

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40P1-45

DIST. 4 REGION

W.P. No. 40-74-03

CONT. No.

W. O. No.

STR. SITE No. 1-171

HWY. No. B.S.A.R

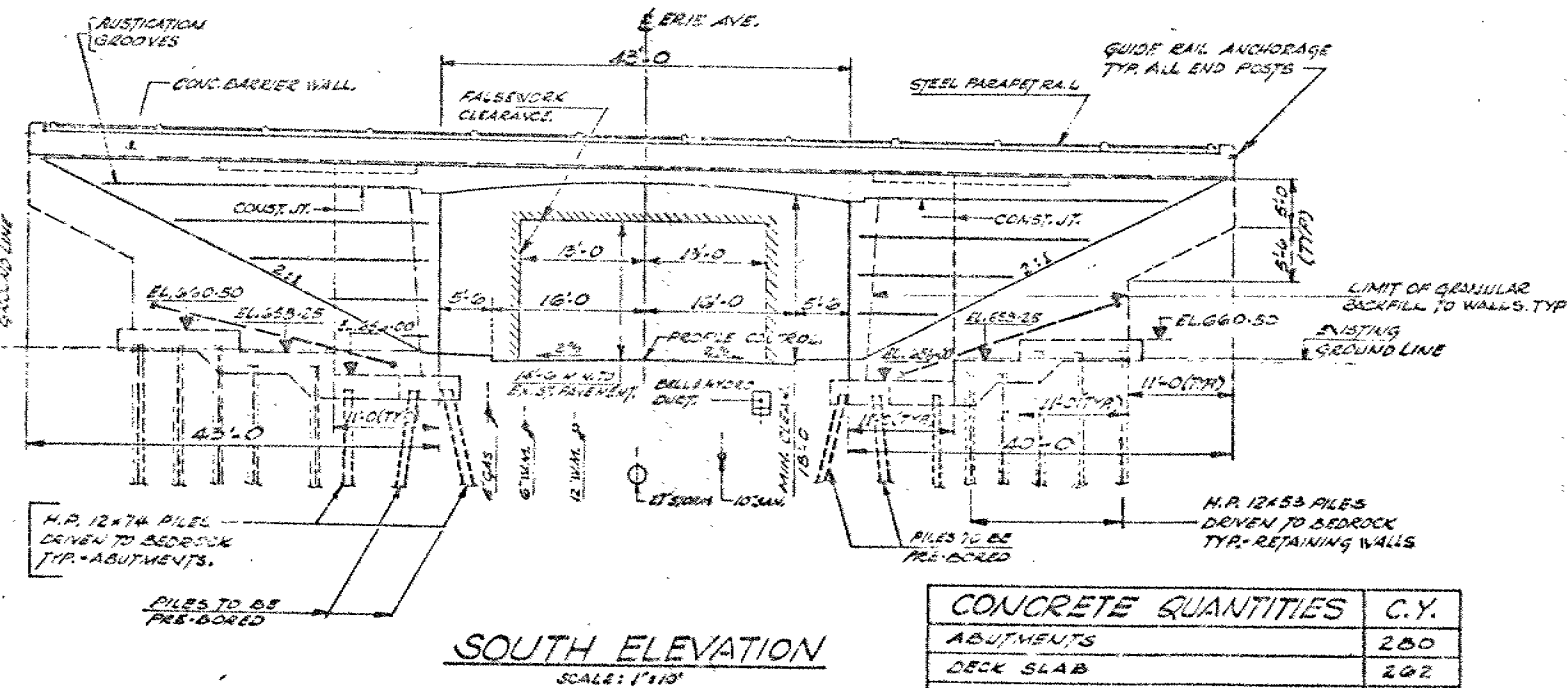
LOCATION BRANTFORD - ERIE AVE
OVERPASS

No of PAGES -

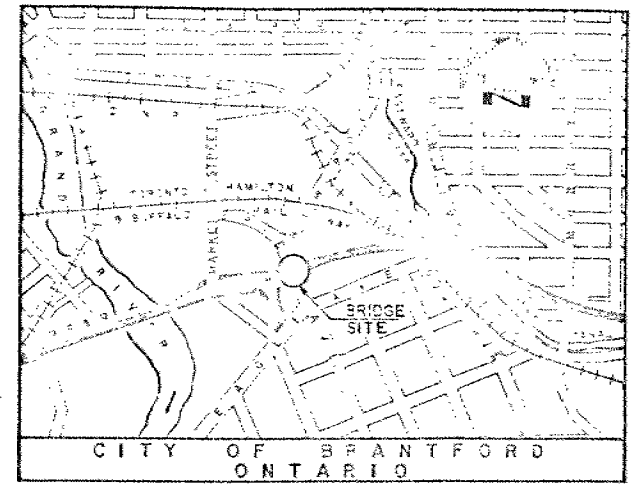
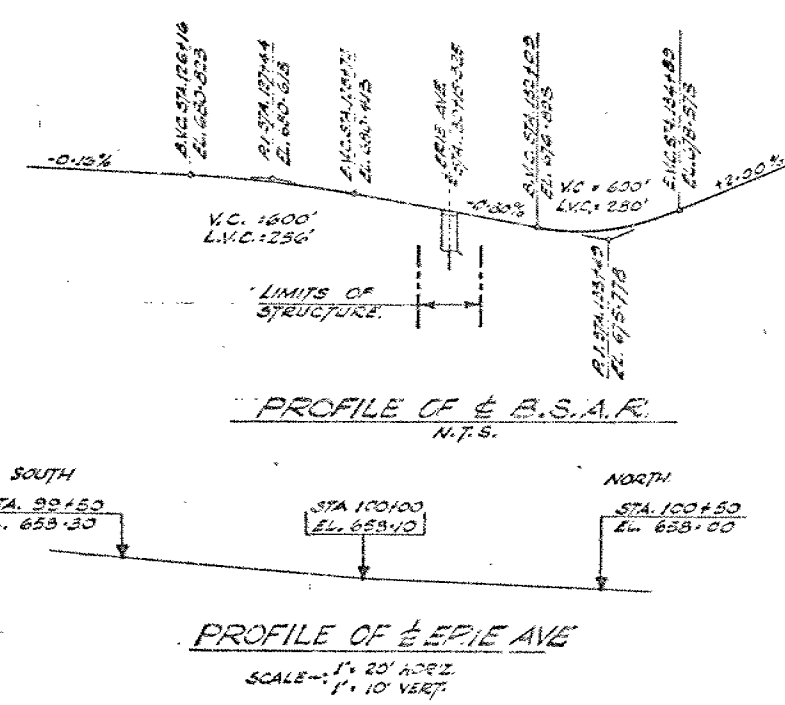
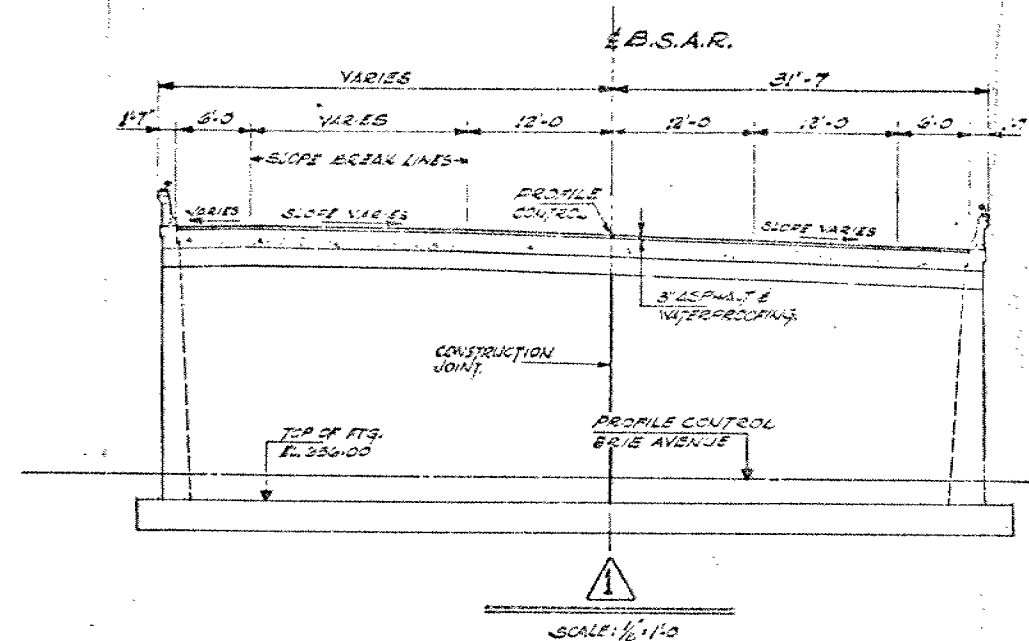
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



CONCRETE QUANTITIES	C.Y.
ABUTMENTS	250
DECK SLAB	102
RETAINING WALLS	30
BARRIER WALLS	20
APPROACH SLAB	62



KEY PLAN
SCALE : 1" = 800'

GENERAL NOTES:-

- CLASS OF CONCRETE FOOTINGS & APPROACH SLABS 3000 P.S.I.
DECK SLAB 4000 P.S.I.
- CLEAR COVER TO REIN. STEEL: DECK SLAB 2" TOP; 1 1/2" BOTTOM.
BARRIER WALL 1 1/2"
FOOTINGS & WALLS AGAINST SOIL 3"
ELSEWHERE 2"
- TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED IN THE TOP OF DECK SLAB, THE TOP LAYER OF BARS SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 2 1/2" TOLERANCE.

DRAWING LIST	
1	GENERAL PLAN
2	BORE HOLE LOCATIONS AND SOIL STRATS
3	LAYOUT OF FOOTINGS
4	REINFORCEMENT OF FOOTINGS
5	LAYOUT OF EAST & WEST ABUTMENTS
6	REINFORCEMENT OF EAST & WEST ABUTMENTS
7	LAYOUT OF GDECK
8	REINFORCEMENT OF GDECK
9	LAYOUT OF RETAINING WALLS
10	REINFORCEMENT OF RETAINING WALLS
11	APPROACH SLABS
12	CONCRETE BARRIER WALL
13	STEEL PARAPET RAILING
14	STANDARD DETAILS
15	STANDARD DETAILS
16	ELECTRICAL — PLAN & DETAILS
17	ELECTRICAL — STANDARD DETAILS
18	ELECTRICAL — STANDARD DETAILS

M.T.C. PRECISE B.M. 136-68
ELEVATION: 659-550

REVENUES			
	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

BRANTFORD SOUTHERN ACCESS ROAD
ERIE AVENUE OVERPASS

KING'S HIGHWAY No. B. S. A. R. DIST. No. 4.
CO. BRANT
TWP. CITY OF BRANTFORD LOT - CON. -

GENERAL PLAN

APPROVED _____				CONTRACT No.	
STRUCTURAL ENGINEER					
DESIGN	M. R.	CHECK	O. S. M.		
DRAWING	D. R. S.	CHECK	E. H. A.		
DATE	SEPT. 75	LOADING	HS-10-44		
			SITE No.	1-171	SHEET 01

TO BE USED
FOR ESTIMATING
PURPOSES ONLY

DATE NOV 3 1975



**Consulting
Engineers
& Planners**

FOR REDUCED PLAN



(cc: R.M. 110 LAB BLDG)

DEPARTMENT OF HIGHWAYS ONTARIO
MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.
ATTENTION: Mr. S. McCombie
OUR FILE REF.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.
DATE: April 16, 1970
IN REPLY TO **APR 22 1970**

SUBJECT:

40 P1-45
GEOCRE No.

FOUNDATION INVESTIGATION REPORT
For
The Erie Avenue Overpass on the
Proposed Brantford Expressway #2
City of Brantford
District No. 4 (Hamilton)
W.J. 70-F-1 -- ~~W.P. 70-63-08~~

NEW WP: 40-74-03 (PP) MAR 10/75

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/MdeF
Attach.
cc: Messrs. E. R. Davis
H. A. Tregaskes
D. W. Farren
W. Zonnenberg
C. R. Robertson
A. P. Watt (2)
J. Roy
B. A. Singh

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

Foundations Files ✓
Gen. Files

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF THE SITE.
 3. FIELD AND LABORATORY INVESTIGATIONS.
 4. SOIL CONDITIONS:
 - 4.1) General.
 - 4.2) Granular and Organic Fill.
 - 4.3) Sandy Gravel to Gravelly Sand.
 - 4.4) Stratified Clayey Silts and Silty Clays.
 - 4.5) Bedrock.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) General.
 - 6.2) Structure Foundations.
 - 6.3) Foundations at the Vicinity of Utilities.
 - 6.4) Approach Embankments.
 7. MISCELLANEOUS.
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FOUNDATION INVESTIGATION REPORT
For
The Erie Avenue Overpass on the
Proposed Brantford Expressway #2
City of Brantford
District No. 4 (Hamilton)
W.J. 70-F-1 -- W.P. 70-68-08

1. INTRODUCTION:

The results of a foundation investigation at the site of the Erie Ave. overpass on the proposed Brantford Expressway #2 is reported. The investigation was requested by Mr. A. P. Watt, Bridge Planning Engineer, Southwestern Region, in a memo dated December 3, 1969.

The subsequent field work and laboratory testing were supervised by the Foundation Section.

Following is a description of the site and subsoils, together with recommendations pertaining to foundations and approach fill stability.

2. DESCRIPTION OF THE SITE:

The site of the proposed Erie Ave. overpass is a busy commercial section of the City of Brantford. The width of the existing blacktop pavement of Erie Ave. is 35 ft. At the location of the future east abutment there is an existing building - (Brewers' Retail) with deep storage rooms in the basement. The location of the west abutment is a parking area and a drive-in restaurant at present.

Geologically the area lies somewhere around the border of the physiographic regions known as the "Norfolk Sand Plain" and the "Horsehoe Moraines". The beds of silts and sands are considered to be deltaic in glacial lakes Whittlesey and Warren. The varved silts and clayey silts were also deposited by Lake Warren, during a recession of the Wisconsin glacier.

3. FIELD AND LABORATORY INVESTIGATIONS:

Eight boreholes were drilled during the course of the field investigation, using a hollow stem continuous flight auger. The relative density of the granular layers and the consistency of the cohesive stratum were evaluated by performing Standard Penetration tests. A few field vane shear tests were also carried out within the firm and stiff cohesive layers. "Undisturbed" soil samples were taken, where possible, by means of Shelby tubes, which were advanced 18 inches into the soil hydraulically. Bedrock was proved at one borehole location by diamond drilling.

All the samples were visually identified in the laboratory by performing simple manual tests. Further laboratory tests of Atterberg limits, grain-size analyses, unconfined compression and quick triaxial shear strengths, were carried out on representative samples. Field and laboratory test results are plotted on the accompanying borelog sheets, while the stratigraphical soil profile is shown on Drawing #70-F-1A, at the end of this report.

4. SOIL CONDITIONS:

4.1) General:

The overburden at the proposed crossing consists of a recent deposit of sandy mixed fill with organic matter, followed by a layer of granular material, which in turn, is underlain by a stratified stratum of clayey silt. At approx. el. 601 ft. - 602 ft. dolomite bedrock was encountered. A brief description of the various deposits is given as follows:

4.2) Granular and Organic Fill:

The surficial deposit of the entire area investigated was found to be a recent fill. The fill is predominantly of a granular nature containing gravel and sand particles in excess of 50%. At certain boreholes, cinders, pieces of wood, fragments

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

4.2) Granular and Organic Fill: (cont'd.) ...

of brick and other rubbish, were recovered with some decomposed organic substances. The overall thickness of this recent fill varies between 10 ft. and 18 ft. Penetration 'N' values were noted to range from 4 blows per ft. to 47 blows per ft., corresponding to a very loose to dense relative density.

4.3) Sandy Gravel to Gravelly Sand:

Underlying the fill, a 2.5 ft. - 5 ft. thick sandy gravel to gravelly sand layer was observed, except in the holes placed along the sunken alley (B.H.'s #5, 5A and 6. See Drawing #70-F-1A). The relative density of this deposit is compact to very dense with penetration resistances ranging from 18 blows per ft. to 54 blows per ft. Grain-size analyses resulted in 43 - 67% gravel, 30 - 53% sand, and 3 - 4% silt and clay size particles within the samples tested. The natural moisture content of the stratum was measured to be 8 - 10%.

In B.H.'s #5 and 5A, placed at the sunken alley adjacent to the Brewers' Retail store, some concrete was hit by the auger, under the fill material at el. 645 ft. The thickness of the concrete is not known, but the approx. easterly edge of it is marked on the site plan.

4.4) Stratified Clayey Silts and Silty Clays:

This cohesive stratum was found in every borehole extending down to the bedrock surface, the overall thickness being 35 - 38 ft. The deposit is irregularly stratified; the seams are usually near horizontal, some contorted varves, however, were also noted. Among the seams pure silts, clayey silts, silty clays and clays were identified with a wide variation of colours (brown, red, grey). The thickness of the seams ranges from 1/16 of an inch to several inches. The average values of plastic limits of the clayey silts were estimated to be 20%,

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

4.4) Stratified Clayey Silts and Silty Clays: (cont'd.) ...

the silty clays 21%, and those of liquid limits of the clayey silts 26% and the silty clays 45%. Laboratory unconfined compression and quick triaxial tests resulted in undrained shear strengths ranging from 750 PSF to 2900 PSF, indicating firm to very stiff consistencies. For estimating purposes an average value of 1300 PSF was used, with bulk density of 125 PCF.

4.5) Bedrock:

Bedrock was proved by diamond drilling in Borehole #6, at the location of the proposed east approach fill. The rock surface was estimated by using the known bedrock elevation at the neighboring Market St. overpass as well. The drilling resulted in 100% recovery in the AXT size core barrel, and the core was identified to be dolomite of the Lockport Formation. The upper surface of the rock is taken to be at el. 601 - 602 ft.

5. GROUNDWATER CONDITIONS:

The groundwater level was found to lie between el. 646.5 ft. and 638 ft. In most of the borings the water level is within the sandy gravel aquifer; at the sunken alley, however, the water level is depressed by an extensive storm sewer system. This area, right behind the Brewers' Retail building, has actually the lowest ground elevation within the entire city.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

The proposed expressway will cross Erie Ave. by means of a three-span twin overpass structure. The future grade of the expressway at the crossing is designed to be around el. 678 ft. - 679 ft., resulting in approach fills of 20 - 27 ft. heights.

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

6.1) General: (cont'd.) ...

As discussed earlier, subsoils at the site consisted of a 10 - 18 ft. thick fill, followed by sandy gravels and stratified clayey silts. Sound bedrock lies around el. 601 - 602 ft.

6.2) Structure Foundations:

On account of the loose relative density and the organic contamination of the uppermost fill material, spread footings within this stratum are ruled out. Lowering the footings into the sandy gravel layer would result in excavations in excess of 10 ft.; furthermore, dewatering problems might arise in view of the permeable nature of the granular deposit.

It is therefore believed that piled foundations will be the most economical solution for this crossing. Steel H-piles should be driven to refusal on bedrock, which will be reached around el. 601 ft. - 602 ft. The full structural strength of the particular pile used may be employed on the piles, provided that they are supported on sound rock. The caps may be placed at some four ft. below finished ground. In contemplating perched abutments, pile caps may be formed within the approach fills. No bouldery material should be placed at the location of the abutments if the latter method of construction is adopted.

As was mentioned under Section (4.3), a concrete slab was found at el. 645 ft. near the location of the proposed east abutments. This concrete, together with the concrete basement floor of the existing building, must be removed prior to pile driving.

6.3) Foundations at the Vicinity of Utilities:

Several underground utilities exist near the proposed footings. When piles are to be driven adjacent to existing utilities, special precautions must be taken to ensure that no damage results. We suggest that the following procedure be adopted:

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

6.3) Foundations at the Vicinity of Utilities: (cont'd.) ...

- (a) Where piles will be 12 ft. or more from the edge of a utility, no special precaution need be taken.
- (b) All piles closer than 12 ft. from the utility should be prebored to a depth of 6 ft. below the pipe bottom. The size of the augered hole need only be slightly larger than the pile section.
- (c) Where holes are augered in non-cohesive subsoil, casing may be required to prevent the hole from caving in.
- (d) Voids left around piles after driving, should be filled with sand or concrete.

6.4) Approach Embankments:

No stability problems are foreseen for approach fills of up to 30 ft. height, provided, of course, that they are built with 2 horizontal to 1 vertical slopes. Settlements will occur under the imposed embankment load, due to the consolidation of the overburden. Consolidation of the granular deposits will take a relatively short period of time, thus settlements due to these layers, will likely be completed during construction. Long-term settlements will take place due to the consolidation of the cohesive clayey silts. The magnitude of such settlements is estimated to be 3" - 6".

The organic material should be removed and replaced by acceptable soils under the proposed approach fills. The extent of the organic matter should be determined by the Soil Section during the regular soils investigation.

7. MISCELLANEOUS:

The field work, carried out during the period January 23 - 29, 1970, was supervised by Mr. D. Mullett, Technician.

Equipment used was owned and operated by P.V.K. and Sons Drilling Co.

This report was prepared by Mr. A. K. Barsvary, Senior Foundation Engineer, and reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

April, 1970

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

 JOB 70-F-1 LOCATION Co-ords. 672,894 N; 796,935 E.
 W.P. 79-68-08 BORING DATE January 26, 1970
 DATUM Geodetic BOREHOLE TYPE Auger

 ORIGINATED BY DM
 COMPILED BY AKB
 CHECKED BY AKB

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
658.3	Ground Level						1000	2000	20	40	60		GR. SA. SI. CL.
0.0	Gravelly sand fill some organic matter		1	SS	23	650							64 33 (3) 0 2 73 25 127 124 130 123 125 122
	Compact		2	SS	17								
644.8	Dark Brown		3	SS	13	640							
13.5	Sandy gravel	4&5	SS	18									
640.3	Compact												
18.0	Irregular seams and pockets of silt, clayey silt, silty clay & clay		6	SS	20	630							
			7	TW	PH								
	Stiff to very stiff		8	SS	9	620							
	Grey, Brown & Red		9	TW	PH								
			10	TW	PH								
			11	SS	29	610							
604.1			12	SS	118								
54.2	End of Borehole												

JOB 70-F-1 LOCATION Co-ords 672,786 N; 796,991 E. ORIGINATED BY DM
W.P. 79-68-08 BORING DATE January 23, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.		WATER CONTENT %						
								\circ UNCONFINED \bullet QUICK TRIAXIAL	$+$ FIELD VANE \times LAB. VANE						
659.2	Ground Level							1000	2000				20 40 60		
0.0	Silty sand with organic matter. Fill		1	SS	86	650									
	Loose		2	SS	8										
	Dark Grey		3	SS	4										
643.7	Sandy gravel		4	SS	44	640									
15.5	Dense		5	SS	16	630									
638.2	Irregular seams of silt, clayey silt & silty clay	6	TW	PH											
21.0	Stiff to very stiff	7	SS	14											
	Grey, Brown & Red		8	TW	PH	620									
		9	SS	13											
		10	TW	PH											
			11	SS	12	610									
			12	SS	18										
601.7															
57.5	End of Borehole														
	N.B. N.F.P. @ 57.5'														

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-F-1 LOCATION Co-ords. 672,930 N; 797,007 E. ORIGINATED BY DM
W.P. 70-68-08 BORING DATE January 29, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
							\circ UNCONFINED \bullet QUICK TRIAXIAL	$+$ FIELD VANE \times LAB. VANE	1000	2000	20		
657.5	Ground Level												
0.0	Pavement and sandy gravel												
652.0	Fill												
5.5	Sandy silt becoming sandy gravel, some organics.		1	SS	11	650							
639.5	Compact					∇ 640							
18.0	Clayey silt to silt with seams of silty clay.		2	SS	7								
	Firm to very stiff		3	TW	PH	630							129
	Grey & Red		4	SS	18	620							
			5	TW	PH	610							125 128
604.2													
53.3	End of Borehole												
	N.F.P. @ 604.2												

FOUNDATION SECTION

CHECKED BY

FOUNDATION SECTION

ORIGINATED BY **DM**

COMPILED BY **AKB**

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 70-F-1LOCATION Co-ords. 672,890N; 797,070 E.ORIGINATED BY DMW.P. 70-68-08BORING DATE January 27, 1970COMPILED BY AKBDATUM GeodeticBOREHOLE TYPE AugerCHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE		WATER CONTENT % 20 40 60				
653.0	Ground Level												
0.0	Sandy gravel fill	X	1	SS	13	650							64 31 (5)
645.0	Concrete		2	SS	100 1/2"								
8.0	No further penetration												
<p><u>NOTE:</u> At around 8 ft. below ground auger hit concrete slab & there was no further penetration. Adjacent holes indicated that the near horizontal concrete slab extends approx. 28 ft. east of the retaining wall of the sunken alley as shown on the plan of Drawing #70-F-1A.</p>													

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5A

FOUNDATION SECTION

JOB 70-F-1 LOCATION Co-ords. 672,900 N; 797,099 E. ORIGINATED BY DM
W.P. 70-68-08 BORING DATE January 28, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT	BLOWS/FOOT	RESISTANCE	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W	WATER CONTENT %		
652.0	Ground Level										
0.0	Silty sand with gravel pieces of wood, cinder organic matter.										
	Loose										
640.0	Fill	1	SS	8							50 32 17 1
12.0	Irregular seams of silt, clayey silt & silty clay.	2	SS	11							
	Stiff to very stiff	3	TW	PH						120 121	0 1 69 30
		4	TW	PH						127	
		5	SS	8							
	Grey, Brown & Red	6	TW	PH						125 124	0 0 90 10
		7	TW	PH						122 127	
		8	SS	15							
603.0	Bouncing	9	SS	21/6"							
49.0	End of Borehole Probably Bedrock										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 70-F-1

LOCATION

Co-ords. 672,964 N; 797,247 E.

ORIGINATED BY DM

W.P. 70-68-08

BORING DATE

January 27, 1970

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE

Auger & Diamond Drilling

CHECKED BY

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UN-CONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE 1000 2000		w_p ——— w ——— w_L WATER CONTENT % 20 40 60				
648.8	Ground Level												
0.0	Cinder and organic fill.		1	SS	16								
	Compact to dense		2	SS	47	640						N.P. ○	
639.3													
9.5			3	SS	14								
	Irregular seams of silt, clayey silt & silty clay.		4	TW	PH	630	9 ●						120
			5	TW	PH		●						121
	Stiff to very stiff		6	SS	13	620		+					124
			7	TW	PH		●						126
	Grey, Brown & Red		8	SS	20	610		+					125
			9	SS	21								
601.5													
47.3	Dolomite Bedrock		10	RC	100%	600							
595.1													
53.7	End of Borehole												

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

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:-

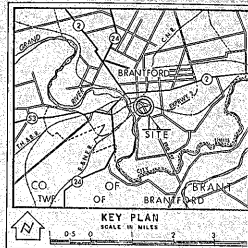
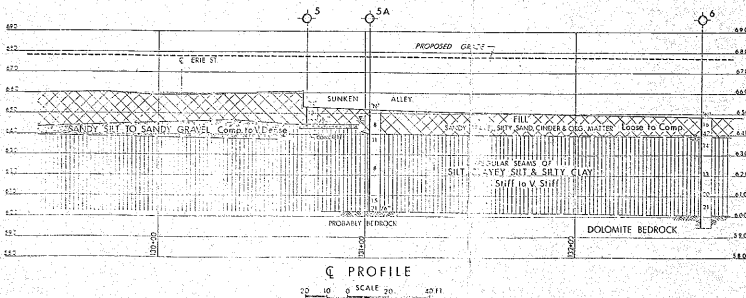
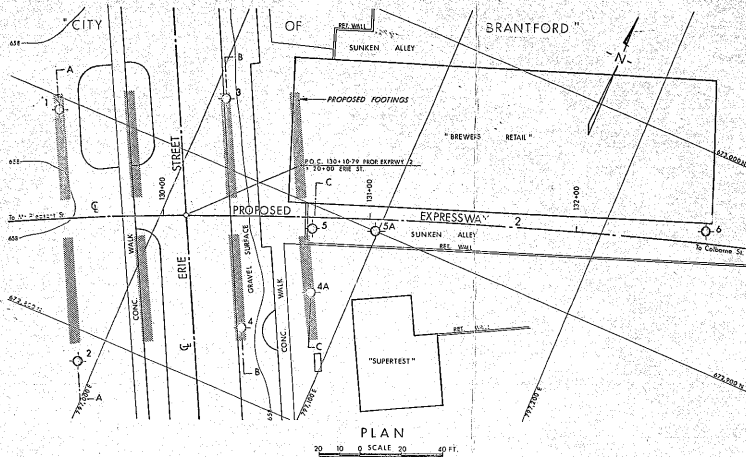
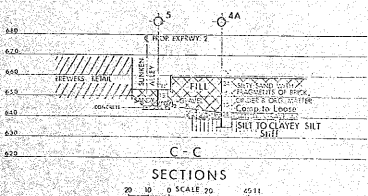
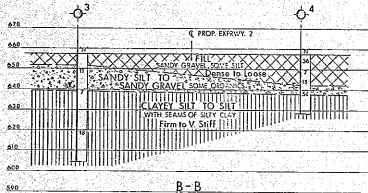
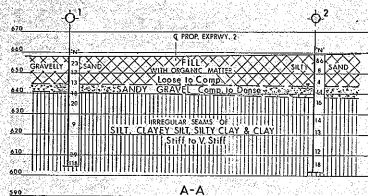
<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 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



LEGEND			
	Bore Hole		
	Case Penetration Hole		
	Bore & Case Penetration Hole		
NOTE: Water Levels established at time of field investigation, JAN. 1970			
NOTE: Worm length in Bore Holes 6A & 5 not established at time of field investigation.			
NO.	ELEVATION	CO-ORDINATES	
		EAST	
1	658.3	672,894	796,935
2	659.2	672,786	796,091
3	657.5	672,930	797,007
4	657.5	672,838	797,057
4A	659.0	672,861	797,083
5	653.0	672,890	797,070
5A	652.0	672,900	797,099
6	648.8	672,964	797,247

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are drawn from geological evidence and may be subject to considerable error.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

ERIE STREET

KIND'S HIGHWAY NO. EXPRESSWAY 2 DIST NO. 4
CO. BRANT CITY OF BRANTFORD
TWP. BRANTFORD LOT COM.

BORE HOLE LOCATIONS & SOIL STRATA

SOUND A-3 CHECKED BY EXP. NO. 70-08-08 BY DRAWING NO.
DRAWN S.O. ENCHESER JOB NO. 70-F-1 70-F-1A
DATE 24 JULY 1970 DATE 80
APPROVED BY [Signature] (JRM) (JRM)
PROJECT NUMBER 42