

#64-F-72

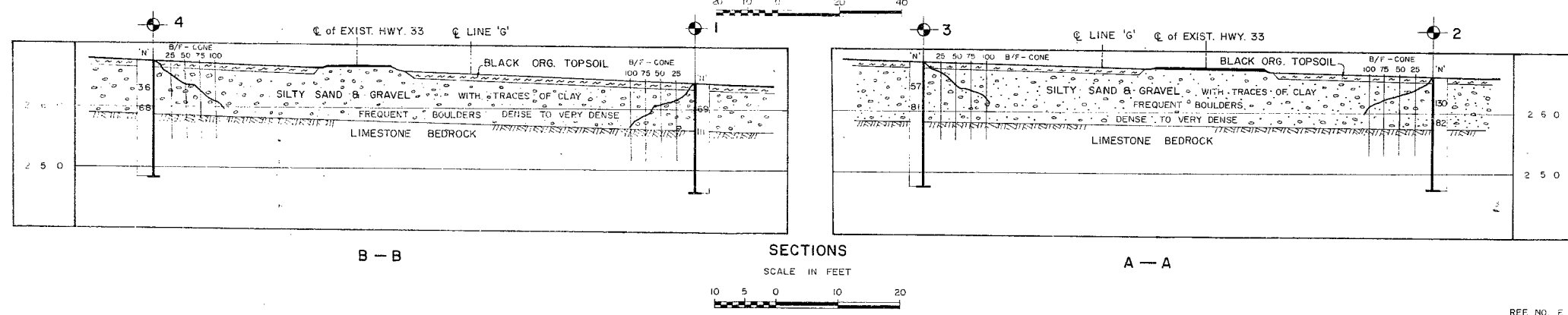
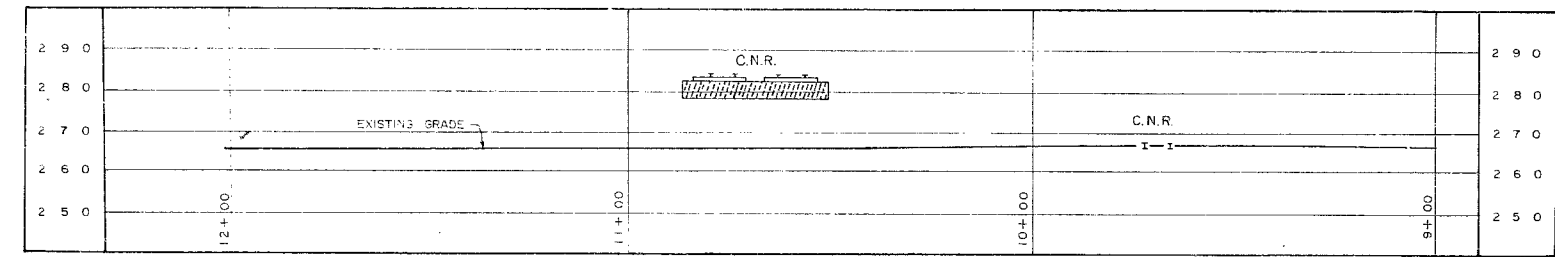
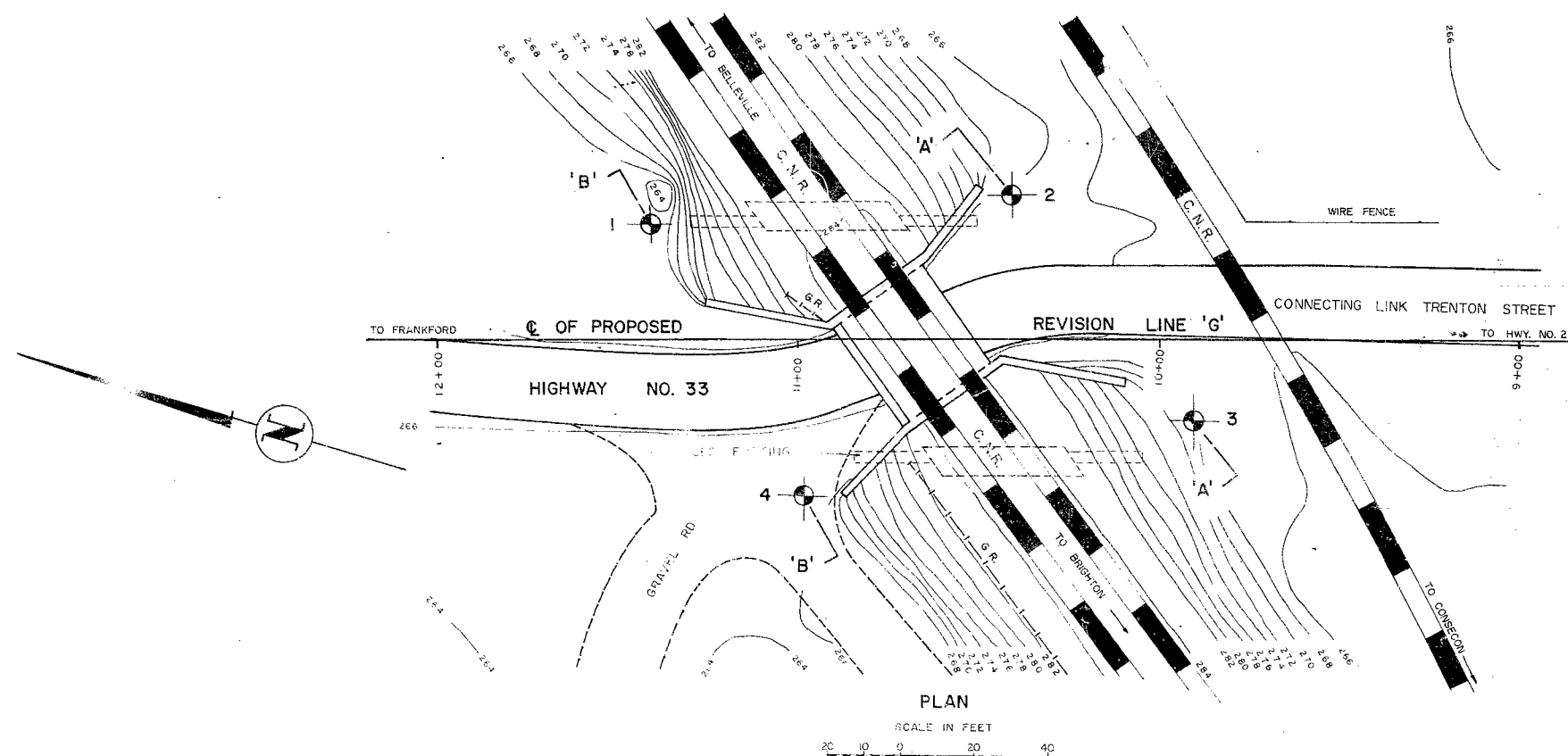
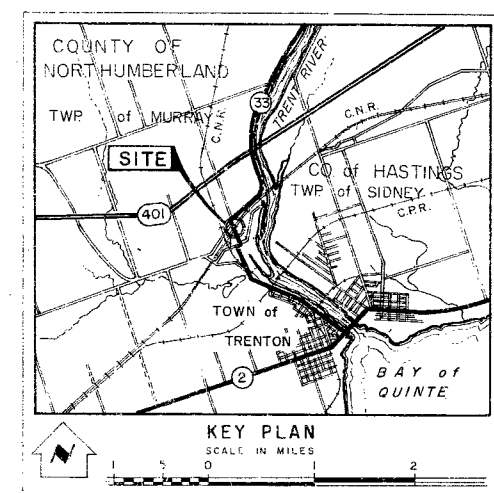
W.P.# 245-62-01

Hwy. #33 :

C.N.R.

792150 E
4887900 N

31C4E



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation.		
NO.	ELEVATION	STATION	OFFSET
1	274.0	11+40	3'2" RT.
2	276.1	11+40	4'0" RT.
3	277.8	9+90	2'1" LT.
4	277.0	10+47	4'3" 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.

REVISION	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION			
CANADIAN NATIONAL RAILWAYS			
KING'S HIGHWAY NO. 33		LINE 'G'	DIST. NO. 7
CO. HASTINGS		TOWN of TRENTON	
TWP. _____		LOT 485	CON. II
BORE HOLE LOCATIONS & SOIL STRATA.			
SUBMIT. W. K.	CHECKED <i>[Signature]</i>	WP NO. 245 - 62-01	M.B.R. DRAWING NO.
DRAWN P. T.	CHECKED <i>[Signature]</i>	JOB NO. 64-F-72	64-F-72 A
DATE 21 SEPT. 64	SITE NO.		BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT. NO.		

REF. NO. E-4,001-1

MEMORANDUM

W.P. 245-62

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

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

Attention: Mr. S. McCombie

DATE: September 14, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

C.N.R. and Hwy. #33, Line 'G',
Hastings County, Sidney Township,
District No. 8.1

W.J. 64-F-72 -- W.P. 245-62 -61

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

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

KYL/MoeF
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 ✓

A. G. Carmac,
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT

For

C.N.R. and Hwy. #33, Line 'G',
Hastings County, Sidney Township,
District No. 8.
W.J. 64-F-72 -- W.P. 245-62

1. INTRODUCTION:

A request to carry out a foundation investigation at realigned Hwy. #33 and C.N.R., was received from the Bridge Location Engineer, Mr. J. B. Curtis, dated July 13, 1964.

It is proposed to erect a new bridge to carry the C.N.R. over the realigned Hwy. #33, Line 'G'. The site of the proposed bridge is located in the Town of Trenton. At this location, the chainage of the realigned Hwy. #33, Line 'G' is from 9+90 to 11+40.

In order to determine the soil properties and decide on the type of foundation, an investigation was carried out by this Section. Results and the discussion of the field and laboratory investigations, as well as conclusions and recommendations for the future design work, are contained in the following paragraphs of this report.

2. DESCRIPTION OF SITE:

The site of the proposed bridge is located in the Town of Trenton. The surrounding area is generally flat terrain. Physiographically, the site is located in the so-called "Peterborough Drumlin Field".

cont'd. /2 ...

2. DESCRIPTION OF SITE: (cont'd.) ...

The wingwalls and abutments of the existing bridge, which was built in 1920, are in a very good condition. From the information gathered at the site, it seems that the bridge was constructed on spread footings placed on bedrock.

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, four sampled boreholes and four dynamic cone penetration tests were carried out at this site. Ten feet of rock core was taken in each borehole.

Split-spoon samples were taken at various depth intervals. Samples were used to determine the following physical properties:

1. Natural Moisture Content.
2. Atterberg Limits.
3. Grain Size Distributions.

Results of these laboratory tests are summarized in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The stratigraphy of the soil at the site was found to be generally uniform. A detailed description of various soil types encountered during the investigation, is shown in Appendix I of this report and is also given in subsequent paragraphs. The estimated stratigraphical profile, shown on Dwg. No. 64-F-72A, is based upon this information.

cont'd. /3 ...

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

4.2) Silty Sand and Gravel with Traces of Clay, Frequent Boulders - Dense to Very Dense:

This layer, which extends down to bedrock for a depth of about 7 to 9 feet, was found immediately below the topsoil.

The percentage of sand in this layer is 44%, gravel 36%, silt forms 18% and the rest of 2% is clay. Moisture content determinations for this layer averaged about 5.6%, ranging from 1.8% to 8.6%. The overall layer was found in a dense to very dense state with an average 'N' value of over 100 blows/foot. The 'N' values varied from 36 blows/foot to over 150 blows/foot.

4.3) Limestone Bedrock:

Following the layer of silty sand and gravel is limestone bedrock. Rock core taken in each borehole to a depth of 10 feet showed that the bedrock is in a sound condition.

5. GROUND WATER CONDITIONS:

No ground water level was encountered during the time of the investigation.

It may be assumed that the water level will vary with the seasons of the year.

6. DISCUSSION AND RECOMMENDATIONS:

The investigation has revealed that the best solution would be to place the footings directly on bedrock. A net allowable pressure of 10 tons/sq.ft. may be assumed for design purposes. Since the subsoil consists of relatively dense and impermeable material, and the ground water table being low, dewatering of the excavations should not present problems.

7. SUMMARY:

A foundation investigation at the proposed C.N.R. and Hwy. #33, Line 'G' is reported.

Subsoil was found to consist of dense to very dense silty sand and gravel with traces of clay and frequent boulders, followed by sound limestone bedrock.

Due to the proximity of the bedrock to the surface, it is recommended that the footings for the future structure should be placed directly on bedrock. A net allowable pressure of 10 tons/sq.f may be assumed for design purposes.

Dewatering of the excavations should not present problems.

8. MISCELLANEOUS:

The field work, performed during the period from August 4 to August 7, 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.

September 1964.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOE 64-F-72

LOCATION C.N.R. & Hwy. #33 Line "G" Ch. 11/40 32'-0" Rt.

ORIGINATED BY W.W.K.

W D 245-62

BORING DATE Aug. 4, 1964.

COMPILED BY W.W.K.

DATUM 264.0

BOREHOLE TYPE Washboring - NX Casing.

CHECKED BY K.G.S.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20 40 60 80 100	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W		
264.0	Groundlevel										
263.2	Black org. topsoil										
0.8	Silty sand & gravel with traces of clay. Frequent boulders.	1	SS	69	260						
256.7	Dense to very dense.	2	SS	111							
7.3	Limestone Bedrock.				10"						
246.7	End of borehole.				250						
17.3					240						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 64-F-72

LOCATION C.N.R. & Hwy. #33 Line "G" Ch. 9+90 22'-0" Lt.

ORIGINATED BY W.W.K.

W. P. 245-62

BORING DATE Aug. 6, 1964.

COMPILED BY W.W.K.

DATUM 267.8

BOREHOLE TYPE Washboring - NX Casing.

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— W _L	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	P.C.F.	
267.8	Groundlevel						
267.0	Black org. topsoil.						
	Silty sand & gravel, with traces of clay. Frequent boulders. Dense to very dense.		1	SS	57		
258.1			2	SS	81		
9.7	Limestone						
	Bedrock.						
247.8							
20.0	End of borehole.						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOE 64-F-72

LOCATION C.N.R. & Hwy. #33 Line "G" Ch. 10/97 43'-0" Lt.

ORIGINATED BY W.W.K.

W. P. 245-62

BORING DATE Aug. 7, 1964.

COMPILED BY _____ W.W.K.

DATUM 267.0

BOREHOLE TYPE Washboring NX Casing.

CHECKED BY _____ K.G.S.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY X P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT	W _P ——— W _L		
267.0	Groundlevel									
266.0	Black org. topsoil									
	Silty sand & gravel with traces of clay. Frequent boulders. dense to very dense.		1	SS	36	260				
258.5			2	SS	68					
8.5	Limestone									
	Bedrock.									
248.5						250				
18.5	End of borehole.					240				

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_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