

#64-F-82

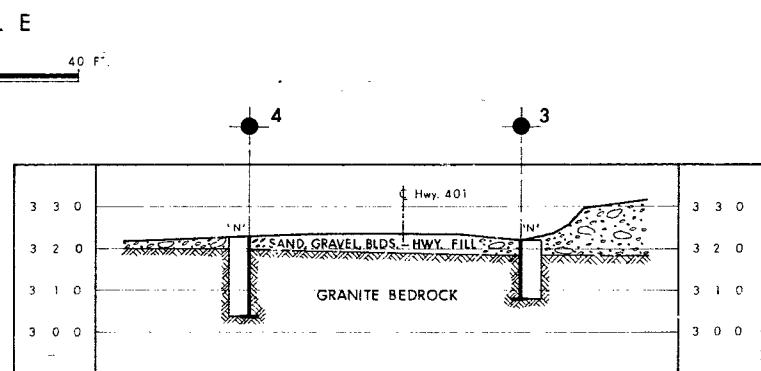
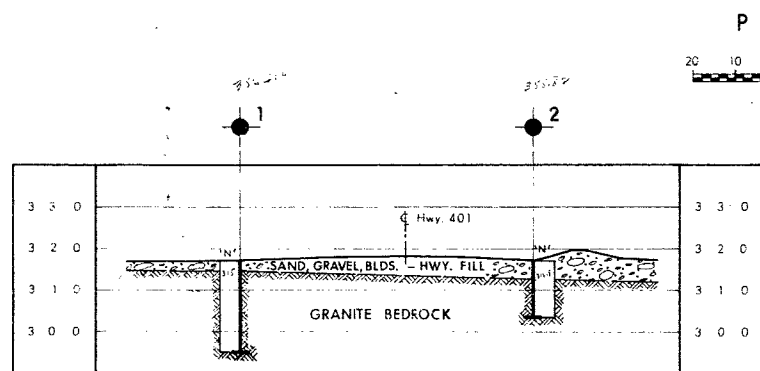
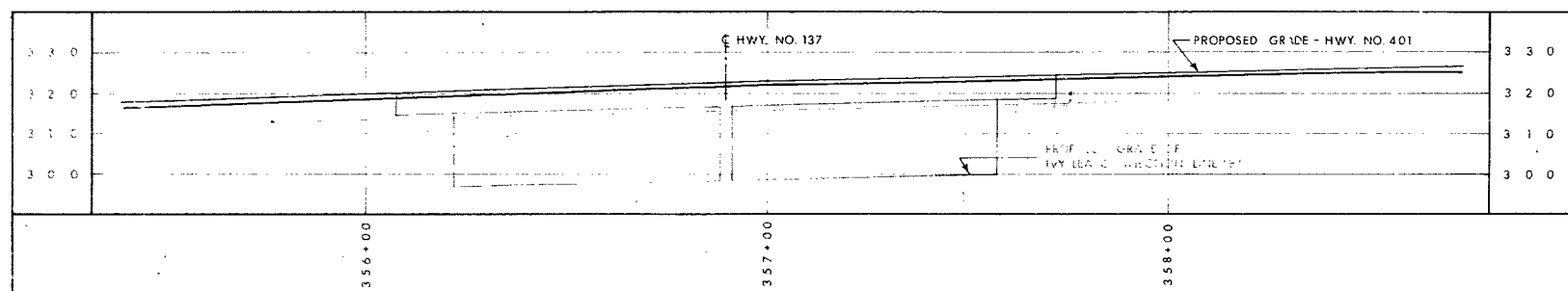
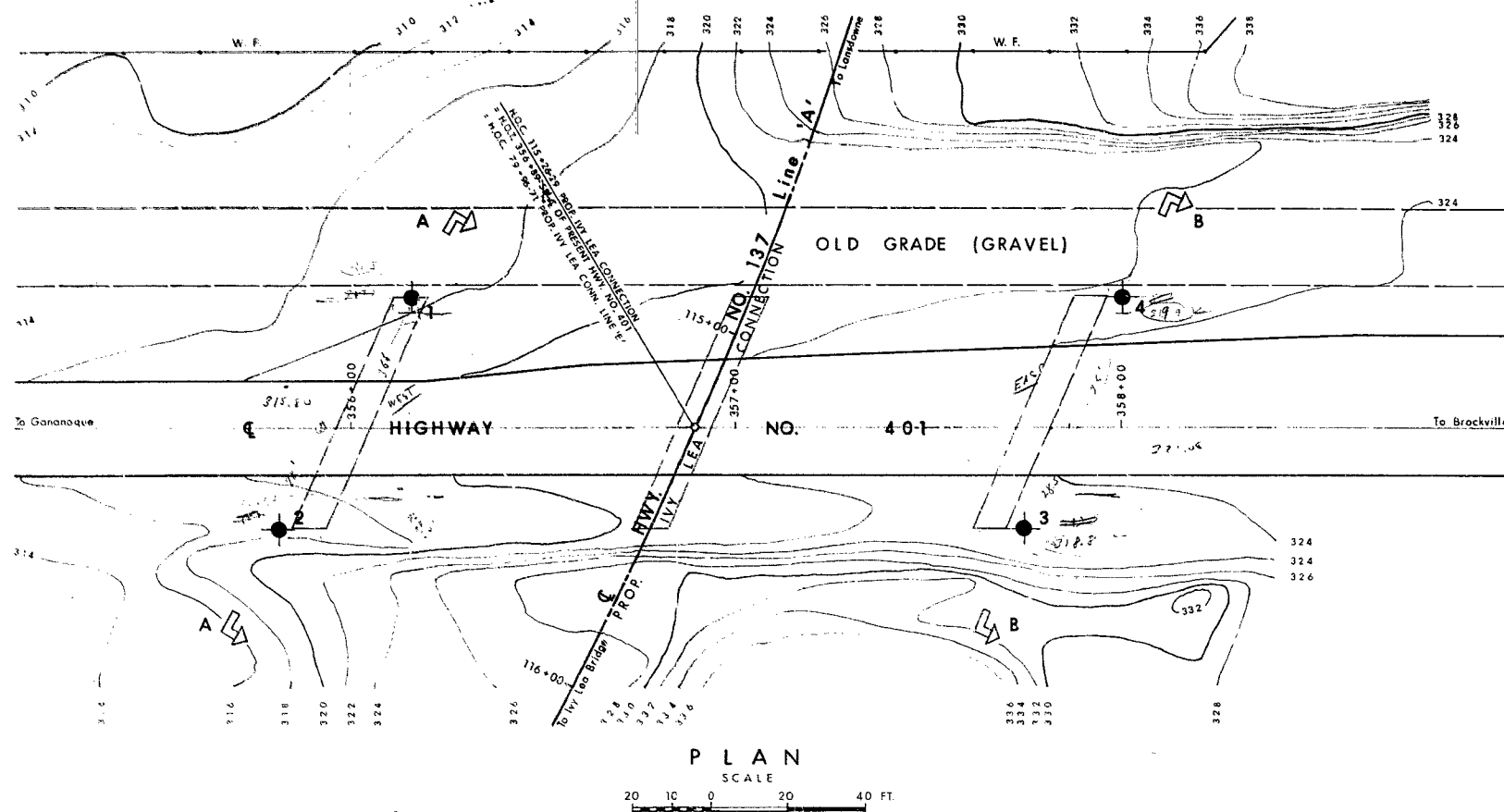
W.P. # 182-61

Hwy. # 401 ;

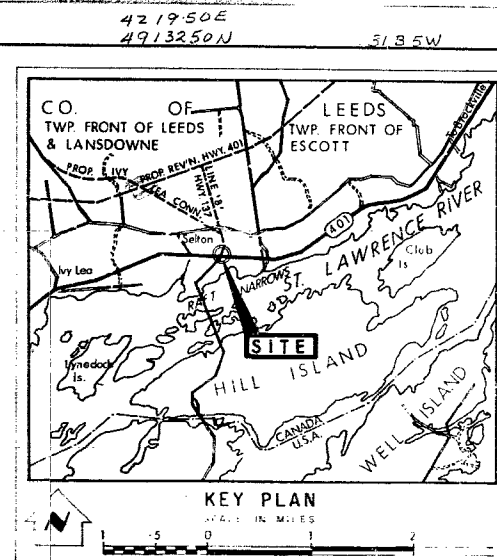
Hwy. # 137 AT

Ivy LEA

CONNECTION



SECTIONS
SCALE 20 10 0 20 40 FT.



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore Bore Penetration Hole		
	Water Levels established at time of field investigation		

NO.	ELEVATION	STATION	OFFSET
1	317.1	356+16	74' LT.
2	317.1	355+82	26' RT.
3	322.1	357+75	26' RT.
4	323.1	358+00	34' LT.

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.

REVISIONS	DATE	BY	DESCRIPTION

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

PROPOSED IVY LEA CONNECTION LINE 'A'
(HIGHWAY NO. 137)

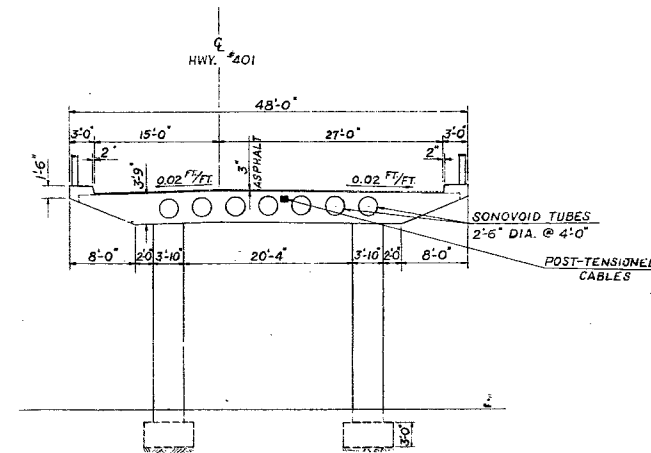
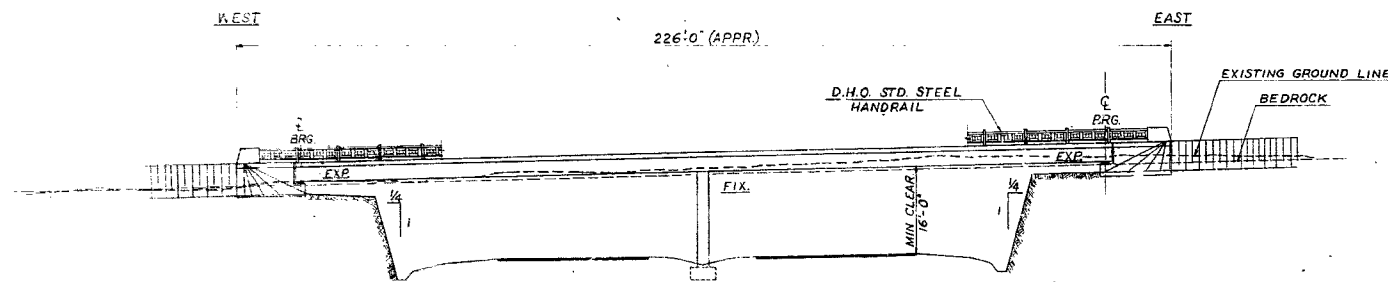
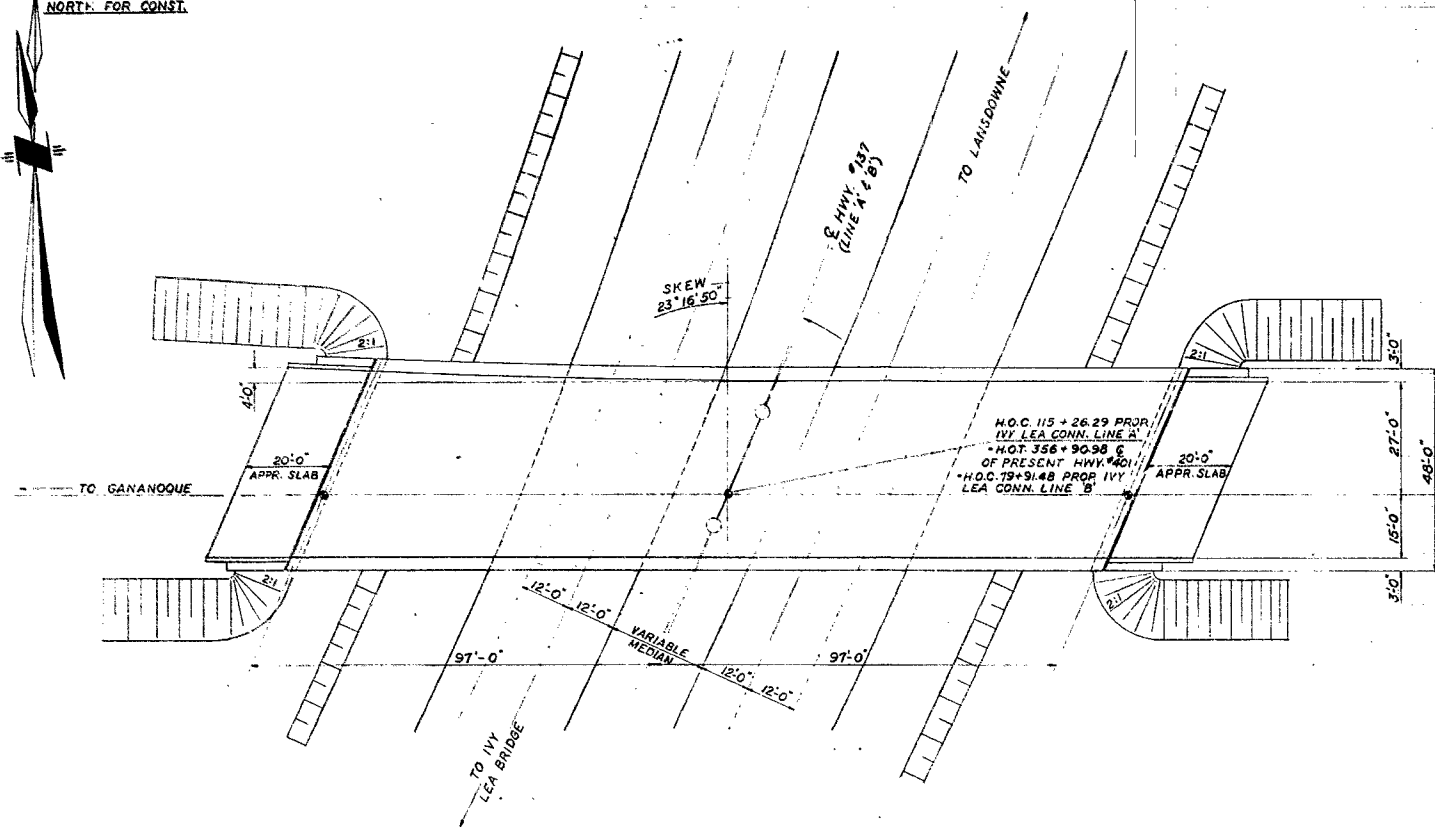
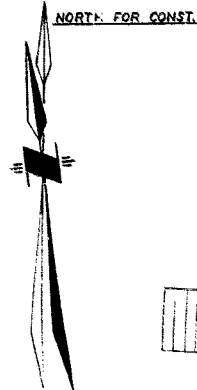
KING'S HIGHWAY NO. 401 DIST NO. 8
CO. LEEDS
TWP. FRONT OF LEEDS & LANSLOWNE LOT 23 CON. I

BORE HOLE LOCATIONS & SOIL STRATA

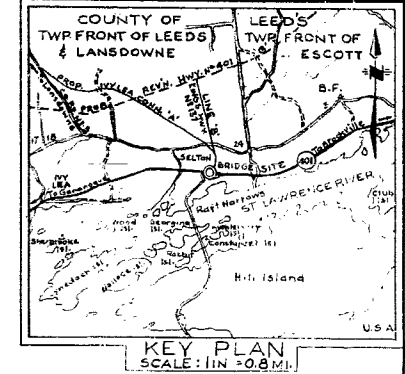
SUB'D W.K.	CHECKED W.K.	DATE 22 SEPT. 1964	SITE NO.	APPROVED <i>A. G. Thomas</i>
DRAWN D.M.	CHECKED D.M.	JOB NO. 64-F-82	BRIDGE DRAWING NO.	

64-F-82 A

REF. NO. E-4116-1



PROPOSED PROFILE OF HWY. #401
N.T.S.



PRINT RECORD			
No.	FOR	DATE	

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
PROPOSED CROSSING AT PROP IVY LEA CONN. LINE A & KING'S HIGHWAY NO. 401			
KING'S HIGHWAY No. 401 & 137		DIST. No. 8	
CO. LEEDS		CON. I	
TWP. FRONT OF LEEDS & LANSDOWNE		LOT 23	
GENERAL PLAN (PRELIMINARY)			
APPROVED		SITE No. 182-61	
DESIGN		CONTRACT Nos.	
DRAWING R.T.		DRAWING No. D-5585-P1	
DATE DEC/64		LOADING H20-S15	

MEMORANDUM

23-65-250
BA 1924

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

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

Attention: Mr. S. McCombie

DATE: September 18, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Ivy Lea Connection, Line 'A' and
Hwy. #401, Co. of Leeds, Twp. of
Front of Leeds & Lansdowne,
District #8

W.J. 64-F-82 -- W.P. 182-61

A verbal request to carry out a foundation investigation at Ivy Lea Connection Line 'A' and Hwy. #401 was received from the Regional Bridge Location Engineer, Mr. A. Watt, during the month of August, 1964.

The proposed site is located approx. 2.5 miles west of the Village of Pockport. The surrounding area is very hilly; rock is very close to the ground surface. Actually, the proposed site is located in a rock cut.

In order to obtain sufficient information, four AXT rock cores were taken at the site. B.F.'s #1 & #4 were taken down to 22'-6" and 19'-6", below existing ground elevations, respectively, and 10'-0" of AXT core was taken in B.H.'s #2 and #3.

The rock cores were inspected by Mr. B. K. Glassford, D.H.O. Geologist, and his recommendations are as follows:

cont'd. /2 ...

1. Rock is mainly a granite type with sections of granitized gneiss; approximately below the 15' depth the rock increases in quartz content and in places resembles a coarse grained quartzite.
2. Rock is massive, coarse textured, hard and varies in colouring of red, pink, and grey.
3. Numerous joint fractures traverse the rock mass at various angles, some are tight (closed), while others appear to be open.
4. This rock type would have excellent bearing and crushing strengths.
5. Some trouble might be experienced in obtaining a straight line face with the sheer blasting technique, due to the numerous joint fractures inherent within the rock mass.
6. A shatter zone of 3 to 4 feet might be expected from sheer blasting in this type of rock structure.
7. Bearing points for bridge beams should be placed 12 - 15 ft. behind the sheer face of the cut.
8. Some revision might be expected in bearing points for the beam locations on the rock, after the face of the cut has been completed and examined for blast fracture depth.
9. Beam bearing locations should be suitably capped with concrete to prevent water seepage into the rock fractures that are present.

cont'd. /3 ...


The field work, performed during the period September 3, 1964, to September 11, 1964, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. K. G. Selby, Senior Foundation Engineer, who reviewed this report.

We believe that the information contained in this report will suffice for your design work. Should further information be required, please do not hesitate to contact our Office.

WWK/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
J. Ford
E. A. Cash
J. E. Gruspier
A. Watt

Foundations Office
Gen. Files


for A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

64-F-82

LOCATION Hwy 401 & Prop. Ivy Lea Connection Line A

Sta. 355+82 26' Rt.

ORIGINATED BY: M.H.K.

182-61

BORING DATE Sept. 9, 1964.

COMPILED BY **W.H.K.**

047-4 317.1

BOP. AXT Coring.

MECKEL L. K.G.S.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 64-F-82

LOCATION Hwy 401 & Prop. Ivy Lea Connection Line A

Sta. 357+75 26' Rt.

ORIGINATED BY W.W.K.

W P 182-61

BORING DATE Sept. 8, 1964.

COMPILED BY W.W.K.

DATE 322.1

BOREHOLE TYPE AXT Core

CHECKED BY K.Q.S.

SOIL PROFILE		STRAT. PLOT	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT _____	BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT		
						SHEAR STRENGTH P S F	WATER CONTENT _____		
322.1	Groundlevel						WATER CONTENT %		
0.0	Sand, gravel, boulders.				320				
318.8	Hwy. Fill								
3.3	Grey granite with horizontal and vertical fissures.								
308.8					310				
13.3	End of borehole.				300				

JOB 64-F-82

LOCATION Hwy 401 & Prop. Ivy Lea Connection Line A

Sta 358+00 34' Lt.

ORIGINATED BY W.A.K.

W D 182-61

BORING DATE Sept. 3, 1964.

COMPILED BY W.H.K.

DATUM 323.1

BORE HOLE TYPE **AXT Core**

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _P WATER CONTENT _____ W _e <div>W_P ——— W_e ——— W_L WATER CONTENT %</div>	BULK DENSITY P X F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE				
323.1	Groundlevel							
0.0	Sand, gravel, boulders.							
319.9	Hwy Fill							
3.2	Gray granite with horizontal and vertical fissures.							
302.6								
19.5	End of borehole.							

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_i	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 $\log \sigma$	LOGARITHM 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
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

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Watt,
Regional Bridge Location
Engineer.

From: Mr. B.K. Glassford.

Date: August 24th. 1964.

Our File Ref.

IN REPLY TO

SUBJECT: W.P. 182-61, Highway #401, Bridge Site #17-164,
Ivy Lea Interchange Underpass.

Examination of the rock in the immediate vicinity of the proposed cut for the above bridge, indicates an unfavourable rock structure situation for benching to carry the ends of the bridge beams as proposed.

The rock here is a granite and granitized gneiss, massive, coarse grained and varying in type within a few feet. There are three main joint fracture patterns traversing the rock in this area, one horizontal and two vertical or inclined to the horizontal. Other lesser fracture joints are present in an inclined position and striking at angles to the main fractures. This leaves a rock mass traversed by numerous joint fractures, some open and others tight. This gives a situation where the rock mass is entirely composed of dimensional blocks of rock of various sizes and shapes resting upon and against each other. Thus this would appear to be a bad structural bearing placing for bridge beams close to the edge of the rock cut face as proposed.

The type of rock in itself is an excellent one for bearing and crushing strengths, but its structural pattern as a mass appears undesirable for the purpose proposed for it at this rock-cut site.

B.K. Glassford
B.K. Glassford,
Geologist.

BKG:ch

c.c.--V.R. Bennett
J. Gruppier
L.-. Cash

MEMORANDUM

cc: W.R. Bennett
M. Devata
A.P. Watt
J. Gruspier
E. Cash.

To: Mr. K.G. Selby,
Foundation Engineer,
Foundation Section.

FROM: B.K. Glassford

DATE: September 16th. 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: Bridge Site 17-164, W.P. 182-61,
Diamond Drill Core for 64-F-82,
Ivy Lea Interchange Underpass.

Examination of the cores for this project showed the following characteristics:

1. Rock is mainly a granite type with sections of granitized gneiss; approximately below the 15' depth the rock increases in quartz content and in places resembles a coarse grained quartzite.
2. Rock is massive, coarse textured, hard and varies in colouring of red, pink, and grey.
3. Numerous joint fractures traverse the rock mass at various angles, some are tight (closed), while others appear to be open.
4. This rock type would have excellent bearing and crushing strengths.
5. Some trouble might be experienced in obtaining a straight line face with the wheel blasting technique, due to the numerous joint fractures inherent within the rock mass.
6. A shatter zone of 3 to 4 feet might be expected from sheer blasting in this type of rock structure.
7. Bearing points for bridge beams should be placed 12 - 15 ft. behind the sheer face of the cut.
8. Some revision might be expected in bearing points for the beam locations on the rock, after the face of the cut has been completed and examined for blast fracture depth.
9. Beam bearing locations should be suitably capped with concrete to prevent water seepage into the rock fractures that are present.

BKG:ph

B.K. Glassford
B.K. Glassford,
Geologist.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: Bridge Division,
Downsview, Ontario.

DATE: January 25, 1965.

Our File Ref.

IN REPLY TO

SUBJECT: W.P. 182-61 Site 16-173
Old King's Highway 401 Underpass
At the Intersection of Old King's Highway 401 & 137
Highway 137, District #8

Enclosed please find one copy of the preliminary
plan D 5585-P1 for the above noted structure.

Would you kindly review the bridge foundation pro-
posed and inform us if they are satisfactory.

A. P. Watt

APW/es

A. P. Watt,
Regional Bridge Location Engineer.

*No comment
also
Jan 29/65*

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundation Eng.
Room 107,
Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

DATE: July 30, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 182-61,
Bridge Site # 17-164,
Ivy Lea Bridge Road Interchange Underpass,
Hwy. 401,
District 8.

64-F-82

Would you kindly arrange to have a foundation investigation conducted at the above location. I have enclosed one copy of the site plan number E-4116-1 with the probable footing locations marked in red. Bedrock will likely be at the surface in a majority of the holes.

Would you kindly investigate the rock to see if it can be excavated along a vertical wall as shown on the E plan and if the rock can be excavated along a vertical wall, the overbreak that may occur. On the other hand if the rock can not be excavated along a vertical wall, would you give the minimum slope at which the rock can be excavated and what overbreak may occur.

Would you also give a bearing value for the rock encountered.

A. P. Watt

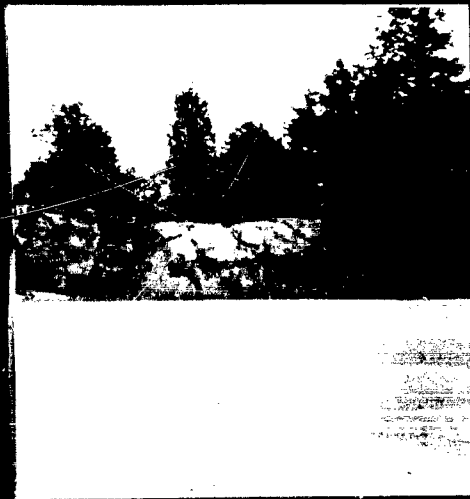
CPW/jf

A. P. Watt,
Regional Bridge Liaison Engineer.
cc. N. D. Smith
R. Fitzgibbon



ROCK OUTCROPS VICINITY OF
PROPOSED IVY LEA UNDERPASS.
SHOWING "BLOCKY" NATURE OF THE
GRANITE ROCK MASS.

SUPER IMPROVED DOCUMENT MAY
APPEAR AS MULTI-FEED ON FILM.



ROCK OUTCROPS VICINITY OF
PROPOSED IVY LEA UNDERPASS.
SHOWING "BLOCKY" NATURE OF THE
GRANITE ROCK MASS.