

MEMORANDUM

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

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

Attn: Mr. K.L. Kleinsteinber

DATE: February 26, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Sideroad No. 20 and C.P.R. Crossing,
Twp. of Albion. approx. one-half
mile West of Hwy. No. 50, Dist.No.6.

W.J. 63-F-143 -- (Municipal Job)

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design work. If further information concerning this project is required, please feel free to contact our Office.

KYL/MdeF

Attach.

cc: Messrs. A. M. Toye (3)
J. P. Howard
J. G. Tillcock
T. J. Kovich

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

Foundations Office
Gen. Files

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FOUNDATION INVESTIGATION REPORT

For

Sideroad No. 20 and C.P.R. Crossing,
Twp. of Albion, approx. one-half
mile West of Hwy. No. 50, Dist. No. 6
W.J. 63-F-143 -- (Municipal Job)

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed overhead structure at the crossing of relocated 20th sideroad and C.P.R. crossing was received from Mr. T. J. Kovich, Regional Materials Engineer, dated November 25, 1963.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Presented in this report are the results of this investigation, together with the recommendations pertaining to the design of the structure foundations and approach cut sections.

2. DESCRIPTION OF SITE:

The site is located in the "Oak Ridges" physiographic region. The topography at the site is hilly. The single C.P.R. line runs approximately north-south and underpasses side road No. 20 in a cut of about 30 ft. The existing side slopes are $1\frac{1}{2}:1$. The existing bridge is of timber construction and consists of a trestle type structure.

3. FIELD AND LABORATORY WORK:

Field work consisted of two sampled boreholes, one at the east end and one at the west end of the proposed new structure.

cont'd. /2 ...

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

Adjacent to each borehole, a dynamic cone penetration test was also carried out. The boring was carried out by means of a conventional diamond drill adapted for soil sampling purposes.

Samples were recovered at regular intervals by means of a 2" O.D. split-spoon sampler. The dimensions of the split-spoon sampler and the energy used in driving it conform to the requirements of the Standard Penetration Test.

The samples were brought to the laboratory and on a selection of these, tests were carried out to determine the Atterberg limits, natural moisture contents and grain size distribution.

The locations and elevations of the boreholes are shown on Drawing No. 63-F-143A which accompanies this report. All survey work was carried out by a survey crew from Duncan Hopper & Associates, Ltd., Consulting Engineers.

4. SUBSOIL CONDITIONS:

4.1) General:

The subsoil at the site was found to be generally uniform, and consists mainly of an extensive glacial deposit of clayey silt, sand and gravel. Within this main deposit a 15-ft. thick stratum of silty fine sand was observed to be about 30 ft. below the ground surface.

4.2) Clayey Silt, Sand, Gravel (Glacial Till):

This layer extends from below the topsoil to a depth of more than 70 ft. which was the maximum depth tested. It consists

cont'd. /3 ...

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

4.2) Clayey Silt, Sand, Gravel (Glacial Till): (cont'd.) ...
of clayey silt with some sand and gravel. The laboratory test results showed the following physical properties:

Liquid Limit	17% to 31%
Plastic Limit	12% to 20%
Moisture Content	11% to 20%

The material is in a compact to very dense state having an 'N'-value range of 14 to > 100 blows/foot.

4.3) Silty Fine Sand with Gravel:

A layer of silty fine sand with gravel 15 ft. thick, was found and extends from approximate elevation 905 ft. down to 890 ft. The material is mainly silty fine sand with occasional gravel. The layer is in a compact to very dense state having an 'N'-value range of 26 to > blows/foot.

5. GROUND WATER CONDITIONS:

The observed ground water level in the boreholes was encountered at about elevation 913.0.

These are shown on Drawing 63-F-143A as well as on the borehole logs appended in this report.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to replace the existing timber bridge by constructing a new three-span overhead structure at this site.

The subsoil conditions at the site are very uniform, consisting of very dense glacial till, suitable for spread footing type foundations.

cont'd. /4 ...

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

It is recommended to support the abutments and the piers for the new structure on spread footings. The footings can be placed about 5 ft. below ground level with a safe bearing pressure of 2 T.S.F.

No dewatering problems are expected to occur during excavations. No stability problems are anticipated with regard to the proposed 2:1 cut slopes.

7. SUMMARY:

The subsoil at the site consists of a compact to very dense stratum of glacial till.

It is recommended to support the abutments and piers for the new structure on spread footings. The footings may be placed at 5 ft. or below ground level. A safe bearing value of 2 T.S.F. may be assumed for design purposes.

8. MISCELLANEOUS:

The field work was carried out under the supervision of Mr. V. Korlu, Project Foundation Engineer, during January 20 to January 28, 1964, who also wrote this report. The report was reviewed by Mr. M. Devata, Senior Foundation Engineer.

The drilling equipment was supplied by Johnston Drilling Co. of Ottawa.

February 1964.

APPENDIX I.

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
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 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

FOUNDATION SECTION

ORIGINATED BY V.K.

COMPILED BY V.R.

CHECKED BY M.D.

COUNTY OF PEEL
TOWNSHIP OF ALBION

PROPOSED STRUCTURE

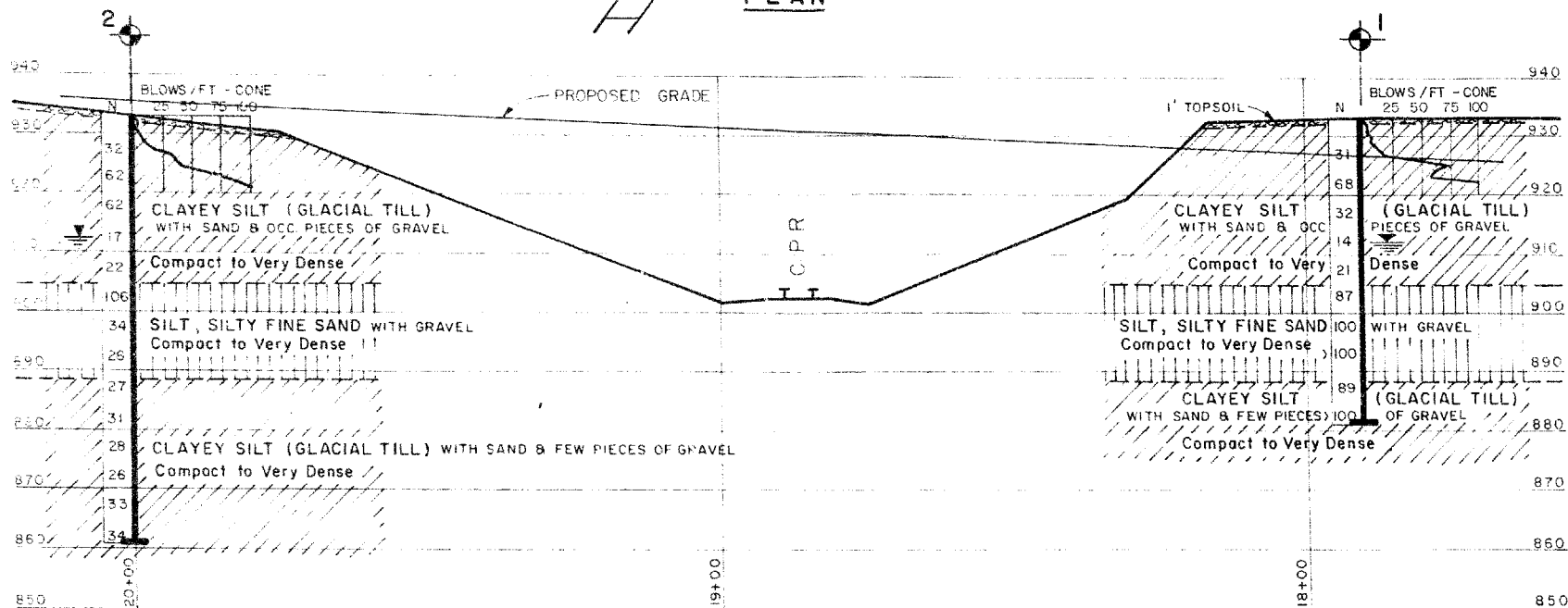
PROPOSED

DEVELOPMENT ROAD NO. 20

To Highway No.50

C.P.R.

PLAN



PROFILE

ORIGINATED V. KORLU	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE 1 IN 20 FT
DRAWN JC	MATERIALS & RESEARCH DIVISION	W.P. NO.
CHECKED <i>HR</i> <i>RS</i>	PROPOSED DEVELOPMENT RD. NO. 20	JOB NO 63-F-143
APPROVED <i>W. G. G.</i>	AND	DWG NO 63-F-143A
DATE FEB. 17, 1964	CANADIAN PACIFIC RAILWAY	

63-F-143

W.P. MUNICIPAL

SIDE ROAD #20 E

C.P.R. CROSSING

