

221 GEN. FILES
23-66-290

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. S. McCombie

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

DATE: July 22, 1966

OUR FILE REF.

IN REPLY TO

SEP 26 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Retaining Wall on Highway #63
At
Trout Mills, District 13 (North Bay)
W.J. 66-F-59 -- W.P. 270-682

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

We believe you will find the factual data and recommendations contained therein, adequate for your design requirements.

Should further information be required, please do not hesitate to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
H. McArthur
G. E. French
E. R. Saint
J. Curtis
A. Watt

Foundations Office
Gen. Files

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

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FOUNDATION INVESTIGATION REPORT
For
Retaining Wall on Highway #63
At
Trout Mills, District 13 (North Bay)
W.J. 66-F-59 -- W.P. 270-672

1. INTRODUCTION:

A foundation investigation for the proposed retaining wall on Hwy. #63 at Trout Mills, was requested by Mr. J. B. Curtis, Regional Bridge Location Engineer, in a memorandum dated June 9, 1966.

Following this request, a field investigation was carried out by this Section during the period of June 15 to June 21, 1966.

2. FIELD WORK:

The site is bounded by a relatively steep sloped hill on one side, and by Trout Lake on the other.

A total of five boreholes was drilled during the course of the field investigation.

The locations and elevations of the borings are shown on Dwg. 66-F-59A, which forms part of this report.

3. SUBSOIL CONDITIONS:

The subsoil at the site was found to be generally uniform. The extreme upper 6 - 10 ft. consists of a heterogeneous mixture of sand and gravel with boulders up to 6" in size. Underneath this bouldery material, a sandy silt to silty sand stratum was encountered to the full depth of exploration. The material consists of sand and silt with traces of gravel and clay and occasional boulders. The moisture content, as determined in the laboratory, ranges from 11% to 20%. 'N' values varied from 16 to over 100 blows per foot, indicating a compact to very dense relative density.

cont'd. /2 ...

4. RECOMMENDATIONS:

It is proposed to reconstruct Hwy. #63, which would require further cutting into an existing side slope. Due to this fact, a retaining wall is necessary along the realigned roadway. The proposed wall will run from approximate Sta. 57+50 to approximate Sta. 68+25, ranging in height from 1 ft. to 10 ft. The existing and the future side slope will be at approx. 2:1.

The subsoil at the site was found to be suitable for spread footing type foundations. A safe pressure of 3.0 t.s.f. may be assumed for design purposes at or below El. 666.

At some borehole locations the groundwater level was found to be close to ground level. Due to the water level position and the granular nature of the subsoil, some dewatering problems may be anticipated.

5. MISCELLANEOUS:

Equipment used for the field investigation was owned by Canadian Longyear Ltd. Supervision of the field work and the preparation of this report, was undertaken by Mr. P. Payer, Project Foundation Engineer. The report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

July 1966

APPENDIX I.

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-F-59 LOCATION Sta. 68 + 00 ; 331 Lt. ORIGINATED BY P.P.
W.P. 270 - 63 BORING DATE June 16 & 17, 1966 COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE Washboring & Diamond Drilling CHECKED BY [Signature]

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 % 10 20 30				
686.5	Ground Level													
0.0	Sand And Gravel With Boulder Concentration					680								W.L. El: 679.5 Gr. 28a.71 Si. 31.27 Gr. 08a.43 Si. 54cl.3 Sa. 50 Si. 49cl.1
676.5														
10.0	Sandy Silt To Silty Sand With Traces Of Gravel & Clay Brown To Grey Compact To v. Dense		1	SS	19									
			2	SS	17	670								
			3	SS	16									
			4	SS	72/9"									
663.0			5	SS	84/12"									
23.5	End Of Borehole					660								

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-59
W. P. 270-632
DATUM Geodetic

LOCATION Sta. 58 + 00; 22' It.
BORING DATE June 16 & 17, 1966
BOREHOLE TYPE Washboring & Diamond Drilling

ORIGINATED BY P.P.
COMPILED BY P.P.
CHECKED BY [Signature]

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 % 10 20 30					
689.3	Ground Level															
0.0	Sand & Gravel With Boulder Concentrations														W.L. El: 685.0'	
683.3																
6.0	Silty Sand With Traces Of Gravel & Clay Occasional Boulders Brown To Grey Very Dense		1	SS	41/7"	680									Gr. 6Sa.60 Si. 30Cl.4	
			2	SS	85											
			3	SS	110											
			4	SS	140											Gr. 7Sa.52 Si. 39Cl.2
			5	SS	90/6"											
			6	SS	48/15"		670									
669.3																
20.0	End Of Borehole															
						660										

FOUNDATION SECTION

JOB 66-F-59

LOCATION Sta. 65+00; 34' Lt.

ORIGINATED BY P.D.

W. P. 270-63²

BORING DATE June 17, 18, 1966

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Washboring & "diamond Drilling

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 % 10 20 30				
691.1	Ground Level					690								
0.0	Sand & Gravel With Boulder Concentration													
681.1						680								Gr. 13a.89 Si. 61.10 W.L. EL. 679.5
10.0	Silty Sand To Sandy Silt With Some Gravel And Traces of Clay Occasional Boulders Brown To Grey Compact To V. Dense		1	SS	34									Gr. 03a.17 Si. 75 Cl. 8
			2	SS	22									
			3	SS	26									
			4	SS	31	670								Gr. 12Sa.64 Si. 24 Cl. 0
			5	SS	35/5"									
662.1														
29.0	End Of Borehole					660								

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 66-P-59

LOCATION Sta. 61 + 00: 22' L.

ORIGINATED BY P.P.

W.P. 270-637

BORING DATE June 18 & 20, 1966

COMPILED BY P.F.

DATUM Geodetic

BOREHOLE TYPE Washboring & Diamond Drilling

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	SHEAR STRENGTH P.S.F.		WATER CONTENT % 10 20 30			
681.9	Ground Level									W.L. 680.7 Gr. 1Sa. 56 Sl. 39Cl. 4 Gr. 5Sa. 64 Sl. 61Cl. 32	
0.0	Sand And Gravel With Boulder Concentration					680					
675.9											
6.0	Silty Sand With Traces Of Gravel & Clay Occasional Boulders Greyish Brown Dense To V. Dense		1	SS	30						
			2	SS	95/7	670					
661.9			3	SS	70/6						
20.0	End Of Borehole					660					

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-59

LOCATION Sta. 62 + 75; 25' It.

ORIGINATED BY P.P.

W.P. 270-6

BORING DATE June 20, 1966

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Washboring & Diamond Drilling

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 % 10 20 30			
676.4	Ground Level											
0.0	Sandy Silt With Traces Of Gravel & Clay Grey Compact To V. Dense		1	SS	23	670						W.L. 676.4
			2	SS	22							Gr.8Sa.42 Si.45Cl.5
			3	SS	47/5"							Gr.1Sa.28 Si.69Cl.2
661.4			4	SS	20/5"							
15.0	End Of Borehole					660						

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_r	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
$\bar{\sigma}$	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

#66-F-59

W.P. #270-62

Hwy. #63

TROUT MILLS

RETAINING WALL

