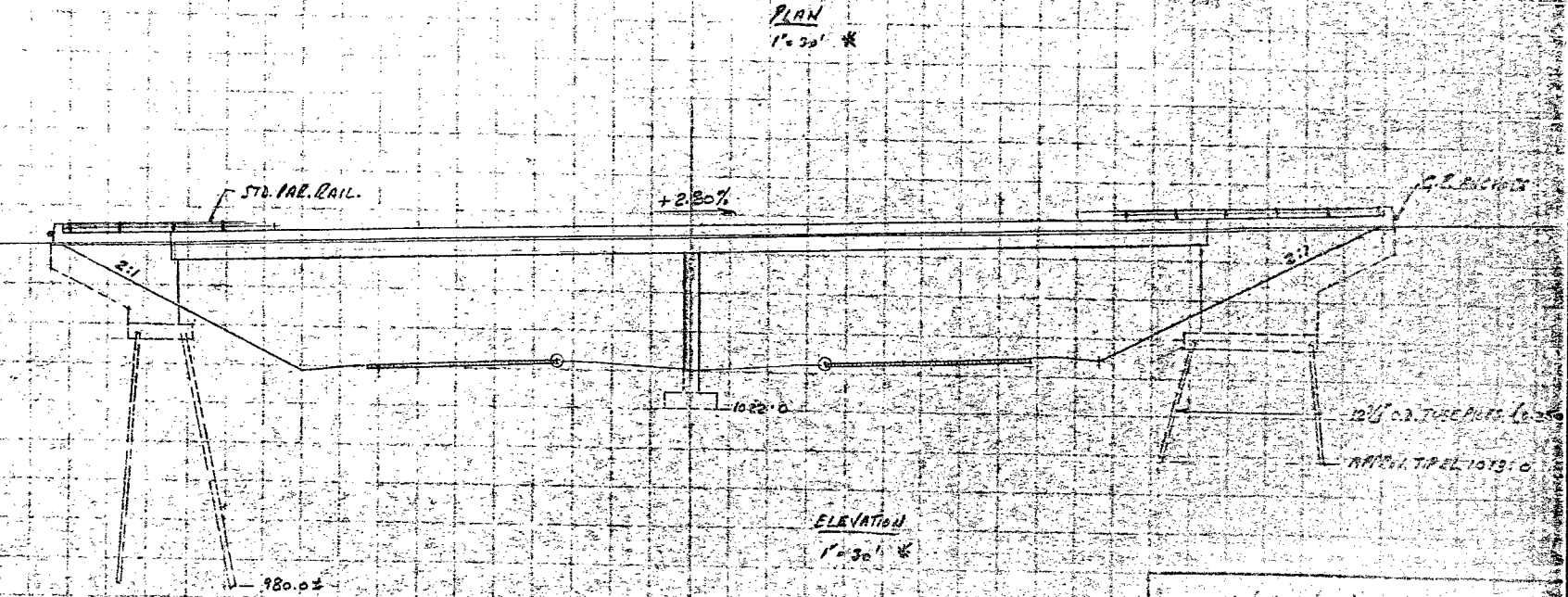
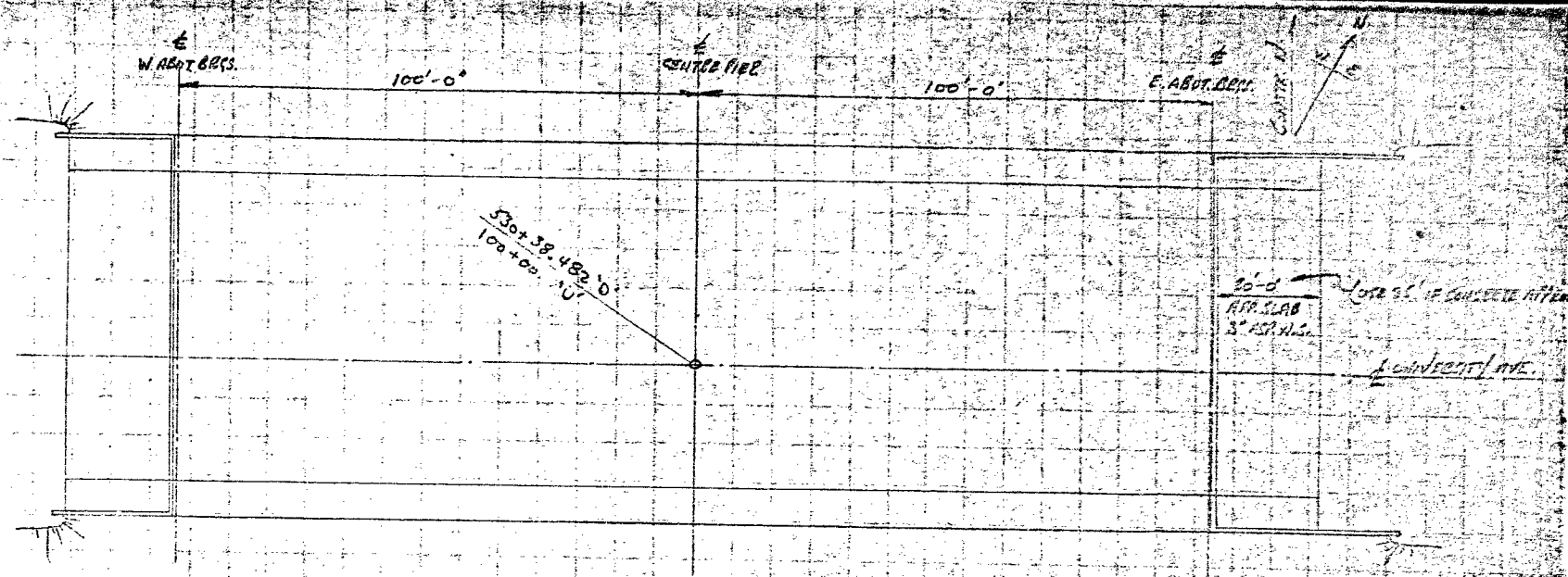
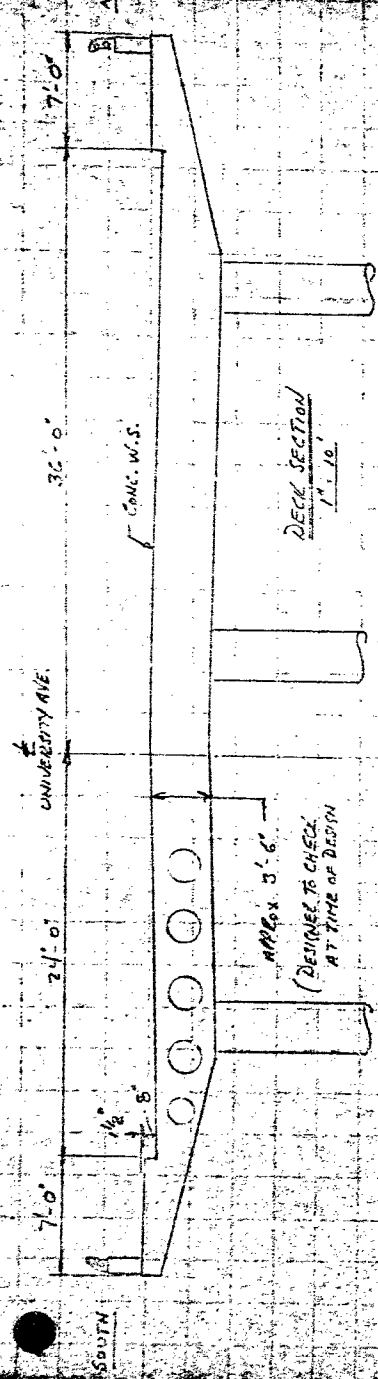


ELEVATION
1" = 20' *

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

* USE 1" = 20' FOR DETAILS

UNIVERSITY AVENUE BRIDGE
U.P. 642-24
PRELIMINARY SKETCH FOR DESIGN



DEFECTS IN NEGATIVE DUE TO
 CONDITION OF ORIGINAL DOCUMENT * USE 1" = 20' FOR DRAWING

UNIVERSITY / HIGHWAY OVERPASS
 N.P. 642-64 SITE 33-242
 PRELIMINARY PLANNING FOR DESIGN

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

Mr. W. Malinsahyn,
Reg. Bridge Location Engineer,
Central Region,
Administration Building

FILES
Bridge Division,
Downsview, Ontario

December 4, 1967

Kitchener-Waterloo Expressway
University Avenue Underpass
W.P. 642-64, Site 33-242
Dryden Blvd., District No. 4

Attached herewith are prints of the Preliminary Bridge
Plan Drawing D-6188-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$212,000.
This cost includes tender, materials, engineering and sundry
construction.

Any comments or revisions you may have should be submitted
within three weeks.

CSG:rd

G.S. Grebski,
Bridge Design Engineer

Attach.

c.c. S. McCombie
A. Stermac (2)
J. Anderson

NO COMMENTS :-

DEC. 8TH 1967

H. M. Smith

MEMORANDUM

To: Mr. K. Selby,
Foundation Section,
Room 109, Lab. Building

From: Bridge Division,
Downsview, Ontario

ATTENTION:

DATE: September 19, 1968

OUR FILE REF:

IN REPLY TO

SUBJECT: University Avenue Underpass
Kitchener-Waterloo Expressway
W.P. 642-64, Site 33-242
W.J. 67-F-4, District No. 4

The above proposed structure will be a two-span continuous deck underpass with the central pier on a spread footing. The large perched abutments are supported by piles driven through the fill (for a short distance) and terminating at the elevations shown on the accompanying sketch. The piles are concrete filled 12-3/4 O.D. tube piles, 0.250 inch wall, to be driven to the tip elevations indicated for a design load of 45 tons. The Hiley Formula as per standards DD1218 and -19 is not applicable.

If the tube piles were changed to 12BP53 steel H-piles on a pile per pile basis with the design load and pile lengths remaining the same as for the tube piles, an estimated saving from \$2,500 to \$3,000 is possible. Also, installation of the H-piles would likely be much easier than for tube piles considering that hard driving is anticipated for tube piles, particularly at the west abutment.

In your opinion do you feel that it is feasible to use H-piles as outlined above?

Also, would it be feasible to use a design load greater than 45 tons with H-piles by increasing the length if necessary.

J. L. Keen

J.L. Keen,
Regional Bridge Project Engineer

JLK:rd

Attach.

cc: Foundations Files (Rm. 110)

als

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

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

Mr. J. L. Keen,
Regional Bridge Project
Engineer

September 24, 1968

University Avenue Underpass
Kitchener-Waterloo Expressway
W.P. 642-64 -- W.J. 67-F-4
District No. 4 (Hamilton)

We have reviewed our recommendations concerning
pile foundations of the above project.

It is felt that the use of 12 BP 53 steel H-piles
instead of the 12-3/4 O.D. tube piles, is acceptable on a pile
per pile basis. The length and the design load of the H-piles
ought to be the same as originally suggested.

The use of the design load greater than 45 tons/pile,
by increasing the pile lengths, however, does not seem feasible
on account of the soil conditions of the deeper zones.

AKB/ndcF

cc: Foundations Files ✓
Gen. Files

a. G. Selby

fr K. G. Selby,
SUPERVISING FOUNDATION ENGINEER
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

MEMORANDUM

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

From: Bridge Division,
Downsview, Ontario

ATTENTION:

DATE: November 27, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT: University Avenue Underpass
Kitchener-Waterloo Expressway
W.P. 642-64, Site 33-242
District No. 4

67-F-4

Attached herewith we are submitting the final bridge drawings which show the foundation design for this structure.

Kindly give us your comments at your earliest convenience.



for C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Section

To be reviewed at a later date
— further design changes are
contemplated.

H. L. Gault

Nov. 28th 1968.

A. D. Margison and Associates Limited
Consulting Professional Engineers

UNIVERSITY AVENUE UNDERPASS

W.P. 642-64

Project No. 2146

67-F-4

Borehole No.	North Coordinate	East Coordinate	Ground Elevation
1	210,820 210,824.423	202,774 202,883.451	1028.08
2	210,840.133	202,777.025	1029.60
3	210,782.924	202,840.506	1029.28
4	210,862.891	202,816.784	1029.86
5	210,893.674	202,868.283	1030.33
6	210,931.468	202,935.398	1031.35
7	210,949.020	202,965.695	1031.87
8	210,819.206	202,910.113	1030.69
9	210,873.402	203,000.728	1034.51
10	210,859.508	202,975.240	1031.87

cc: Gen. File

23-69-102

RE: UNIVERSITY AVENUE
UNDERPASS
KITCHENER-WATERLOO EXPRESSWAY
DISTRICT NO. 4

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

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

September 24, 1963

Mr. J. L. Keen,
Regional Bridge Project
Engineer

University Avenue Underpass
Kitchener-Waterloo Expressway
W.P. 642-54 -- W.J. 67-F-4
District No. 4 (Hamilton)

We have reviewed our recommendations concerning
pile foundations of the above project.

It is felt that the use of 12 BP 53 steel H-piles
instead of the 12-3/4 O.D. tube piles, is acceptable on a pile
per pile basis. The length and the design load of the H-piles
ought to be the same as originally suggested.

The use of the design load greater than 45 tons/pile,
by increasing the pile lengths, however, does not seem feasible
on account of the soil conditions of the deeper zones.

AKB/Edg?

cc: Foundations Files
Gen. Files

C. K. Selby
K. C. Selby,
SUPERVISING FOUNDATION ENGINEER
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

Re: University Ave Underpass.
Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

July 5, 1967

Attention: Mr. J. L. Keen,
Reg. Bridge Project
Engr.

University Avenue Underpass -
Kitchener-Waterloo Expressway,
(Dryden Blvd.) - Site #33-242,
W.P. 642-64 -- W.J. 67-F-4
District #4 (Hamilton)

Following your memo of June 16, 1967, we have reviewed our recommendations regarding pile driving at the west abutment of the above mentioned structure. Above el. 983.0 + the subsoil consists of very stiff to hard silty clay: past experience has shown that

- (1) such material does not provide high end bearing for piles;
- (2) the support provided by friction is not easy to predict; and
- (3) the capacity of piles within such a layer cannot be predicted by means of a dynamic pile driving formula and, in fact, is usually grossly overestimated.

We are of the opinion that the piles should be driven into the much coarser-grained and less plastic clayey silt layer which occurs below el. 983.0 ±. It is believed that satisfactory end-bearing support will be achieved in this case.

KGS/mdeF

cc: Foundations Files
Gen. Files ✓

H. L. Selby
K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.