

MEMORANDUM

22-64-39

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

FROM: F. DeVisser,
Bridge Location Engineer.

DATE: December 7, 1962

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 211-61-2, Site 25-44
Humber River at Cedar Mills
Arch Widening, 2.6 miles south
of Palgrave, Hwy. #50, Dist. #6.

BA 1437

Attached is one print of preliminary plan
D 5174-P for the subject structure.

If you have any comments, please let us
know.

F. DeVisser

FDeV/rt

F. DeVisser,
Bridge Location Engineer.

Note Jan 14th 1963.

Sheet piling not needed from the hydraulics point of view. A note should be put on the drawing for the contractor advising him of the predominantly granular nature of the subsoil and of the necessity to provide an adequate dewatering scheme.

Frank E. Ebbes

A. Stermac

62-F-33 and 62-F-32 W.P.

Discussion with Jack Reid - Bridge Office

Barrel arch culvert extensions footings will be founded on piles - Subsoil is basically silt and sand. Water level is about 6-8 ft above footing excavation bottom and therefore piping could occur.

Since structure will be on piles, some piping could be tolerated. It is therefore suggested that a cofferdam be built, a sump be excavated and the pump intake covered with gravel. This intake has to be below the excavation bottom. It is believed that in this manner the steel sheet piling can be dispensed with.

This recommendation should be checked with hydrologist to ascertain whether sheetpiling is necessary for scour protection.

Nov 22, 1962

A. Stumey

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)
Attention: Mr. S. McCombie.

May 29, 1962.

D.H.C. FOUNDATION INVESTIGATION
REPORT.
W.J. 62-F-32 -- W.P. 211-61-2.

Re: Proposed Humber River Barrel Arch
Extension, 2.5 Mi. South of Palgrave, (2 6 10)
Hwy. #50 - District #6 - Toronto.

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

We believe you will find the factual data and
recommendations contained therein, adequate for your future
design work. Should you require further information with
respect to this project, please feel free to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
I. C. Campbell
C. Fraser
T. J. Kovich
J. Roy
J. E. Gruspier
B. E. Saint
F. Norman
A. Watt
Foundations Office
Gen. Files.

KyLo.
K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

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-

FOUNDATION INVESTIGATION

For

Proposed Humber River Barrel Arch
Extension, 2.5 Mi. South of Palgrave,
Hwy. #50 - District #6 - Toronto,
W.J. 62-F-32 -- W.P. 211-61-2.

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed Arch Extension at the Humber River and Hwy. #50, 2.5 Mi. South of Palgrave, was received from the Bridge Location Section, dated March 13, 1962.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the location of the proposed structure extension. Presented in this report are the results of this investigation, together with recommendations pertaining to the design of the proposed foundations, approach cuts and embankment.

2. DESCRIPTION OF THE SITE:

The site is situated some 2.5 mi. south of Palgrave where Hwy. #50 crosses the Humber River.

The centre line of the proposed new crossing is located approximately 55' east of the existing centre line of Hwy. #50.

The topography of the area consists of a rolling knob and basin relief. The site is intersected by the River Humber which is some thirty feet wide and about two feet deep, and follows a meandering course. On the south bank of the river, the highway cuts through the knob of a hill; on the north bank, the ground is

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

generally flat and in places, swampy, and the highway is built on an embankment about twenty feet in height.

The site is located in the physiographic region of Oak Ridges. They consist of interlobate moraines built between two opposing lobes of a glacier. Much of this moraine is covered with sandhills and coarse outwash.

3. FIELD INVESTIGATION PROCEDURE:

A total of three boreholes and three dynamic cone penetration tests was carried out during the course of the field investigation. Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. Undisturbed soil samples were obtained by means of 2-inch I.D. Shelby tubes, which were either pushed into the soil by hand, or hammered by means of a 140-lb. hammer. Disturbed samples were secured by means of a standard split-spoon sampler driven into the soil with an energy of 350 ft.-lbs. per blow. Dynamic cone penetration tests were carried out adjacent to each borehole. Driving energy to advance the cone was 350 ft.-lbs./blow.

The locations and elevations of all boreholes are shown on Drawing #62-F-32A, which accompanies this report.

4. LABORATORY TESTS:

Soil samples were visually examined and classified at the site as well as in the laboratory. For more precise classification and identification, laboratory tests were carried out on representative samples. These tests consisted of Atterberg limits,

cont'd. /3 ...

4. LABORATORY TESTS: (cont'd.) ...

moisture content determinations and grain size distributions. Results of the latter are plotted on a grain size distribution chart, and are attached under Appendix #1. Other laboratory test results are shown on the borehole logs which form part of this report.

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Subsoil at the site consists of about five different deposits. The boundaries of the main layers are shown on the accompanying borelog sheets. The estimated stratigraphical profiles and cross sections shown on Drawing #62-F-32A are based upon this information. From ground level downwards, the various soil types are as follows:

5.2) Organic Material with Sand:

This material was observed only in B.H. #2 and #3 and extended from ground level to a depth of about 8.0'. The constituent material is predominantly of an organic nature occurring in layers about 3 inches thick, parted by thin seams of fine to coarse sand. The average moisture content of the composite material of the deposit is about 40%. The consistency of the deposit may be classified as generally soft.

cont'd. /4 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.3) Silty Fine Sand to Fine Sandy Silt:

Following the organic material in B.H. #2 and #3, a silty fine sand to fine sandy silt deposit was encountered. The depth of this deposit is 20 - 24 ft., extending from about elevation 816.0 to 792.0. In B.H. #1, the same deposit was found to extend from elevation 806.0 to 786.0, the upper boundary being about 28 feet below ground level. The moisture content of the material ranges from 15 - 22%. The 'N' values measured by means of the standard penetration tests, vary from 5 to 34 blows/ft. indicating a loose to dense relative density, increasing with depth.

5.4) Clayey Silt:

This material immediately underlies the silty fine sand to fine sandy silt stratum in B.H. #3, extending for a depth of about 17'. The same deposit was observed in B.H. #1 in two different layers. The upper layer extended from ground level to 28.0' and the lower layer from 47.0' to at least 71.5', the latter being the full depth of the boring. The plastic limit of the material was found to range from 10% to 15% and the liquid limit from 14% to 21%. The moisture content was found to be generally close to the plastic limit. The consistency of the upper layer in B.H. #1 was found to vary from firm to hard, whilst in the other layers, the consistency was generally hard.

cont'd. /5 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.5) Silty Fine Sand to Fine Sand:

This material was found in B.H. #3, extending from elevation 774.0' to 762.0', the latter being the end of the borehole. The moisture content of this deposit, as determined in the laboratory, was found to be in the neighbourhood of 20%. According to the 'N' values obtained by means of the standard penetration test, the relative density can be described as compact.

5.6) Stratified Layers of Clayey Silt, Silty Fine Sand and Fine Sand:

This deposit was encountered only in B.H. #2 and extended from a depth of 32.0' to 60.5', the latter being the full depth of the borehole. The different layers were generally one to two inches in thickness and occurred in random order. The properties of the different materials are similar to the corresponding materials described in the previous paragraphs. The 'N' values of the deposit varied randomly from 23 to 80, indicating a compact to very dense relative density.

6. GROUND WATER CONDITIONS:

Ground water observations were carried out during the field investigation. The water level in the boreholes was at elevations, as follows:

B.H. #1 = 823.0'
B.H. #2 = 820.5'
B.H. #3 = 821.5'

Generally, the ground water level in the boreholes is at the elevation of the river water level, or slightly above it.

7. DISCUSSION AND RECOMMENDATIONS:

A 39.0' span barrel arch bridge - as an extension of the existing one - is proposed for this location.

At the location of the proposed extension, subsoil consists of deposits of silty fine sand and clayey silt. At the probable elevation of the proposed footing bases, the upper subsoil is generally loose to compact silty fine sand to fine sandy silt.

Because of the relatively low 'N' values, the permissible bearing capacity of this material is not sufficient to support the proposed structure on a spread footing type of foundation. The water level would not only necessitate an extensive dewatering scheme, but would reduce the safe bearing capacity of the stratum to approximately half of the calculated value. For the aforementioned reasons, it is recommended to use piled foundations for both footings. The calculated safe design load for 30' long by 12" diameter timber piles is 20 T/pile. Alternatively, in the case of 40' long 12 $\frac{3}{4}$ " x .203" steel tubes, the safe design load is estimated to be 45 T/pile.

Information on the foundation of the existing structure is not available, but there are indications that the structure is supported on piles.

As hydrological information is at present, not available, the exact footing elevations cannot be decided. This point should be clarified by consulting with the Bridge Planning Section, as soon as this information is available.

cont'd. /7 ...

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

A dewatering scheme will be necessary if it is desired to place the concrete for the footings in the dry. To prevent the excavations boiling, it is recommended that steel sheet piling be driven to a depth below the excavation bottom equal to the height of the prevailing water level above it. Because of relative low permeability indicated by the grain size distribution of the subsoil, it is felt that a well point dewatering scheme would not be practical.

In order to eliminate the effect of differential settlements between the existing and new structure, the extension should be built as an independent unit. At present, the ends of the existing arch are sloped at 2:1 to conform with the embankment. Prior to constructing the extension the east end of the existing arch should be reconstructed to the vertical. A vertical expansion joint may then be formed between the existing and new sections.

No stability problems are anticipated for the approach fills or cut sections provided they are constructed with side slopes of 2 horizontal to 1 vertical.

8. SUMMARY:

It is proposed to construct a new Barrel Arch Bridge extension at the Humber River and Hwy. #50, 2.5 Mi. south of Palgrave.

cont'd. /8 ...

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

Subsoil at the site consists of deposits of silty fine sand to fine sandy silt, clayey silt and silty fine sand to fine sand. The deposits have varying depths, the denseness or consistency of the strata generally increasing with depth.

Recommendations pertaining to the foundation of the proposed structure are as follows:

- (1) Due to the low penetration resistance and the possible expensive dewatering problems likely to be encountered in the silty fine sand to fine sandy silt layer, a spread footing type foundation at this site is not recommended.
- (2) The structure can be supported on friction piles.
- (3) Recommendations were given for the use of 30' long by 12" diameter timber piles with a design load of 20 T/pile, and alternatively, for the use of 40' long 12 $\frac{3}{4}$ " x .203" steel tubes with a design load of 45 T/pile.
- (4) A dewatering scheme utilizing steel sheeting is recommended.
- (5) The new extension should be built as an independent unit to minimize the effect of possible differential settlement.
- (6) No stability problems are anticipated for the approach fills or cut sections, provided they are constructed with side slopes of 2 horizontal to 1 vertical.

cont'd. /9 ...

9. MISCELLANEOUS:

The field work, performed during the period from April 6th to 17th, 1962, together with the preparation of this report, was undertaken by Mr. A. K. Barsvary. The investigation was carried out under the general supervision of Mr. K. G. Selby, who reviewed this report.

Equipment used was owned and operated by F. E. Johnston Drilling Co., Ltd. of Ottawa.

May 1962.

1. The first part of the document is a list of the names of the persons who have been appointed to the various offices of the city government. The names are listed in alphabetical order, and each name is followed by the office to which he or she has been appointed. The names are: John A. Smith, Mayor; James B. Jones, Mayor Pro Tem; William C. Brown, Mayor Pro Tem; Thomas D. Green, Mayor Pro Tem; Charles E. White, Mayor Pro Tem; and so on.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 62-F-32 LOCATION Sta. 389+78, 27' Rt. of E ORIGINATED BY A.B.
W.P. 211-61 BORING DATE April 9 & 10, 1962. COMPILED BY B.K.
DATUM G.S.C. BOREHOLE TYPE Washboring BX Casing. CHECKED BY A.B.

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		20	40	60	80	100	WP	WL	W		
834.0 0.0	Groundlevel														
	Clayey silt firm to hard.		1	SS	5										
			2	SS	26										
	Grey coloured.		3	SS	30										
			4	SS	29										
			5	SS	48										
806.0 28.0	Silty fine sand to fine sandy silt.		6A	SS	21										
	Compact.		6B	SS	15										
	Grey coloured.		7	SS	20										
			8	SS	14										
			9	SS	21										
786.0 48.0	Clayey silt hard to very stiff.		10	SS	45										
	Grey coloured.		11	SS	33										
			12	SS	27										
762.5 71.5	End of borehole.														

Penetration ends @elev. 818.0

W.L. in the borehole.

823.0'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 62-F-32

LOCATION Sta. 390/44 52' Rt. of E

ORIGINATED BY A.B.

W.P. 211-61

BORING DATE April 11 & 12, 1962.

COMPILED BY B.K.

DATUM G.S.C.

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY A. B.

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		BLOWS / FOOT					WATER CONTENT %				
							20	40	60	80	100	WP	W	WL		
							SHEAR STRENGTH P.S.F.									

						830.0										
824.5	Groundlevel															
0.0	Organic material with sand.															
819.5	Soft.		1	SS	1	820.0										
5.0	Fine sand with traces of organics.		1A	TW	PM											
816.5	Compact.		2	SS	19											
8.0			2A	TW	PM											
			3	SS	11											
	Silty fine sand to fine sandy silt.		4A	TW	PM											
			4	SS	21	810.0										
	Compact to dense Grey coloured.		5	SS	29											
			6	SS	34	800.0										
			7	SS	28											
792.5			8	SS	41	790.0										
32.0	Stratified layers of clayey silt.		9	SS	23											
	Silty fine sand and fine sand.		10	SS	28	780.0										
	Compact to very dense. Grey coloured.		11	SS	23											
			12	SS	80	770.0										
764.0						760.0										
80.5																

Penetration ends @elev. 775.5

W.L. in the bore-hole.

820.5

Penetration ends @elev. 775.5

W.L. in the borehole.
820.5

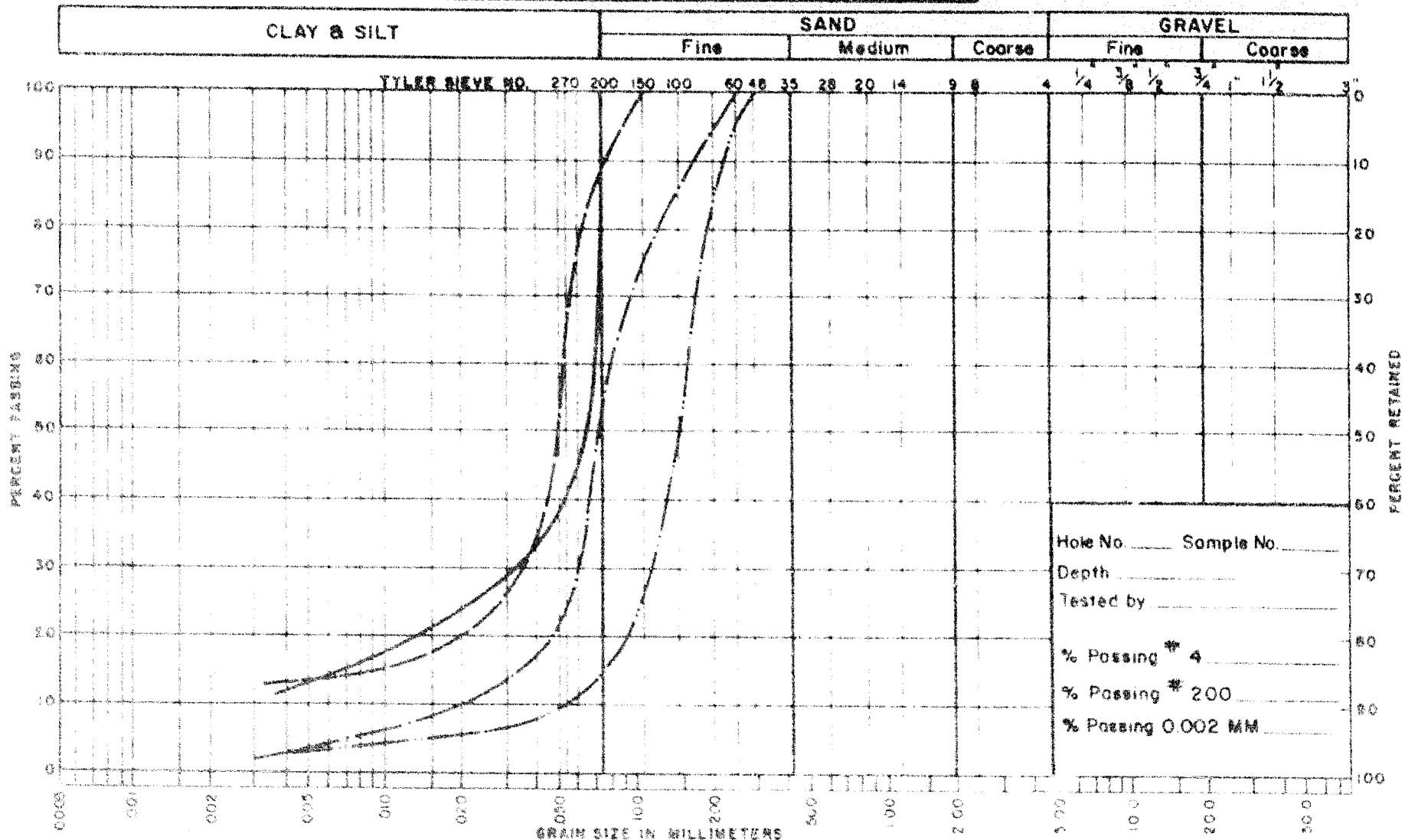
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

FOUNDATION SECTION

JOB 62-F-32 LOCATION Sta. 390/35 E ORIGINATED BY A.B.
W.P. 211-61 BORING DATE April 16 & 17, 1962. COMPILED BY B.K.
DATUM G.S.C. BOREHOLE TYPE Washboring BX Casing. CHECKED BY A.B.

[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES	BOREHOLE NO.	SAMPLE NO.
	2	6
	5	7
	3	10

DEPARTMENT OF HIGHWAYS - ONTARIO
 MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION
 Job No. 62 - F - 32 W.P. No. _____
 Location 2.5 M. SOUTH OF PALGRAVE ON HWY. 30

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_v	APPARENT COHESION
ϕ_b	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	$\pi = 3.1416$
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_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

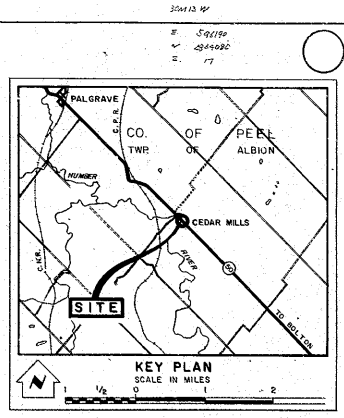
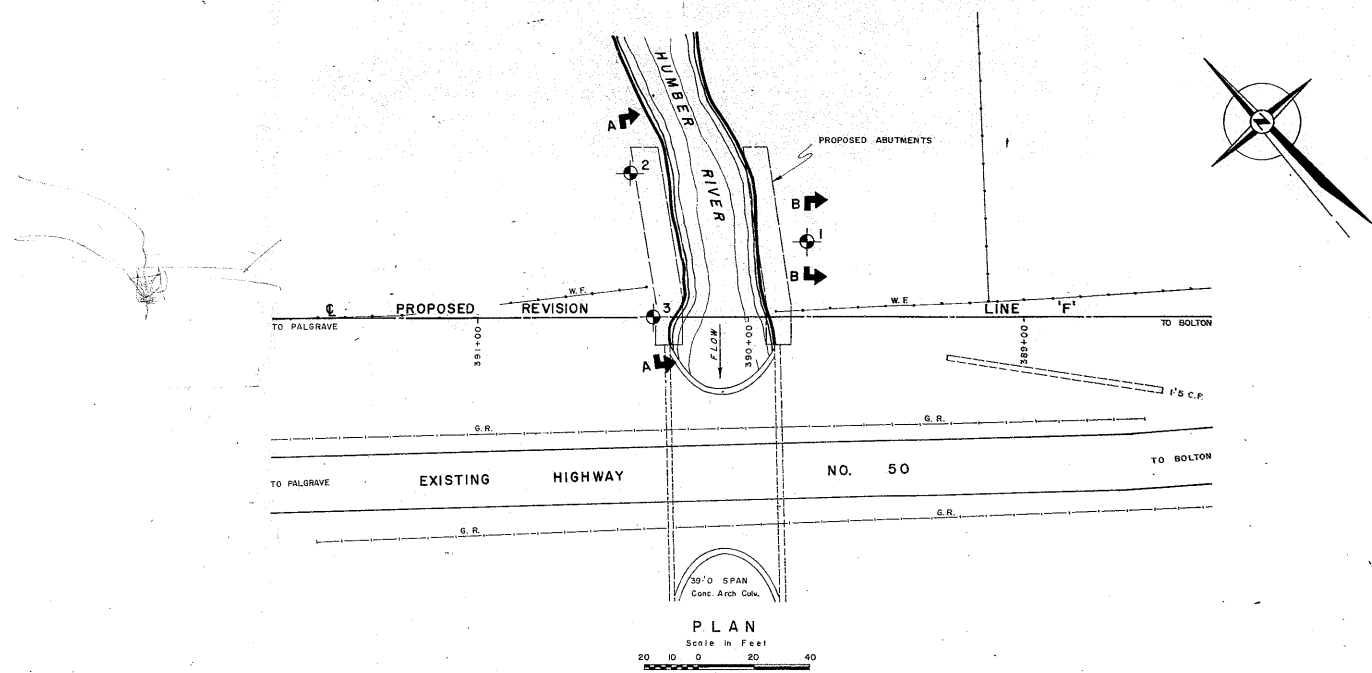
62-F-32

W.P. # 211-61-2

Hwy. # 50 :

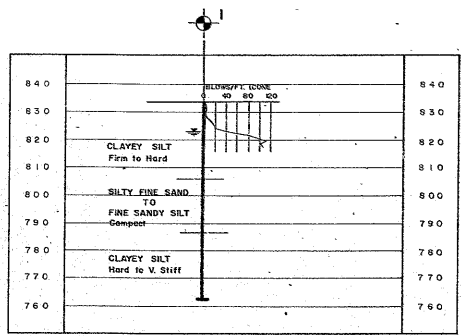
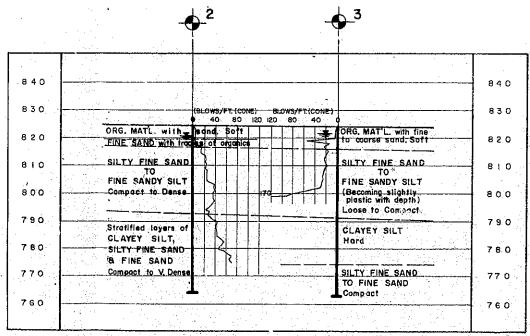
HUMBER RIVER

BARREL ARCH EXT.



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

NO.	ELEVATION	STATION	OFFSET
1	834.0	389+78	27' RT.
2	824.5	390+44	52' RT.
3	824.0	390+35	£



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.

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION		
HUMBER RIVER AND HIGHWAY NO. 50 REVISION LINE 'F'		
ORIGINATED A. BARSARY	DISTRICT NO. 6	DATE 7 MAY 1962
DRAWN D. MUMFORD	W.P. NO. 211-61-2	JOB NO. 62-F-32
CHECKED <i>[Signature]</i>	CONTRACT NO.	DRAWING NO.
APPROVED <i>[Signature]</i>		62-F-32A

