

#65-F-33

W.P. #156-60

Hwy. #403

PROP. CROSSING

C.N.R

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: May 7, 1965

OUR FILE REF.

IN REPLY TO

(REVISED) - Pages 1, 2, 4, 5
MAY 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at C.N.R. and
Hwy. #403, Line 'A', Lot 24, Con. 2,
County of Brant, Twp. of Brantford,
District #24
W.J. 65-F-33 -- W.P. 156-60

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

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

KYL/MdeF
Attach.

7/2/65
(K. Y. Lo,
SUPERVISING FOUNDATION ENGINEER

cc: Messrs. ~~A. M. Toye~~ (2) *B. R. DAVIS*
~~H. A. Tregaskes~~
~~H. D. McMillan~~ *D. M. FARREN*
~~A. Gater~~ *(DESIGN WORK BY DIST 2)*
~~H. C. Dernier~~ *H. GREENLAND*
~~J. Roy~~ *T. J. KOVICH*
A. Watt

Foundations Office
Gen. Files ✓

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FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at C.N.R. and
Hwy. #403, Line 'A', Lot 24, Con. 2
County of Brant, Twp. of Brantford,
District #4
W.J. 65-F-33 -- W.P. 156-60

1. INTRODUCTION:

A request to carry out a foundation investigation at the C.N.R. and Hwy. #403, Line 'A', was received from Regional Bridge Location Engineer, Mr. G. Scott, dated November 3, 1964.

It is proposed to erect a new bridge at the crossing of Hwy. #403, Line 'A' and the C.N.R. The site is located between the Cities of Paris and Brantford, County of Brant, Con. 2, Lot 24. At this location, the chainage of Hwy. #403, Line 'A' is from 347+09 to 351+88.

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 between the Cities of Paris and Brantford, approximately $2\frac{1}{2}$ miles South of the intersection of Hwys. #2 and #5, County of Brant, Twp. of Brantford, Con. 2, Lot 24. The surrounding area is generally flat terrain.

Physiographically, the site is located in the so-called Norfolk Sand Plains.

cont'd. /2 ...

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, five sampled boreholes and five dynamic cone penetration tests, were carried out at this site. Split-spoon samples were taken at various depth intervals; samples recovered in the split-spoon were used to determine the following physical properties:

1. Natural Moisture Content.
2. Grain Size Distribution.

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. 65-F-33A, is based upon this information.

4.2) Silty Sand to Sandy Silt with Traces of Clay and Gravel - Loose to Very Dense:

This layer, which extends to the depth investigated, was found immediately below the topsoil. It may be classified a loose to very dense with an average 'N' value in excess of 100 blows/foot. 'N' values varied from 5 blows/foot to over 150 blows/foot.

cont'd. /3 ...

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

4.2) Silty Sand to Sandy Silt with Traces of Clay and Gravel - Loose to Very Dense: (cont'd.) ...

Grain distribution curves indicated that this stratum is composed of 48% sand, 45% silt, 4% gravel and 3% clay. The average moisture content in this layer was found to be 16.6%, ranging from 6.8% to 25.6%.

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found to be between the elevations 770.9 and 772.7. It may be assumed that the ground water level will vary with the seasons of the year.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new bridge at the future crossing of Hwy. #403, Line 'A' and the C.N.R. Either a subway or an overhead bridge will be constructed and the foundation investigation has been carried out to accommodate both possibilities.

The railway embankment at the site area ranges from about 5 to 12 feet in height, and the subsoil material below this, consists of loose to very dense deposits of silty sand to sandy silt with traces of gravel. Foundations for the two possible types of structure are discussed separately, below.

Subway -

A subway type structure at this site should be supported on spread footings founded at or below el. 772.0 in which case, an

cont'd. /4 ...

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

Subway - (cont'd.) ...

allowable net pressure of 3.5 t.s.f. may be assumed for design purposes. The depth of the footings should be sufficient so as to ensure at least 4 feet of cover for frost protection. It is important to note that the subsoil at the site is highly susceptible to conditions of unbalanced hydrostatic head, and it will therefore, be necessary to take adequate precautions if excavations are carried out below the ground water level. Boiling of the excavations can be prevented by lowering the ground water to below the base level by the use of wellpoints, or by driving interlocking steel sheeting around the excavation to a depth below the base equal to the height of the prevailing ground water level above it.

No stability problems are anticipated for 2:1 cut slopes on the structure approaches provided adequate drainage and sand filters are provided to prevent seepage from the surface of the side slopes.

Overhead -

In the event that the new structure will be an overhead bridge, it is recommended that the bridge piers be founded on spread footings placed approximately 7.0 feet below existing original ground level. For design purposes, an allowable net pressure of 2.5 t.s.f. may be assumed in this case. The proposed abutments may be founded within the approach fills on large displacement end-bearing piles. For 12 $\frac{3}{4}$ " O.D. steel tubes or 12" \emptyset concrete piles driven to approximate el. 770.0, it is estimated

cont'd. /5 ...

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

Overhead - (cont'd.) ...

that a design capacity of 60 tons per pile will be achieved. Pile driving should be controlled in the field by means of the Hiley Formula according to D.H.O. Standards DD 1218 and 1219.

Since the ground water level is fairly low over the site area, no dewatering problems are anticipated for the approximate 7-foot deep excavations.

No stability problems are anticipated for the structure approach embankments provided standard 2:1 slopes are constructed.

7. SUMMARY:

A foundation investigation at the site of the proposed crossing of Hwy. #403, Line 'A' and the C.N.R. in Brantford Twp. is reported.

Subsoil at the site consists of deposits of silty sand to sandy silt with traces of gravel. The relative density of the subsoil ranges from loose to very dense, but is generally very dense.

Recommendations pertaining to foundations for a subway type structure or an overhead structure, are given in Section 6 above.

No stability problems are anticipated for cuts or embankments.

cont'd. /6 ...

8. MISCELLANEOUS:

The field work, performed during the period from March 29 to April 9, 1965, 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 also reviewed this report.

May 1965

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 65-F-33

LOCATION Hwy 403 Line "A" & CNR Ch 347+09 60'-0" Lt.

ORIGINATED BY W.W.K.

W.P. 156-60

BORING DATE March 29-30, 1965.

COMPILED BY W.W.K.

DATUM 777.4

BOREHOLE TYPE Washboring - BK Casing.

CHECKED BY SK

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		20	40	60	80	100	WP	W	WL		
777.4	Groundlevel															
775.4	Black org. topsoil															
2.0	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	6	770										
			2	SS	54											
			3	SS	73											
			4	SS	43	760										
			5	SS	52											
			6	SS	100											
			7	SS	115	750										
				for 11"												
			8	SS	147	740										
				for 10"												
			9	SS	158	730										
				for 9"												
730.9	End of borehole.					720										
46.5																

WL El 771.3
Observed in casing.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 65-F-33 LOCATION Hwy 403 line "A" & C.N.R. Ch 348/19 32'-0" Lt. ORIGINATED BY W.W.K.
W.P. 156-60 BORING DATE April 2, 1965. COMPILED BY W.W.K.
DATUM 783.9 BOREHOLE TYPE Washboring - BX Casing. CHECKED BY W.W.K.

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		20	40	60	80	100	WP	W	WL		
783.9	Groundlevel															
782.2	Black org. topsoil															
1.7																
	Silty sand to sandy silt with traces of clay and gravel.		1	SS	19	780							o			
			2	SS	59	770							o			
	Loose to very dense.		3	SS	51	760							o			
			4	SS	80	750							o			
					for 3"	740							o			
			5	SS	141	730							o			
					for 8"											
727.4			6	SS	164											
56.5	End of borehole.				for 8"											
						720										

WL El 771.7
Observed in
casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 65-F-33

LOCATION Hwy 403 Line "A" & CNR Ch 349/29 52'-0" Lt.

ORIGINATED BY W.W.K.

W.P. 156-60

BORING DATE April 5, 1965.

COMPILED BY W.W.K.

DATUM 786.6

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY W.W.K.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	W	WL			
786.8	Groundlevel																
785.3	Black org. topsoil																
1.5	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	19	780											
			2	SS	31												
			3	SS	104	770											
					for 10"												
			4	SS	105	760											
					for 9"												
			5	SS	80	750											
					for 3"												
740.3			6	SS	80	740											
46.5	End of borehole.				for 3"												
						730											

WL El 771.3
Observed in casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 65-F-33

LOCATION Hwy 403 Line "A" & CNR Ch 350/39 24'-0" Lt.

ORIGINATED BY W.W.K.

W 156-60

BORING DATE April 6-7, 1965.

COMPILED BY W.W.K.

DATUM 789.9

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY

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		20	40	60	80	100	WP	WL	W		
789.9	Groundlevel															
787.9	Black org. topsoil															
2.0	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	6	780										
			2	SS	5											
			3	SS	87											
			4	SS	80	770										
			for 5"													
			5	SS	147	760										
			for 11"													
			6	SS	152	750										
			for 8"													
738.4			7	SS	151	740										
51.5	End of borehole.		for 8"													
						730										

WL El 772.7
Observed
in casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 65-F-33

LOCATION Hwy 403 Line "A" & CNR Ch 348/48 24'-0" Rt.

ORIGINATED BY W.W.K.

W.P. 156-60

BORING DATE March 31, 1965.

COMPILED BY W.W.K.

DATUM 789.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY

[illegible]

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 65-F-33LOCATION Hwy 403 Line "A" & CNR Ch 349/48 64'-0" Rt.ORIGINATED BY W.W.K.W.P. 156-60BORING DATE March 30, 1965.COMPILED BY W.W.K.DATUM 791.0BOREHOLE TYPE Washboring BX Casing.CHECKED BY SL

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		20	40	60	80	100	WATER CONTENT %				
							SHEAR STRENGTH P.S.F.					WP	W	WL		
791.0	Groundlevel					790										
789.5	Black org. topsoil															
1.5	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	17											
			2	SS	25	780										
			3	SS	61											
			4	SS	142	770										
					for 10"											
			5	SS	148											
					for 9"											
			6	SS	80	760										
					for 2"											
						750										
744.5			7	SS	80											
46.5	End of borehole.				for 2"	740										

WL El 771.3
Observed
in casing.

WL El 771.3
Observed
in casing.

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-33LOCATION Hwy 403 Line "A" & CNR Ch 350/78 32'-0" Rt.ORIGINATED BY W.W.K.W.P. 156-60BORING DATE April 7, 1965.COMPILED BY W.W.K.DATUM 790.9BOREHOLE TYPE Washboring BX Casing.CHECKED BY dl

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — w _L	PLASTIC LIMIT — w _P	WATER CONTENT — w	BULK DENSITY	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60			80	100
790.9	Groundlevel					790								
788.9	Black org. topsoil.													
2.0	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	12	780								
			2	SS	48									
			3	SS	140									
				for 9"		770								
			4	SS	80									
				for 5"										
			5	SS	158	760								
				for 10"										
						750								
744.4			6	SS	80	740								
46.5	End of borehole.			for 3"										

For 8"

WL El 771.6
Observed in casing.

WL El 771.6
Observed in casing.

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-33LOCATION Hwy 403 Line "A" & CNR Ch 351/88 - 72'-0" Rt.ORIGINATED BY W.W.K.W.P. 156-60BORING DATE April 8, 1965.COMPILED BY W.W.K.DATUM 791.4BOREHOLE TYPE Washboring BX Casing.CHECKED BY HL

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		20	40	60	80	100	WP	W	WL		
791.4	Groundlevel															
789.4	Black org. topsoil					790										
2.0																
	Silty sand to sandy silt with traces of clay and gravel.		1	SS	2											
			2	SS	4	780										
	Loose to very dense.		3	SS	9											
			4	SS	72	770										
			5	SS	132	760										
749.9			6	SS	141	750										
41.5	End of borehole.			for 9"												
						740										

WL El 771.4
Observed in casing.

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 INVESTIGATION REPORT
For

Proposed Crossing at C.N.R. and
Hwy. #403, Line 'A', Lot 24, Con. 2,
County of Brant, Twp. of Brantford,
District #24
W.J. 65-F-33 -- W.P. 156-60

1. INTRODUCTION:

A request to carry out a foundation investigation at the C.N.R. and Hwy. #403, Line 'A', was received from Regional Bridge Location Engineer, Mr. G. Scott, dated November 3, 1964.

It is proposed to erect a new bridge ^{at the crossing of} ~~to carry~~ Hwy. #403, Line 'A' ^{and} ~~over~~ the C.N.R. The site is located between the Cities of Paris and Brantford, County of Brant, Con. 2, Lot 24. At this location, the chainage of Hwy. #403, Line 'A' is from 347+09 to 351+88.

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 between the Cities of Paris and Brantford, approximately $2\frac{1}{2}$ miles South of the intersection of Hwys. #2 and #5, County of Brant, Twp. of Brantford, Con. 2, Lot 24. The surrounding area is generally flat terrain.

Physiographically, the site is located in the so-called Norfolk Sand Plains.

4. SUBSOIL CONDITIONS: (cont'd.) ...4.2) Silty Sand to Sandy Silt with Traces of Clay and Gravel - Loose to Very Dense: (cont'd.) ...

Grain distribution curves indicated that this stratum is composed of 48% sand, 45% silt, 4% gravel and 3% clay. The average moisture content in this layer was found to be 16.6%, ranging from 6.8% to 25.6%.

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found to be between the elevations 770.9 and 772.7. It may be assumed that the ground water level will vary with the seasons of the year.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

As was described in the previous paragraphs, the subsoil basically consists of silty sand to sandy silt with traces of gravel and clay with a relative density ranging from loose to very dense. The investigation has revealed that within the upper 20 feet of the deposit, the properties are such that adequate support for spread footings could be obtained. In the case of the proposed piers, it is recommended to place the footings approximately 7'-0" below existing original ground levels at the following approximate elevations:

Pier 1	--	Elev. 776.0
Pier 2	--	Elev. 779.0
Pier 3	--	Elev. 783.0
Pier 4	--	Elev. 783.0

cont'd. /4 ...

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

A net allowable pressure of 2.5 t.s.f. may be assumed for design purposes.

The proposed abutments should be founded within the approach fills on $12\frac{3}{4}$ " x $\frac{1}{4}$ " steel tube piles driven to approximate El. 770.0. A design load of 50 tons per pile, may be used in this event.

Since the subsoil consists of relatively dense material and the ground water level is low, dewatering should not present problems. No stability problems are anticipated with the approach fills.

7. SUMMARY:

1) The stratification of the soil which consists of silty sand to sandy silt, is quite uniform. The density of the material encountered varies from loose to very dense.

2) Because of the stiffness of the upper layers, spread footings may be used for the proposed piers with a design load of 2.5 t.s.f. The bottom of the pier footings should be approximately 7 ft. below existing ground levels.

3) $12\frac{3}{4}$ " x $\frac{1}{4}$ " steel tube piles driven through the fill are recommended for the abutments. Piles for the abutments should be driven to approximately Elev. 770.0.

cont'd. /5 ...

7. SUMMARY: (cont'd.) ...

4) Dewatering of the excavations should not present major problems.

5) No stability problems are anticipated for the approach fills.

8. MISCELLANEOUS:

The field work, performed during the period from March 29 to April 9, 1965, 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 also reviewed this report.

May 1965

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DOWN LOND 8 DEC 4/68 11:00A

A G STERMAC - PRINCIPAL FOUNDATION ENGINEER MAT & TESTING DIV
RE WP 156-00, HWY 403 & C N R GRADE SEPARATION TWP OF BRANTFORD
DIST 4 HAMILTON

WOULD YOU SEND US A COPY OF THE FOUNDATION REPORT FOR THIS PROJECT
REPORT NUMBER IS W J 65-F-33.
A MCCONNELL FUNCTION PLANNING

*copy sent
1/2/68*

*To Hamilton Dec 4 for
copy
Jared Dec 6/68*

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MEMORANDUM

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

FROM: Bridge Division,
Downsview, Ontario.

DATE: November 3, 1964.

Our File Ref.

IN REPLY TO

SUBJECT: W.P. 156-60
Bridge Site 1-140
C.N.R. Overhead
Hwy. 403 - District 2

We are sending to you herewith two prints of Bridge Site Plan E-3979-1 on which we have marked in red the proposed location of the above structure.

Please make the necessary arrangements for a Foundation Soils Investigation. We anticipate your Foundation Investigation Report on or before June 2nd., 1965.

John Scott

JS/12

cc. C. McCollie
cc. A. Fitzgibbon
cc. N. D. Smith

A. Scott,
Regional Bridge Location Engineer.

June 1965

65-F-3B