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Bridge Engineer,
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Attention: Mr.S. McCombie.

W.P. 246-62.
Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.
November 19, 1962.

D.H.C. FOUNDATION INVESTIGATION REPORT -
Proposed New Structure over Sandusk Creek
on Hwy. #3, 3 Miles E. of Jarvis, Lot 12,
Conc. VII & VIII, Twp. of Walpole, County
of Haldimand, District #4.

W.J. 62-F-119 -- W.P. 246-62.

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

We believe you will find the factual data and
recommendations contained therein, adequate for your future
design work. Should additional information be required, please
do not hesitate to contact our Office.

KYL/mdeF
Attach.

cc: Messrs. A. M. Toye (2)
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KYL
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SUPERVISING FOUNDATION ENGR.
For:

A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

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FOUNDATION INVESTIGATION

For

Proposed New Structure over Sandusk Crk., on
Hwy. 3, 3 miles E. of Jarvis, Lot 12, Conc. VII
& VIII, Twp. of Walpole, County of Haldimand.
W.J. 62-F-119 -- W.P. 246-62
District #4.

1. INTRODUCTION:

A foundation investigation for the proposed new structure over Sandusk Creek on Hwy. 3 (Stn. 256+18) was requested verbally to our section on October 5, 1962. An investigation was carried out at the site of this structure on Oct. 9, 1962.

This report contains the field and laboratory findings, together with recommendations for the foundations of the proposed new structure.

2. DESCRIPTION OF SITE AND GEOLOGY:

The existing concrete bowstring bridge is a single-span structure (46') supported on spread footings. The area on either side of Hwy. 3 is generally flat and mostly pastureland. There are buildings on either side of the highway. Sandusk Creek is a winding stream and the direction of its flow is from North to South. The velocity of the river is slow and it depends on the prevailing wind conditions at the location of the structure. The adjacent creek banks are protected by hand-laid rip-rap in places.

cont'd. /2 ...

2. DESCRIPTION OF SITE AND GEOLOGY: (Cont'd.)...

Geologically the site is situated in the area of Haldimand Clay Plain. This plain which covers an area of about 1350 square miles lies between the Niagara Escarpment and Lake Erie. It contains an intermixture of clay and till. The underlying rocks are of Palaeozoic origin of hard dolomite variety. Overlying dolomites, is a series of softer rocks which include shale members. The general characteristics of the soils of this region are its heavy structure and poor drainage.

3. DESCRIPTION OF FIELD AND LABORATORY WORK:

Field work consisted of four sampled boreholes and four dynamic cone penetration tests. The relocation of these holes was chosen from the given Plan E-4142-1.

The exploration programme was carried out by a Standard core drill machine adapted for soil sampling. Conventional washboring procedure was followed. Samples were recovered at required depths by means of a 2-inch O.D. split-spoon sampler and in one instance by means of a 2-inch I.D. Shelby tube. The dimension of this spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. Rock samples were obtained by the use of AXT core barrel.

Samples were visually examined and identified in the field before transportation to the laboratory. Tests were

cont'd. /3 ...

3. DESCRIPTION OF FIELD AND LABORATORY WORK: (Cont'd.)... carried out in the laboratory on a selection of samples for the determination of Atterberg Limits, moisture content and grain size distribution. Laboratory and field test results have been summarized and are included in this report in Appendix I.

4. SUBSOIL CONDITIONS:

4.1 General:

The investigation has shown that in general, the subsoil conditions are uniform. Below a layer of fill material, there is a layer of silty clay containing some sand and gravel, overlying bedrock. A detailed description of these layers is given below.

4.2 Fill:

Below a thin layer of topsoil, this layer of cohesive fill material was encountered to a depth of 8' (approx. elev. 650'), in boreholes 1, 5 and 6 which were drilled from the side of the road.

The fill consists of silty clay with traces of fine sand and organic matter. This organic material is in general of fibrous variety. The consistency of the material in this layer is stiff. The value of the Standard Penetration Test, 'N' averages 11 blows per foot. It is of low to intermediate plasticity and dark brown in colour.

cont'd. /4 ...

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

4.3 Silty Clay:

This layer of silty clay was encountered below the above-mentioned layer of fill, between approx. elevations 650 and 635. It contains traces of fine sand throughout its entire depth. Fine gravel were encountered in this layer below elevation 637 and just about bedrock. In borehole 5, a small pocket of fine sand was encountered between elevation 648.8 and 648. On average it is found to contain 49% clay, 35% silt and 16% sand and gravel. The consistency of this layer is stiff to very stiff. The value of Standard Penetration Test, 'N' averages 17 blows per foot. The shear strength of the material may be taken as 2500 p.s.f. The material is of intermediate to high plasticity in general, with average values of Atterberg Limit as 50% and 22% respectively. Moisture content averages 25%. The color of the material is predominantly light brown with grey shade in trace.

4.4 Bedrock:

Below the layer of silty clay, shaley dolomite bedrock was encountered. It was recovered in borings 1 and 4 at approx. elevations 634.8 and 635.6 respectively. AXT size core barrel was used and recovery was 100%. In the remaining holes, hard rocks surface was encountered at approximately the same elevations as above but no core-drilling was undertaken to recover the bedrock.

cont'd. /5 ...

5. WATER CONDITIONS: (Cont'd.)...

The level of water in the creek was observed to be at an approx. elevation 650. The elevation of water in borehole 1 was measured at 649.3 and in borehole 4, at 649.8. Boreholes 5 and 6 were filled with water up to the top surface after drilling and no loss of water was noted due to very low permeability of the material. Under these circumstances the exact ground water table cannot be established.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new bridge of larger dimensions to carry Hwy. 3 over Sandusk Creek. It is located between Conc. VII and VIII, on Lot 12, in the County of Haldimand.

In the preceding paragraphs, the subsoil conditions are described in detail. The soil stratification can be considered as regular. Considering the strength and compressibility characteristics of the subsoil as such, spread footings are feasible for the proposed new structure. A safe bearing load of 2.5 T.S.F. can be used. To provide for effective scour as well as frost protection, it will be necessary to found the footings so as to keep the footing bottom at least 4' below the creek bed level, that is at an approx. elevation 643'.

The natural water content of the soil layer at this depth is at or around the plastic limit, no appreciable settle-

cont'd. /6 ...

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

ment could be expected. It is our opinion that settlements will be negligible because the consistency of the material is stiff to very stiff and the ground is already preloaded by the existing structure.

No dewatering problems are anticipated. However, this will depend on the creek water level at the time of construction. If sheet piles are required to be driven, the elevation of pile bottoms should be 643 or lower.

As an alternative to spread footings, foundation which requires deep excavation a pile supported foundation may be adopted. A structure may be supported on sheet H-piles driven to refusal at bedrock contact. A safe load up to 70 tons may be used for 12 BP74 H-piles.

No slope stability problems are anticipated to be encountered with standard 2:1 slopes. All compressible organic material should be removed before placing any new fill material. The adjacent river banks should be protected by providing rip-rap.

7. CONCLUSIONS:

(a) Subsoil conditions at this site are uniform and favourable. Above shaley dolomite bedrock, there is a shallow overburden (15') of silty clay with traces of sand and fine gravel. Above it lies fill material which is cohesive in nature and about 8' thick.

cont'd. /7 ...

7. CONCLUSIONS: (Cont'd.)...

(b) Elevation of creek water level was around 650 at time of this field investigation. Exact ground water table could not be established with the time of field investigation due to low permeability of the subsoil.

(c) Spread footing support can be provided with a safe bearing load of 2.5 T.S.F. Footings should be founded at elevation 643 or lower to provide adequate scour and frost protection.

No settlement problems are expected to be encountered. No dewatering problems are anticipated.

(d) As an alternative to spread footings, a pile supported foundation may be adopted. A safe load of 70 tons can be used for 12BP74 H-piles, if driven to refusal at bedrock contact.

(e) Adjacent river banks should be protected by providing rip-rap.

8. MISCELLANEOUS:

The field work was undertaken during the period from Oct. 9, 1962 to Oct. 18, 1962, using D. H. O. drilling machine, by Mr. B. Ghadiali, who also prepared this report under the general supervision of Mr. K. G. Selby.

November 1962.

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_α	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 $\log \sigma$	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_o	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

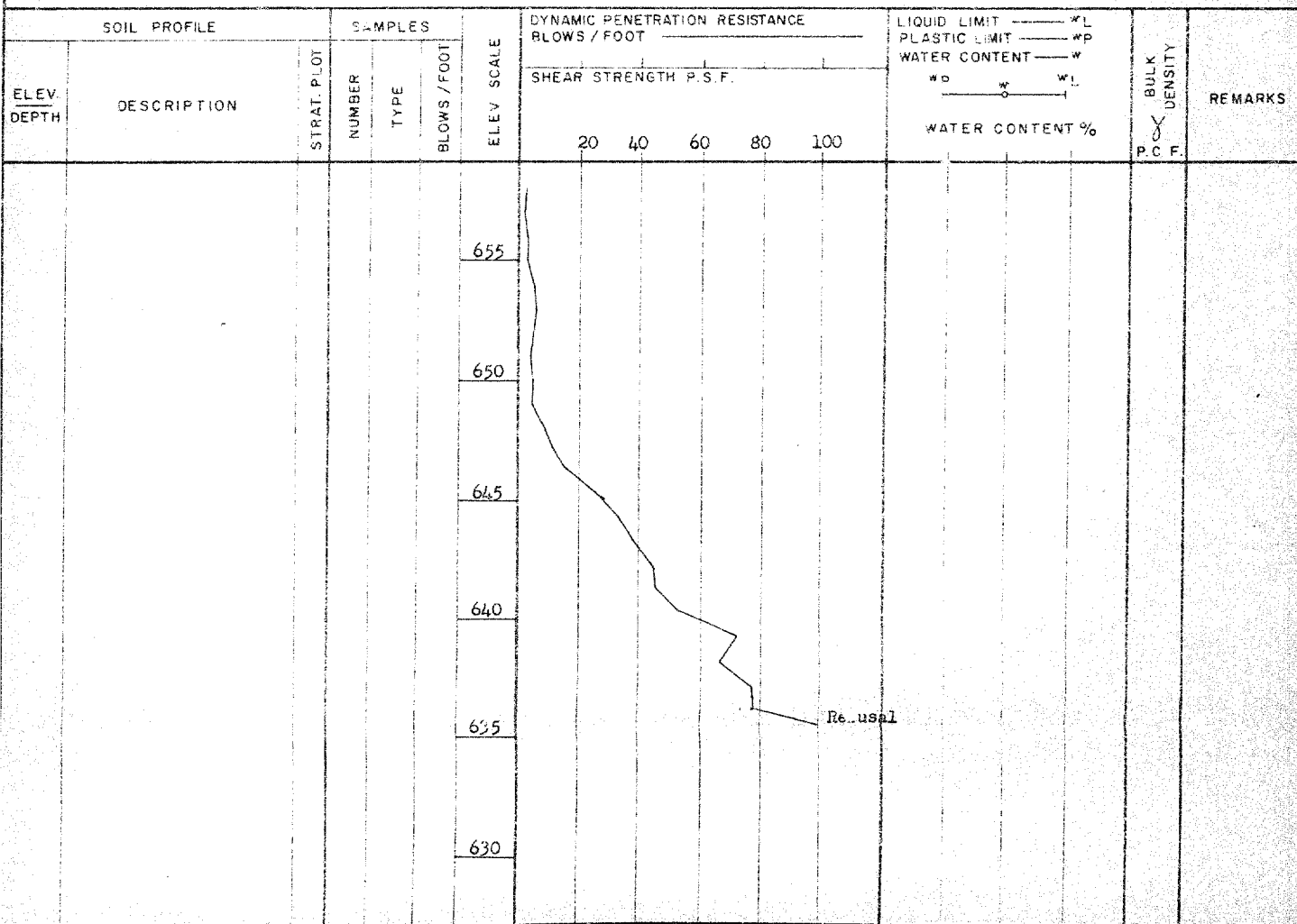
FOUNDATION SECTION

JOB 62-F-119 LOCATION Sta. 256/44 and 20' to left of E Hwy. 3 ORIGINATED BY B.M.G.
 W. P. 246-62 BORING DATE Oct. 9, 1962. COMPILED BY _____
 DATUM Geodetic BOREHOLE TYPE Washboring using NX Casing. CHECKED BY K.Y.L.

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 % WP W WL							
658'	Topsoil						20	40	60	80	100	20	40	60			
0.6	Fill. (Silty clay and trace of fine sand and or- ganic material).					655											
	Stiff.		1	SS	11												
650'	Dark brown.					650											
8.0	Silty clay and trace of fine sand.		2	TW	18												
	Stiff to very stiff.		3	SS	20	645											
	Brown.		4	SS	16	640											
			5	SS	9												
634.8					635		Refusal										
23.2	Bedrock. (Shaley dolomite)	6	RC	-													
		7	RC	-	630												
628.6																	
29.5	End of borehole.																

FOUNDATION SECTION

JOB	62-F-119	LOCATION	Sta. 256-62 and 131-6" to right of E Hwy. 3	ORIGINATED BY	B.M.G.
W.P.	246-62	BORING DATE	Oct. 16, 1962.	COMPILED BY	
DATUM	Geodetic	BOREHOLE TYPE	Dynamic Cone Penetration Test Only.	CHECKED BY	K.Y.L.

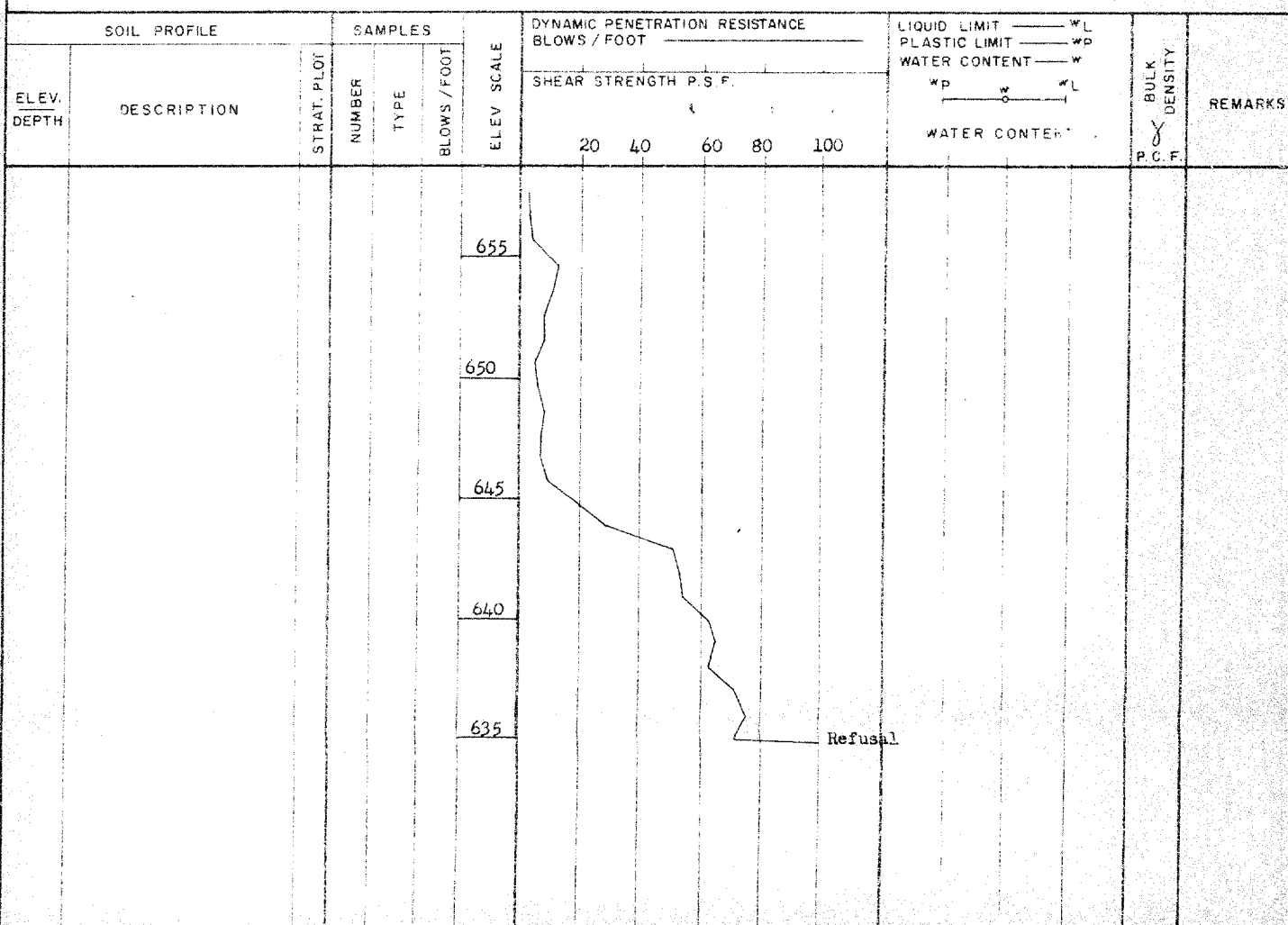


DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 62-F-119 LOCATION Sta. 255+53 and 18' to left of E Hwy. 3 ORIGINATED BY B.M.G.
W.P. 246-62 BORING DATE Oct. 16, 1962. COMPILED BY _____
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test Only. CHECKED BY K.Y.L.



FOUNDATION SECTION

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— WL Plastic Limit ——— WP Water Content —— W wp w WL WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
658'	Topsoil							
0'-6"	Fill. (Silty clay, fine sand and trace of organic material) Stiff. Dark brown and black.		1 SS 15	655				
649.5			2 WS -	650		○————		
8'-6"	Silty clay and some fine sand. Gravel below El. 637'.		3 SS 20					
	Stiff to v. stiff. Brown and grey.		4 SS 12	645		○————		
				640				
635.3			5 SS 11	635		—●		
22.8	End of borehole.							

#62-F-119

W.P. #246-62

Hwy. #3 E.

SANDUSK CR.

3 MILES E. OF

JARVIS

