

#66-F-18

W.P. # 430-64

OTTAWA

QUEENSWAY

Moody DR.

## MEMORANDUM

W.P. 430-64.

23-67-181.

To: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Division.

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

Attention: Mr. S. McCombie

DATE: April 21, 1966

OUR FILE REF.

IN REPLY TO

MAY 11 1966

SUBJECT:

PRELIMINARY  
FOUNDATION INVESTIGATION REPORT

For

The Proposed Underpass at the Ottawa  
Queensway and Moody Drive Interchange,  
District #9 (Ottawa) Hwy: Queensway.

W.J. 66-P-18 -- W.P. 430-64

Attache.. we are forwarding to you, our preliminary 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 design purposes. Should there be any queries in connection with this report, please do not hesitate to contact our Office.

AGS/MdeP  
Attach.

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
R. S. Pillar  
L. E. Walker  
J. E. Gruspier  
A. Watt  
Foundations Office  
Gen. Files

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PRELIMINARY  
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W.J. 66-F-18      --      W.P. 430-64

1. INTRODUCTION:

The Foundation Section was requested to carry out a preliminary foundation investigation at the proposed underpass structure where the Ottawa Queensway crosses Moody Drive. A request was contained in a memo dated January 21, 1966, from the Bridge Location Section (Mr. G. Scott, Regional Bridge Location Engineer). An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site. This report contains the results of our preliminary investigation, together with our recommendations.

The site is located approximately 2 miles west of the Jct. of Hwy. 15 and the Queensway in the Town of Bells Corners. The area surrounding the site is generally residentially developed. Geologically, Carlton County lies within the physiographic region known as the Lowlands of the St. Lawrence. The deposits are predominantly of glacial origin, probably laid down during and immediately following the Wisconsin glaciation, and overlies bedrock, chiefly of Paleozoic age.

2. SUBSOIL CONDITIONS:

2.1) General:

A total of two sampled boreholes and two dynamic cone penetration tests was carried out at the site. These borings revealed that the subsoil over the site consists of a shallow surface deposit of loose silty sand with some organics, followed

cont'd. /2 ....

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

### 2.1) General: (cont'd.) ...

by 16 to 17 ft. of firm to very stiff clay underlain by 10 to 12 ft. of loose silty sand. Immediately below this, the sandstone bedrock was encountered.

### 2.2) Silty Sand:

This deposit was observed immediately above and below the clay stratum. The upper sand layer contains some organics and is only about 3 ft. in thickness. The lower sand deposit is mainly composed of variable amounts of silt and sand-sized particles, and generally has 'N' values ranging from 3 to 11 blows/ft. However, in B.H. #2, the deposit is very dense above bedrock with an 'N' value of 91 blows/ft.

### 2.3) Clay:

This deposit was encountered in both boreholes, having a total thickness of some 16 to 17 ft. The consistency of the material varied considerably from firm to very stiff, although stiff to very stiff material predominated. 'N' values were between 9 to 14 blows/ft and the shear strength as determined by in-situ vane tests and laboratory tests, varied from about 510 p.s.f. to 2900 p.s.f.

### 2.4) Bedrock:

The bedrock was proven by obtaining rock core samples in B.H.'s #1 and #2, and consisted of sandstone. In B.H. #1, the rock appeared fractured, and the recovery was about 40%.

## 3. GROUND WATER:

Water level observations were carried out during the course of the field investigation, and are as follows:

		<u>Water Level</u>
B.H. #1	--	Elev. 216
B.H. #2	--	Elev. 214

cont'd. /3 .....

4. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct an underpass structure at the crossing of the Ottawa Queensway and Moody Drive. The new structure may be a three-span structure having a total length of 200 ft. and some 80 ft. in width.

The presence of stiff clay some 3 ft. below the ground surface, raises the problem of low bearing capacity and large settlements. For these reasons, it is recommended that the proposed piers and abutments of the new structure be supported on end-bearing piles. Allowable loads will depend upon the section chosen (e.g., 14 BP 74 steel H-piles may be designed for 90 tons per pile).

The proposed approach fills may be in the order of 23 ft. above the existing ground surface. Based on an average shear strength of 750 p.s.f. for the underlying clay deposit, no stability problems are anticipated for standard 2:1 side slopes.

It may be necessary to carry out additional borings in the field when the final design details are available. Recommendations given in this report are, therefore, to be regarded as conditional only, and as such, are subject to revision at a later date when and if new information becomes available.

5. MISCELLANEOUS:

The field work, performed during the period March 16 to 18, 1966, was undertaken by Mr. F. Wang, Project Foundation Engineer. Equipment used was owned and operated by Johnston Drilling Co., Ottawa.

The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also prepared this report.

April 1966

APPENDIX I

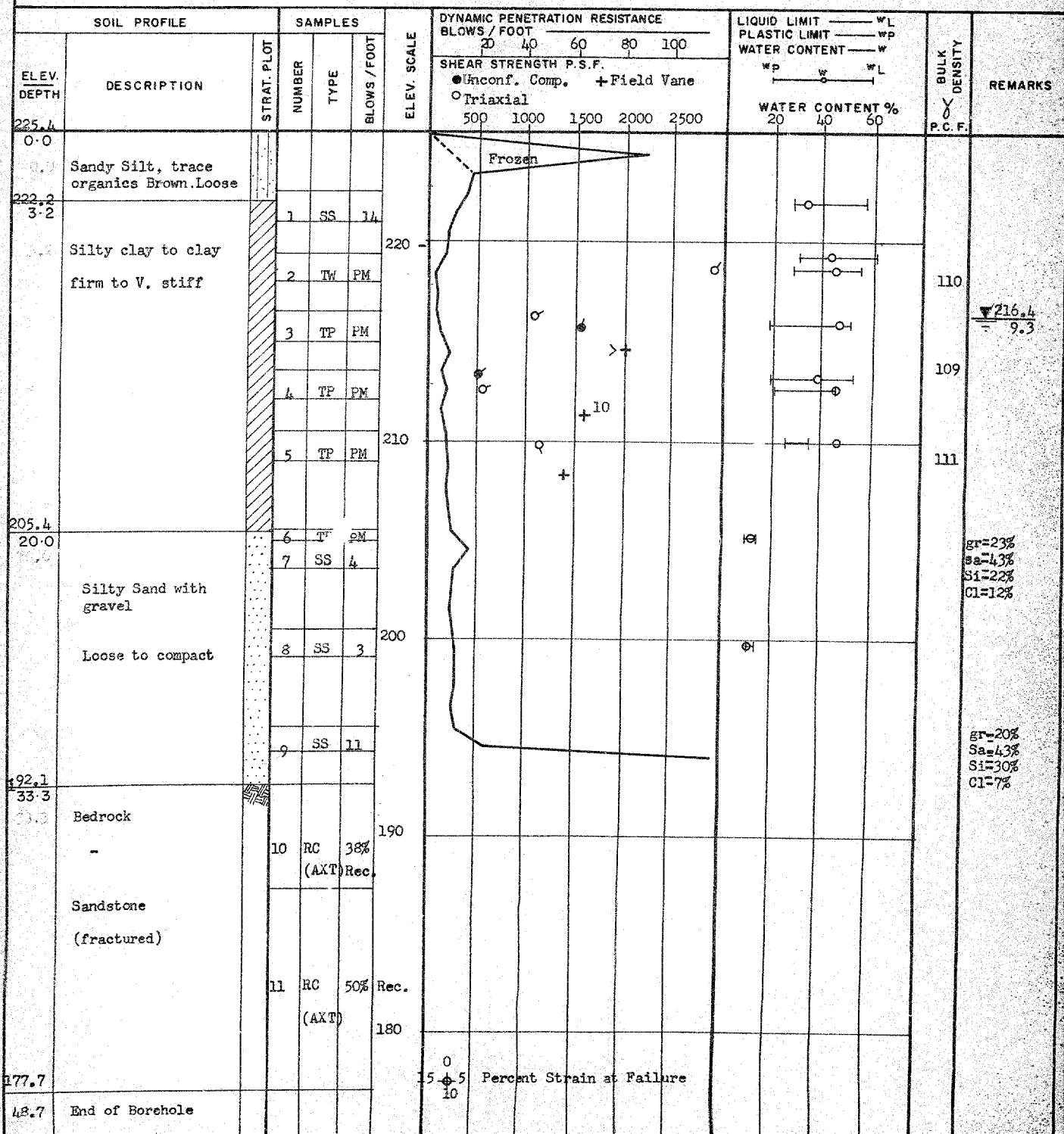
DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-E-18 LOCATION Moodie Dr. & Queensway Extension, 97410 0/s 90' It. ORIGINATED BY P.L.W.  
W.P. 430-54 BORING DATE March 16, 1966 COMPILED BY L.P.  
DATUM Geodetic BOREHOLE TYPE Wash-boring & Diamond drill CHECKED BY dl





DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-18 LOCATION Moodie Dr. & Queensway Extension, 94/80 C/s 100' Rt. ORIGINATED BY P.L.W.  
W.P. 430-64 BORING DATE March 18, 1966 COMPILED BY L.P.  
DATUM Geodetic BOREHOLE TYPE Wash-Boring & Diamond drill CHECKED BY dlr

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.					WP	W	WL		
							• Unconf. Comp. + Field Vane ○ - Triaxial ⊕ Lab. Vane									
							20	40	60	80	100					
						500	1000	1500	2000	2500	WATER CONTENT % 20 40 60					
223.7 0.0	Silty Sand					220	Frozen								Gr=0% Sa=31% Si=61% Cl=8%  ▽214.1 = 9.6	
221.0 2.7	Silty Clay to Clay firm to stiff		1	SS	9											
			2	TW	PM											
			3	TP	PM											
			4	TP	PM		210									
205.2 18.5	Silty Sand with gravel loose		6	SS	2	200								Gr=15% Sa=41% Si=39% Cl=10%		
	(V. dense)		7	SS	91											
195.4 28.3	Bedrock-Sandstone (sound)		8	RC (AXT)	72% Recovery	190										
186.4 37.3	End of Borehole					180										
							0 15 10									
							Percent strain at Failure									

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

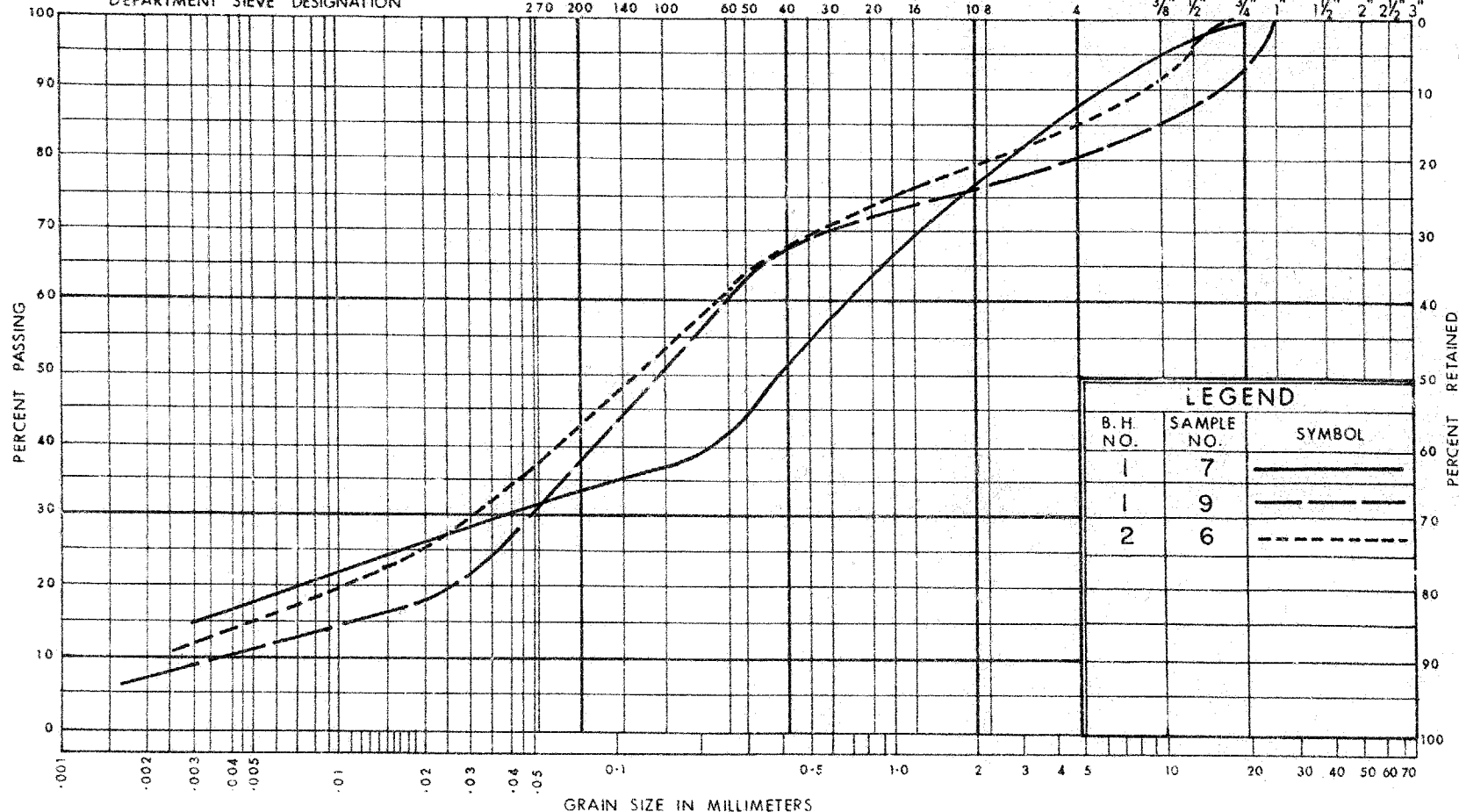
Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION

270 200 140 100 60 50 40 30 20 16 10 8 4 3/8" 1/2" 3/4" 1" 1 1/2" 2" 2 1/2" 3"

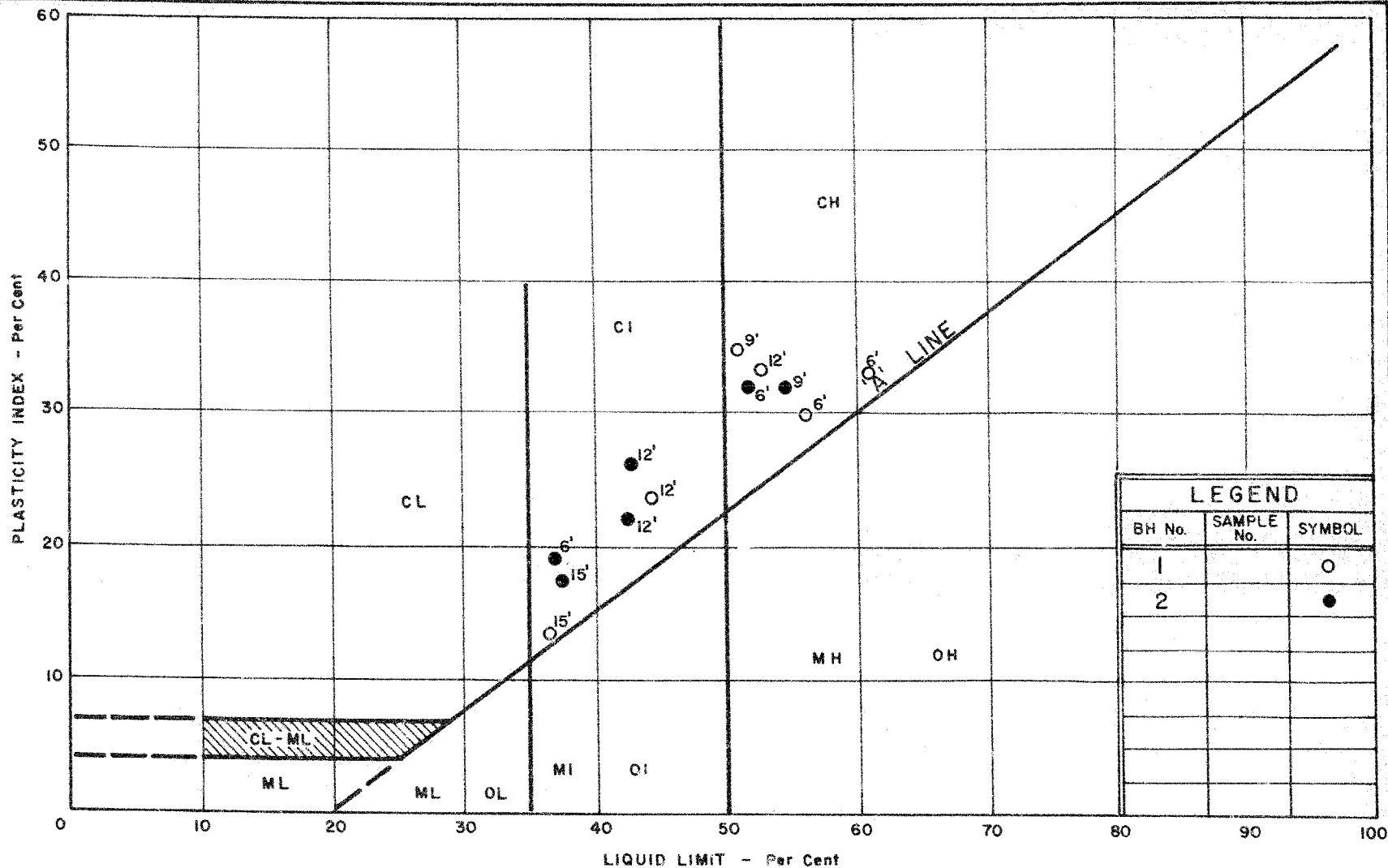


DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
SILTY SAND WITH GRAVEL

W.P. No. 430-64

JOB No. 66-F-18



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1		O
2		•



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## PLASTICITY CHART

WP. No. 430-64

JOB No. 66-F-18

## 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
Ud	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

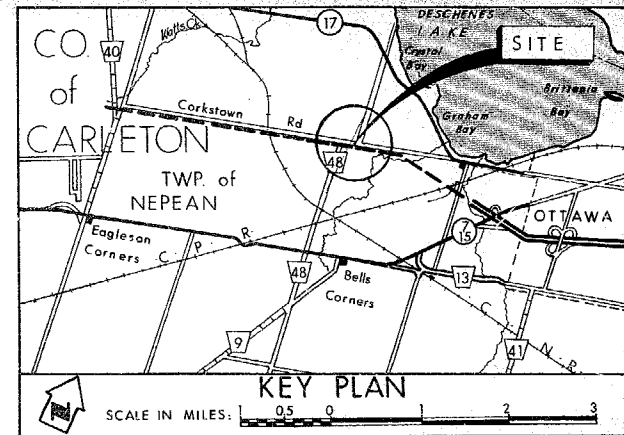
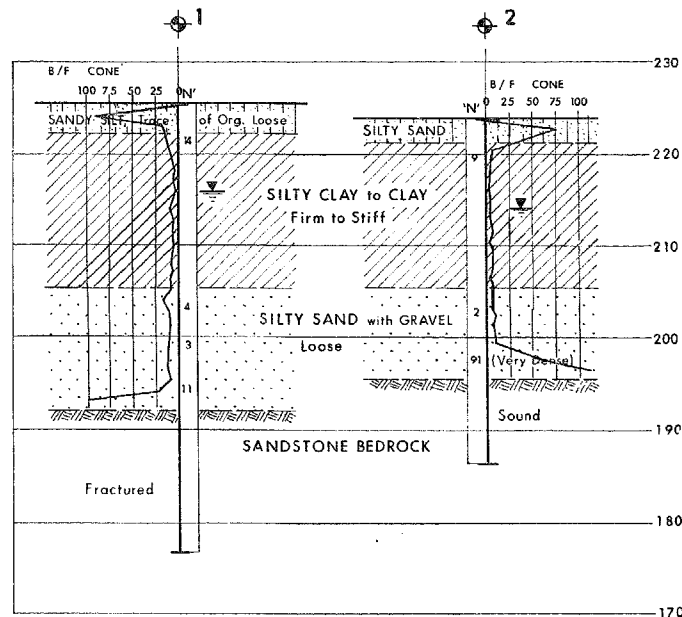
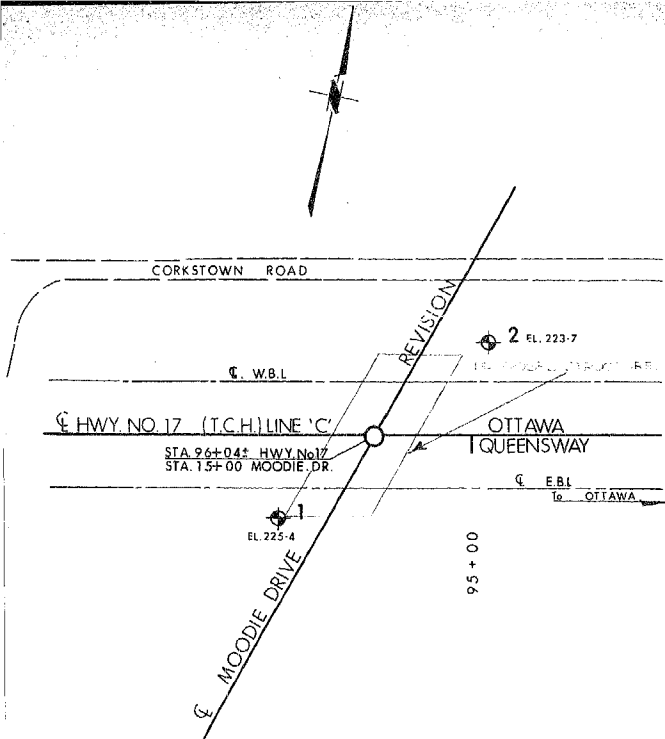
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLIED 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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



LEGEND			
	Water Level (March 1966)		
	Bore & Cone Hole		
NO.	ELEV.	STA.	OFF SET.
1	225.4	97 + 10	90' LT.
2	223.7	94 + 80	100' RT.

Mr. H. Aron,  
Regional Services Manager,  
Regional Office - Kingston.

Foundation Section,  
Materials & Testing Division,  
Rm. 107, Lab. Bldg.

February 14, 1966

Preliminary Foundation Investigations  
for Ottawa Queensway Extension.

W.P. 431-64	--	W.J. 66-P-16
W.P. 108-64	--	W.J. 66-P-17
W.P. 430-64	--	W.J. 66-P-18
W.P. 423-64	--	W.J. 66-P-19

Please arrange the necessary permission from the property owners, in order to carry out the preliminary investigations for the above mentioned Work Projects.

MD/MdeP

*M. Devata*  
M. Devata,  
SENIOR FOUNDATION ENGINEER  
For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office  
Gen. Files

Copy for the information of

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

Mr. G. Scott,  
Regional Bridge Location Engineer,  
Kingston Regional Office

Bridge Division,  
Downsview, Ontario

March 9, 1967

Moodie Drive Interchange  
1.8 Miles West of Jct. Hwy. 15  
W.P. 430-64, Site 3-256  
Ottawa Queensway, District 9

Attached herewith are prints of the Preliminary Bridge  
Plan Drawing D-6137-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$363,000.  
This cost includes tender, materials, engineering and sundry  
construction.

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

CSG:rd

C.S. Grebaki,  
Bridge Design Engineer

Attach.

c.c. S. McCombie  
A. Stermac  
R. Forrest  
E. Cross



*ag*

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

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

March 13, 1967

Woodie Drive Interchange  
1.8 Miles West of Jct. Hwy. 15,  
W.P. 430-64, Site 3-256,  
Ottawa Queensway, Dist. #9 (Ottawa).

*66F-18*

The Preliminary Bridge Plan Drawing  
D-6137-P1 for the above mentioned structure  
has been reviewed.

We have no comments pertaining to  
the structure foundations.

MD/MdeP

*M. Devata*

A. Devata,  
SUPERVISING FOUNDATION ENGR.

For:

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. S. McCombie  
G. Scott

Foundations Files  
Gen. Files