

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

22-67-181

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

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

Attention: Mr. S. McCombie

DATE: May 18, 1966

or FILE REF.

IN REPLY TO

JUN 1 1966

SUBJECT:

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
The Proposed Overhead at the Ottawa
Queensway and C.N.R. Crossing,
District #9 (Ottawa) Hwy: Queensway
W.P. 66-F-17 -- W.P. 108-65

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

We believe that the factual data and recommendations contained therein, will suffice for your present design requirements.

Should additional information be required, please feel free to contact our Office.

AGS/MdeF
Attach.

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

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

*Copies also sent to: P. Harvey (Fund. Plan Toronto)
J. L. Foster - (Fund. Plan Kingston Reg)*

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PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
The Proposed Overhead at the Ottawa
Queensway and C.N.R. Crossing,
District #9 (Ottawa) Hwy: Queensway
W.J. 66-F-17 -- W.P. 108-65

1. INTRODUCTION:

A request, dated January 21, 1966, was received in a memo from the Bridge Location Section (Mr. G. Scott, Regional Bridge Location Engineer), to carry out a preliminary foundation investigation at the proposed overhead structure where the Ottawa Queensway crosses the C.N.R. 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 3 miles west of the jct. of Hwy. 15 and the Queensway in the town of Bells Corners. The general area is flat to undulating. 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 overlie bedrock, chiefly of Precambrian 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 silty sand followed by 35 to 52 ft. of firm to very stiff clayey silt to silty clay underlain by 3 to 4 ft. of sandy till. Immediately below this, the sandstone bedrock was encountered.

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

2.2) Clayey Silt to Silty Clay:

This deposit was observed immediately below the surface sand layer and ranges in thickness from 35 ft. in B.H. #2 to 52 ft. in B.H. #1. The material varied somewhat in plasticity and may be classified as silty clay to clayey silt. Physical properties as determined from field and laboratory tests, are summarized as follows:

Bulk Density	107 - 125 p.c.f.
Liquid Limit	33% - 68%
Plastic Limit	18% - 34%
Moisture Content	26% - 62%
Undrained Shear Strength	620 - 2400 p.s.f.
Field Vane Shear Strength	960 ->2000 p.s.f.
'N' Values	13 to 23 blows/ft.

The consistency of the overall deposit varied considerably from firm to very stiff, although stiff material predominated.

2.3) Sandy Till:

This deposit was encountered in both boreholes immediately below the cohesive deposit and above the sandstone bedrock, having a total thickness of some 3 ft. Grain size distribution tests showed the following average particle sizes: gravel 20%, sand 45%, silt 21%, clay 14%.

2.4) Bedrock:

The bedrock was proven by drilling 5 ft. of AXT rock core samples in B.H. #1 and #2, and consisted of sound sandstone.

<u>B.H. No.</u>	<u>Ground Elev.</u>	<u>Depth to Bedrock</u>	<u>Bedrock Elev.</u>
#1	291.0'	58.8'	232.2'
#2	272.3'	40.9'	231.4'

cont'd. /3

3. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct an overhead structure at the crossing of the Queensway extension and the C.N.R. At present a three-span structure having a total length of 150 ft. and some 40 ft. in width, is contemplated for the preliminary design.

The presence of firm to stiff silty clay to clayey silt approx. 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 structure be supported on end-bearing piles driven to bedrock. Allowable loads will depend upon the section chosen (e.g., 14 BP 74 steel H-piles may be designed for 90 tons/pile).

The proposed approach fills may be in the order of 40 ft. above the existing ground surface. Based on an average shear strength of 1000 p.s.f. for the underlying clay deposit, no stability problems are anticipated for standard 2:1 slopes.

Since it is only the preliminary investigation, the recommendations given in this report are, therefore, to be regarded as conditional only. It may be necessary to carry out additional borings in the field when the final design details are available.

4. MISCELLANEOUS:

The field work was conducted on March 14 to March 16, 1966, using equipment owned and operated by Johnston Drilling Company Ltd., under the supervision of Mr. P. L. Wang, Project Foundation Engineer, who subsequently prepared this report.

Mr. M. Devata, Senior Foundation Engineer, supervised the entire project in general, and reviewed this report.

May 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-F-17

LOCATION Queensway and CNR Crossing-Ottawa-142/75, O/S 90' Lt.

ORIGINATED BY P.L.W.

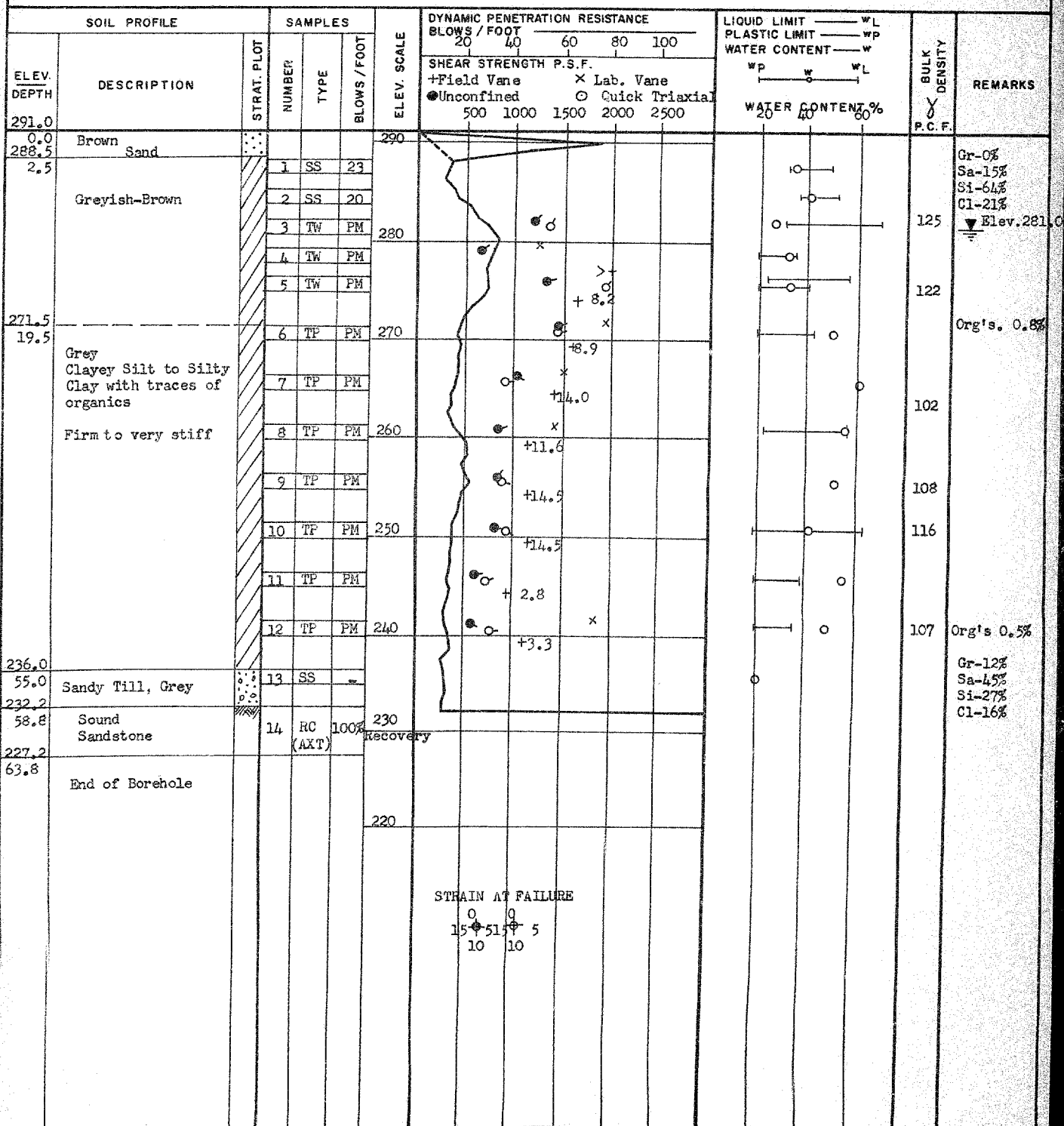
W.P. 108-65

BORING DATE March 14, 1966

COMPILED BY P.L.W.

DATUM Geodetic

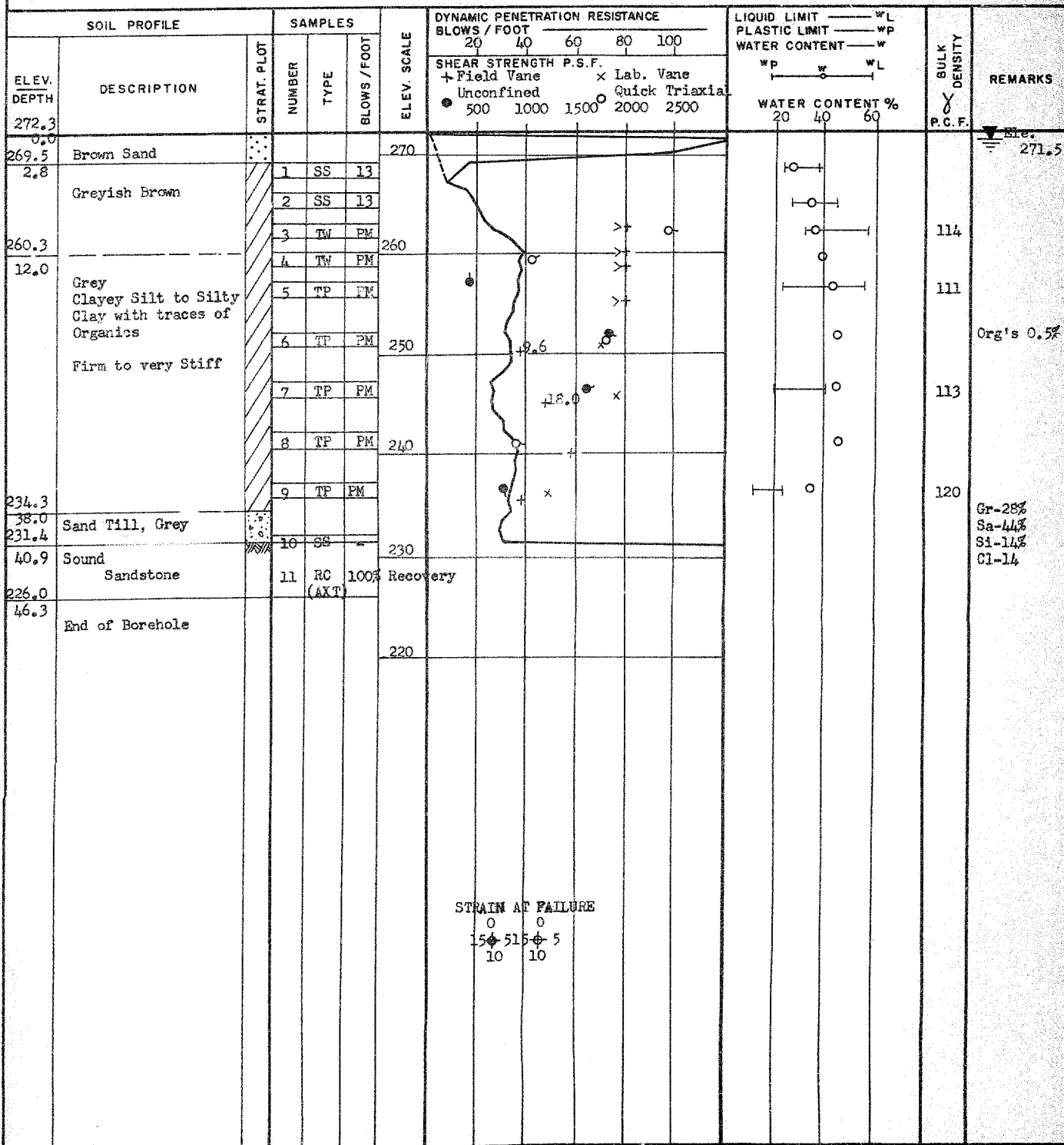
BOREHOLE TYPE Wash-boring & Diamond Drill

CHECKED BY *HL*

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-17 LOCATION Queenway and CNR Crossing-Ottawa- 141/86 O/S 90' Rt.
W.P. 108-65 BORING DATE March 15, 1966
DATUM Geodetic BOREHOLE TYPE Wash-boring & Diamond DrillORIGINATED BY P.L.W.
COMPILED BY P.L.W.
CHECKED BY SR

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

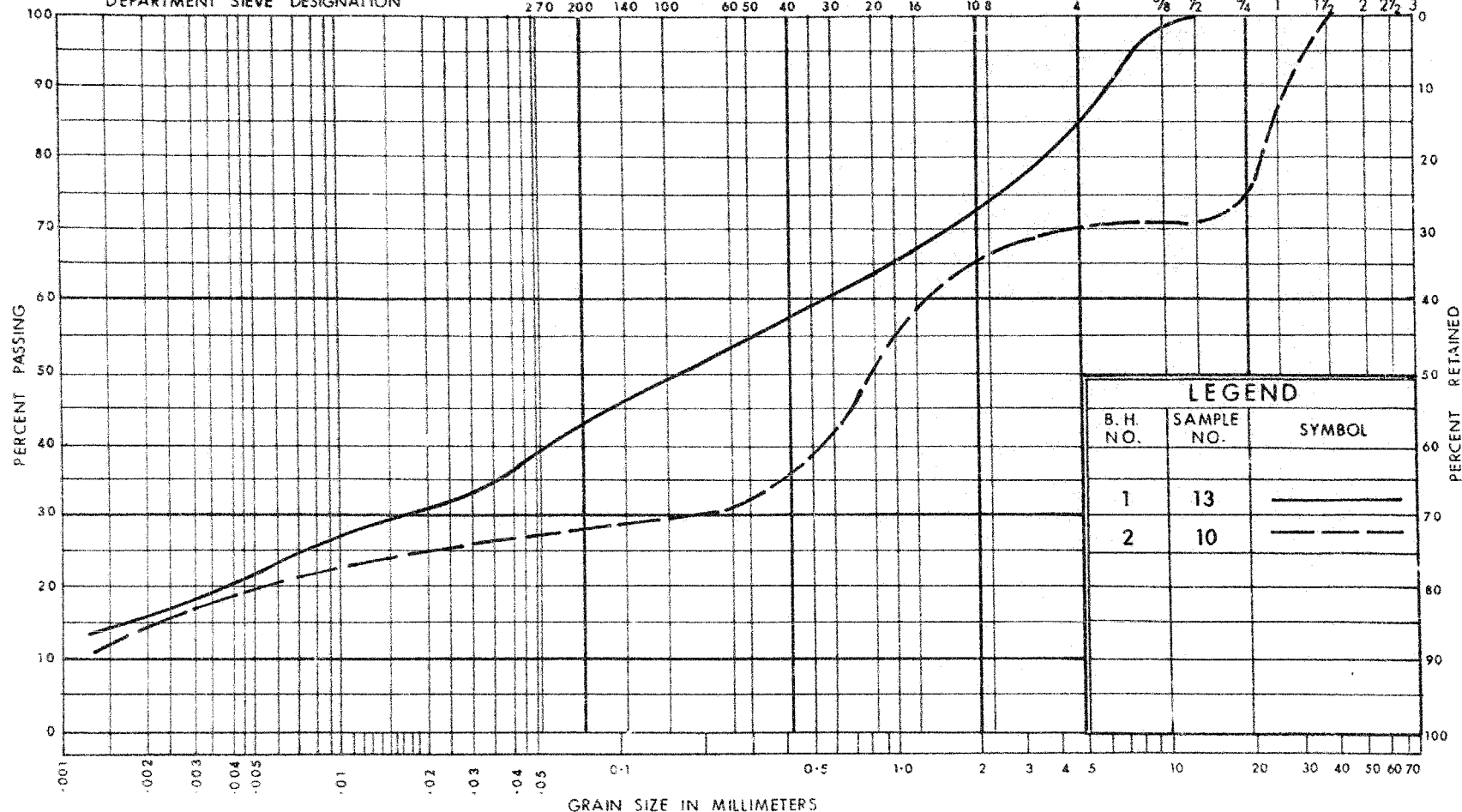
Medium

Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION



LEGEND

B. H. NO.	SAMPLE NO.	SYMBOL
1	13	—————
2	10	- - - - -



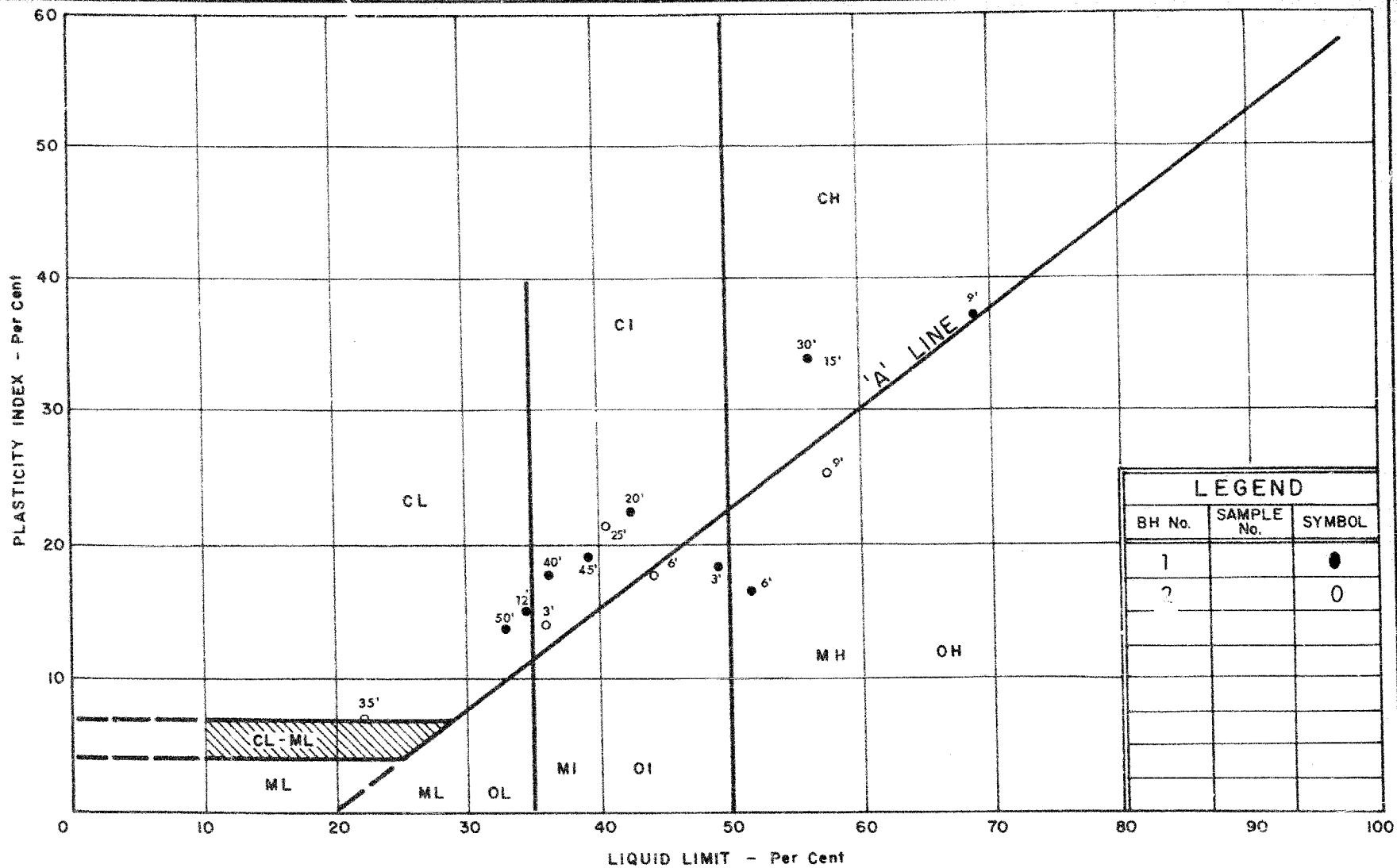
ONTARIO

DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SANDY TILL

W.P. No. 108 - 65

JOB No. 66 - F - 17



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

W.P. No. 108 - 65

JOB No. 66-F-17

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

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOG 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
$\bar{\sigma}$	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

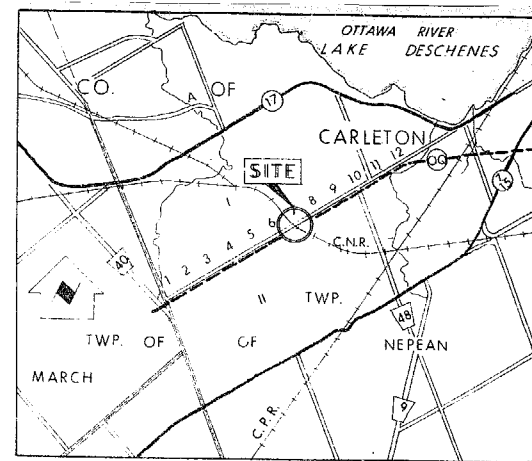
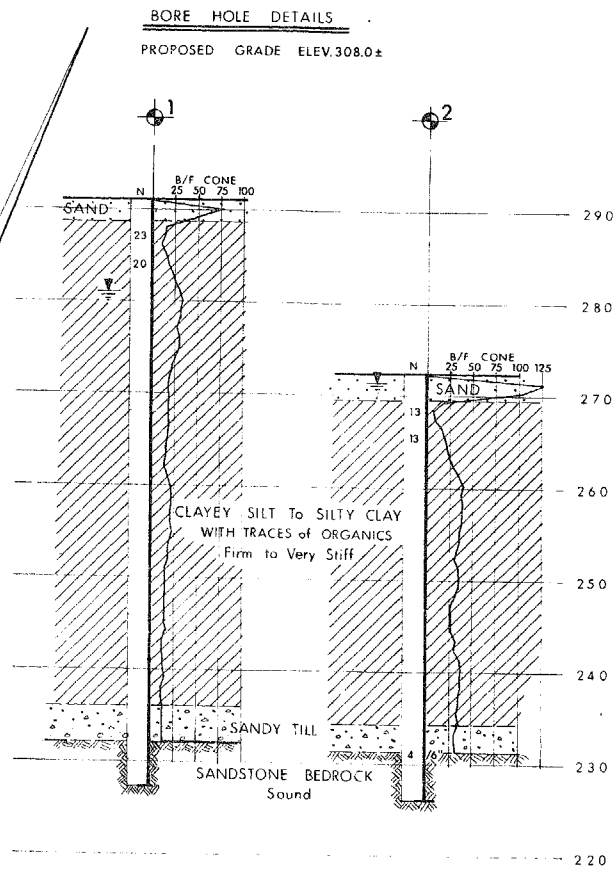
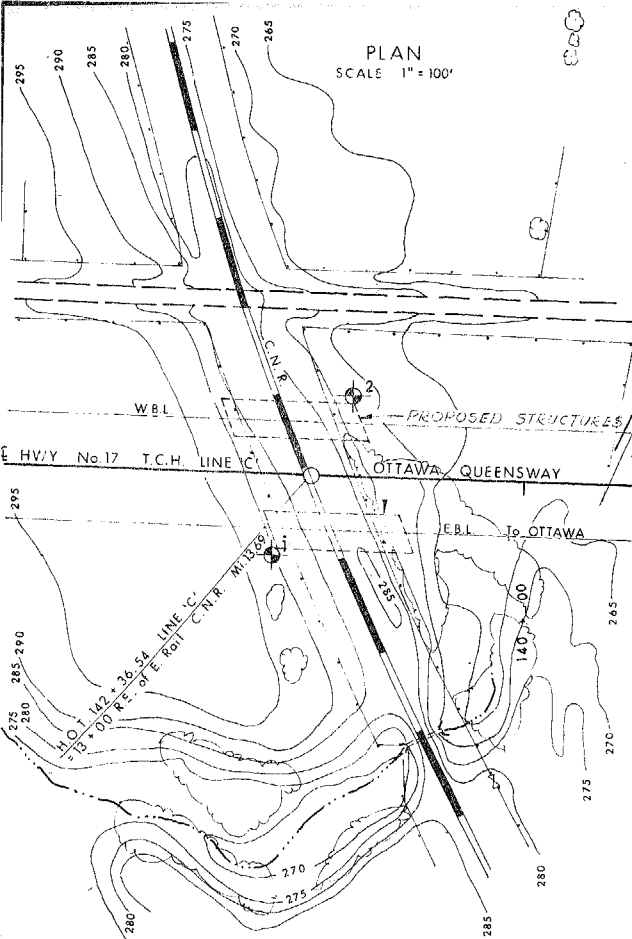
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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 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



WATER LEVELS (7 APRIL 1966)

BORE & CONE PENETRATION HOLE

Hole No.	Elevation	Station	Offset
1	EL. 291.0	STA. 142+75	OFFSET 90' LT.
2	272.3	142+86	90' 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. 106-64	--	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/medf

M. Devata
M. Devata,
SENIOR FOUNDATION ENGINEER
for:
A. G. Sternac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office
Gen. Files

Department of Highways Ontario

Copy for the information of

Mr. M. Devata, Supervising Foundation Engineer,
Room 107, Lab. Building

Bridge Division,
Downsview, Ontario,
January 31, 1967

DeLeuw, Cather and Company
of Canada Limited,
Consulting Engineers,
Billings Bridge Plaza,
Riverside Drive,
Ottawa 8, Ontario

Attention: Mr. G. Saunders, P. Eng.

RE: W.P. 108-65, Site 3-257
C.N.R. Overhead Structures
Ottawa Queensway Extension
2.7 Miles West of Jct. Hwy. 15
District No. 9

Dear Sir:

Enclosed please find a memo received from our Foundation Section which is intended to serve as an interim report pending the final report for the above location.

The writer of the report, M. Devata, P.Eng., Supervising Foundation Engineer, advises me that the designers of the structure and approaches should be sure to provide for fill free of stones and boulders in the vicinity of where piles are to be driven. I understand that rock fill for the approaches may be used at this site, and accordingly wish to bring this point to your attention.

I have also enclosed one copy each of DB-B-4.1.1 and DB-B-4.2.2 for your general information in regard to the use of piles.

Yours truly,

J.L. Keen, P. Eng.,
Senior Bridge Project Engineer

JLK:rd

Encls.

c.c. M. Devata

#66-F-17

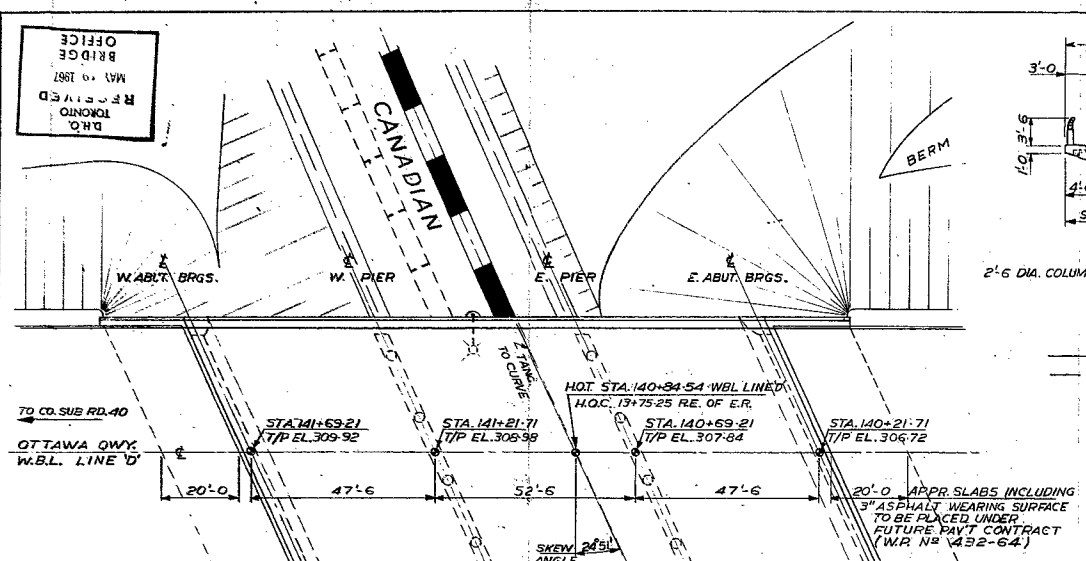
W.P.#108-65

OTTAWA

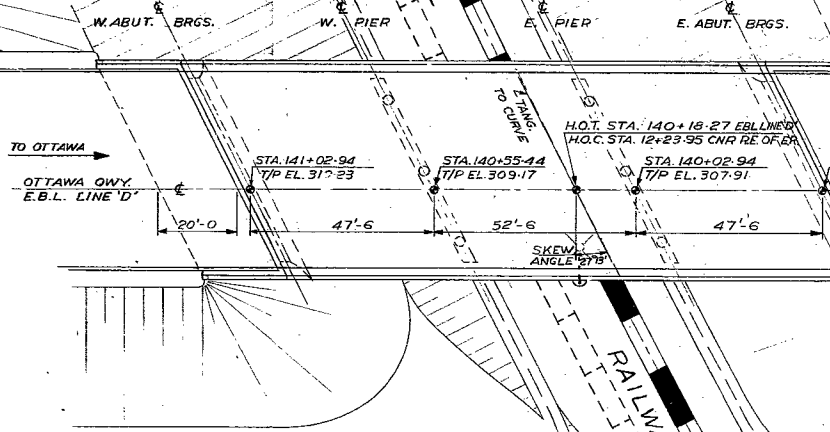
QUEENSWAY

ε C.N.R

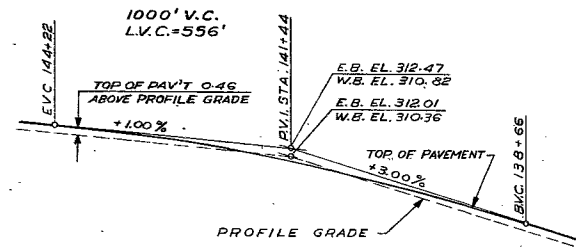
OVERHEAD



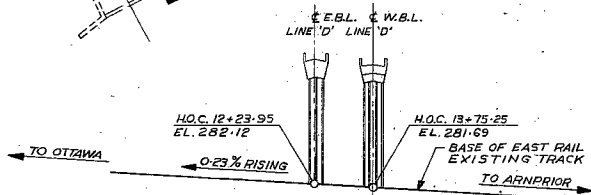
WESTBOUND STRUCTURE



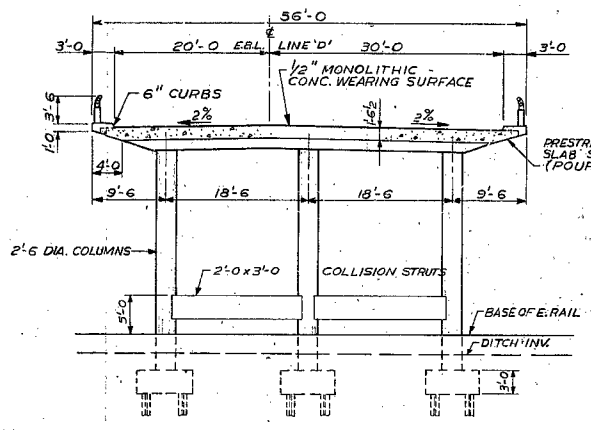
EASTBOUND STRUCTURE



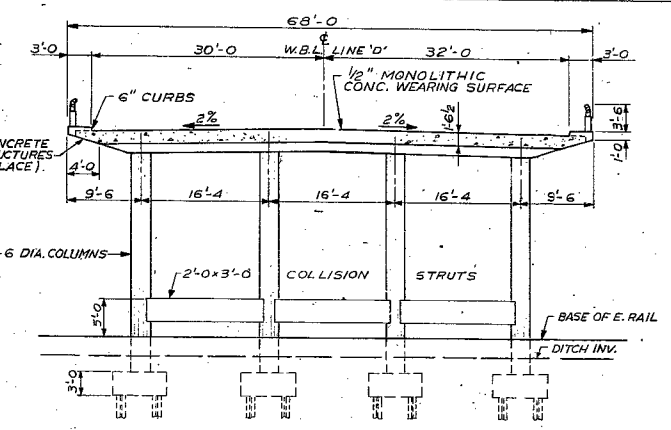
PROFILE OF OTTAWA QWY. LINE 'D' E.B.L. & W.B.L.



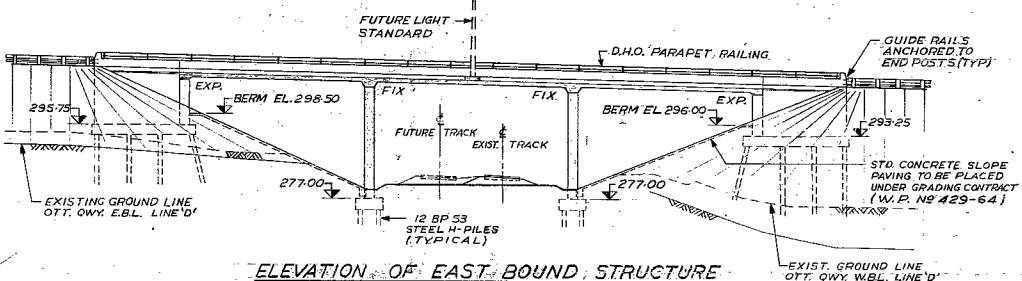
PROFILE OF CANADIAN NATIONAL RAILWAYS



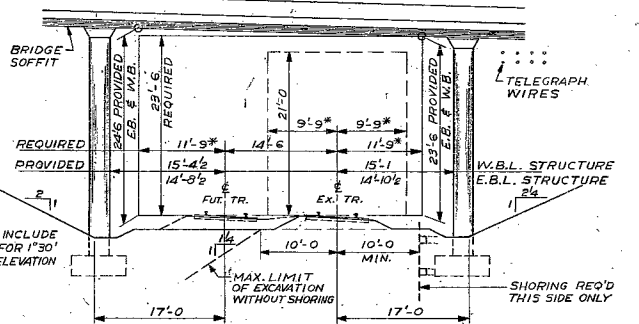
TYPICAL SECTION (EAST BOUND STRUCTURE) SCALE 1"=10'-0"



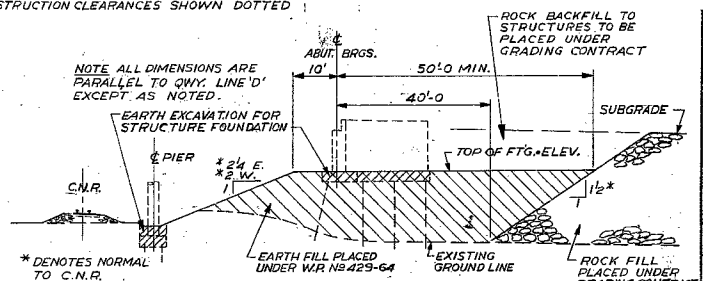
TYPICAL SECTION (WEST BOUND STRUCTURE) SCALE 1"=10'-0"



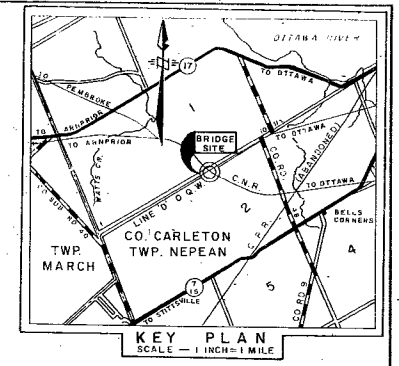
ELEVATION OF EAST BOUND STRUCTURE (WEST BOUND STRUCTURE SIMILAR) SCALE 1"=20'-0"



RAILWAY CLEARANCE DIAGRAM PERPENDICULAR TO C OF TRACKS



LIMIT OF APPROACH FILLS PRIOR TO CONSTRUCTION OF FOUNDATIONS



KEY PLAN SCALE 1"=1 MILE

- DESIGN NOTES**
- DESIGN SPECIFICATIONS: C.S.A. STANDARD 56-1966 DESIGN OF HIGHWAY BRIDGES, AND AS GOVERNED BY D.H.O. BRIDGE DIVISION MEMORANDA.
 - DEAD LOAD: 38 P.S.F. IS INCLUDED FOR FUTURE WEARING SURFACE
 - LIVE LOAD: HS 20-44
 - CONCRETE: MINIMUM STRENGTH AT 28 DAYS
DECK & CURBS - 5,000 P.S.I.
PIER COLUMNS - 4,000 P.S.I.
REMAINDER - 3,000 P.S.I.
 - FOUNDATIONS: 12 BP 53 STEEL H-PILES DRIVEN TO BEDROCK: MINIMUM ALLOWABLE LOAD TO TONS ESTIMATED LENGTH ABUTMENTS 66' PIERS 46'
 - SERVICES: PROVISION WILL BE MADE FOR FUTURE LIGHTING ON THE QUEENSWAY.
 - PRELIMINARY ESTIMATE OF COST: \$ 300,000

REVISIONS	DATE	BY	DESCRIPTION

66-F-17

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION
DE LEUW CATHY & CO. OF CANADA LTD.
CONSULTING ENGINEERS

C.N.R. OVERHEAD
(2.7 MI. WEST OF JCT. HWY. 15)

KING'S HIGHWAY No. OTTAWA QUEENSWAY DIST. No. 9.
CO. CARLETON
TWP. NEPEAN LOT 7 CON. II OTTAWA FRONT

PRELIMINARY PLAN

APPROVED: [Signature] DATE: MAY 67
DESIGN: G.S.S. CHECK: W.S.B. CONTRACT No. 3-257
DRAWING: G.S.S. CHECK: G.S.S. DRAWING No. 108-65
DATE: MAY 67 LOADING HS 2044