

(RM. 110 LAB. BLDG.)

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

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

ATTENTION: Mr. S. McCombie

DATE: August 25, 1969

OUR FILE REF.

IN REPLY TO **AUG 29 1969**

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
"Go" Transit Bridge
Clarkson - County of Peel
District No. 6 (Toronto)
W.J. 69-F-66 -- W.P. 23-69-2

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 do not hesitate to contact our Office.

ACS/MdeF
Attach.

A. G. Sternac
for A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
G. K. Hunter (2)
P. G. Allen
W. S. Melinyshyn
T. J. Kovich
B. A. Singh
Foundations Files ✓
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
"Go" Transit Bridge
Clarkson - County of Peel
District No. 6 (Toronto)
W.J. 69-F-66 -- W.P. 23-69-2

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation for the aforementioned structure. The request was contained in a memo from the Bridge Office - (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer), dated August 11, 1969. Subsequently, an investigation was carried out by this Section at the above site in order to determine the subsoil conditions.

This report contains the results of the investigation, together with our recommendations for the design of foundations for the proposed structure, which will provide vehicular access to an extension to the existing parking lot.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located west of Southdown Rd. (Hwy. #122), immediately south of Bromsgrove Rd., in the Town of Clarkson. The proposed single-span structure will cross the existing concrete-lined drainage canal. The drainage canal is about 100 ft. wide at its crest and 13 feet deep. The existing parking lot is located on the east side of the canal, while the terrain on the west is grass-covered and flat-lying, with the ground surface between elevation 328 and 329.

The lowland bordering Lake Ontario was inundated in late Pleistocene times by a body of water, known as Lake Iroquois; this region is physiographically spoken of as the "Iroquois Plain". In this section of the "Plain" the old shore is cut in shale. A

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

shallow cover of glacial till overlies the bedrock, which is of the Dundas formation, Ordovician Period.

3. SUBSOIL AND BEDROCK CONDITIONS:

During the course of the investigation, four sampled boreholes were put down to depths up to 18.5 feet, by means of a diamond drill rig adapted for soil sampling. Bedrock was proven at two of the boring locations by obtaining BXT size rock core samples.

The locations of the borings are shown in plan on Drawing No. 69-F-66A. The stratigraphy encountered at the boring locations is shown on the Record of Borelog sheets; stratigraphical sections, inferred from this data, are plotted on the drawing as well. A brief resumé of the subsoil conditions encountered are presented in the following paragraphs.

On the east side of the canal, natural ground is overlain by approximately 5 feet of fill, composed of silty sand with some gravel. Occasional pockets of clayey silt and organic matter were present throughout. The relative density of the fill varies from compact to dense ('N' values 25 to 33 blows/ft.), in the parking lot area, to loose elsewhere ('N' values as low as 5 blows/ft.). The fill is underlain by the original topsoil.

Underlying the fill and topsoil on the east side of the canal, and a thin mantle of topsoil on the west side, is a deposit of glacial till composed of clayey silt with some sand and gravel. The thickness of this deposit is between 3 and 4 feet. Fragments of shale are encountered in the lower 1 to 1.5 feet portion of the deposit. Standard penetration resistance testing, carried out within the deposit, the results of which are plotted on the Borelog sheets, gave 'N' values varying from 15 to 85 blows/ft., with the pattern generally increasing with depth. Based on these results, it is estimated that the consistency varies from stiff, increasing with depth, to hard.

3. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

The glacial till is followed by black shale bedrock, the surface of which was encountered between elevations 318.5 to 319.5 and 325 to 325.5, east and west of the canal, respectively. The upper 3.5 to 4.5 feet of the bedrock is in a fractured and jointed condition, while below this upper zone the rock is basically sound.

During the period of the investigation, all the borings were dry to their full depth of penetration.

4. RECOMMENDATIONS:

It is proposed to construct a single-span structure, approximately 81 feet long and 33 feet wide. It is understood that only a minimum amount of fill will be required along the approaches.

The support for foundations is competent at both abutment locations; this being the case, it is recommended that the abutments be founded on spread footings. The east abutment footing could be founded within the lower portion of the glacial till - i.e., at or below elevation 319. The west footing, however, could be founded within the upper fractured portion of the shale bedrock - i.e., at or below elevation 325. Four feet of earth cover should be provided to the underside of the footings for frost protection purposes. Footings founded as above, could be designed using a safe bearing pressure of 5.0 t.s.f.

As an alternative, the foundations could be founded on sound bedrock, which was encountered at approximately elevations 315 and 322 at the location of the east and west abutments, respectively. A safe bearing pressure of 10.0 t.s.f. could be used in design.

To reach foundation level, the footing excavations will probably extend some 5 to 6 feet below existing ground surface.

4. RECOMMENDATIONS: (cont'd.) ...

The groundwater level will be below the base of the footing elevations, based on the observations made during the period of the investigation. No major dewatering problems are, therefore, anticipated. Any minor seepage occurring in the excavations, could be handled by employing conventional techniques, such as pumping from sumps.

Settlement of the spread footings will be negligible and of no consequence as far as design is concerned.

5. MISCELLANEOUS:

The field work, performed during the period August 13 to 15, 1969, was carried out by Mr. K. K. Kwan, Project Foundation Engineer.

Equipment used was owned and operated by Canadian Longyear Co. Ltd.

This report was prepared by Mr. B. T. Darch, Senior Foundation Engineer.

General supervision of the project and review of the report were undertaken by Mr. M. Devata, Supervising Foundation Engineer.

August 1969

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.1

FOUNDATION SECTION

JOB 69-F-66

LOCATION

Refer to Drawing 69-F-66A

ORIGINATED BY

KKK

W.P. 23-69-2

BORING DATE

August 13 & 14, 1969

COMPILED BY

BTD

DATUM Geodetic

BOREHOLE TYPE

Washboring-BX Casing-BXT Rock Core; Cone Test

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		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			
328.7	Ground Level																
0.0	Silty sand, some grav. (Fill) occ. pockets of clayey silt & organic matter		1	SS	11										Open Hole Dry Aug. 14/69		
			2	SS	5												
	Brown Loose to compact		3	SS	5	325											
323.2			4	SS	3												
5.0	Clayey silt (topsoil)																
322.7			5	SS	15												
6.0	Clayey silt, some sand & grav. (Giac. Fill) very stiff																
	Fragments of shale		6	SS	81												
319.5	Hard					320											
9.2	Shale Bedrock																
	Black		7	BXT	21%												
315.0	Fractured					315											
13.7																	
	Sound		8	BXT	100%												
310.0																	
18.7	End of Borehole					310											

Practical refusal
at elev. 318.8

Open Hole
Dry
Aug. 14/69

FOUNDATION SECTION

WKE

BTD

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	WATER CONTENT %	W _p	W _L		
328.4	Ground Level										P.C.F.	GR. SA. SI. CL.
0.0	Silty sand, some gravel (Fill)		1	SS	33							
	occ. pockets of clayey silt & organic matter.		2	SS	25							
	Brown		3	SS	25	325						
323.4	Compact to dense											
322.4	Clayey silt (topsoil)		4	SS	15							
6.0	Clayey silt, some sand & gravel (Glacial Till)		5	SS	19							
	Grey-brown											
	Very stiff		6	SS	20	320						
318.5	Fragments of Shale		7	SS	70/10"							
9.9	End of Borehole Probably Bedrock					315						

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-66 LOCATION Refer to Drawing 69-F-66A ORIGINATED BY KKK
W.P. 23-69-2 BORING DATE August 15, 1969 COMPILED BY LTD
DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — w_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT				PLASTIC LIMIT — w_p			
							SHEAR STRENGTH P.S.F.				WATER CONTENT — w			
328.4	Ground Level													
0.0	Topsoil	11	1	SS	21									
	Clayey silt (glacial till) fragments of shale.	000	2	SS	85									
325.4	Very stiff to hard	000												
3.0	End of Borehole Probably Bedrock	000				325								Open Hole Dry Aug. 15/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-F-66

LOCATION

Refer to Drawing 69-F-66A

ORIGINATED BY KKK

W.P. 23-69-2

BORING DATE

August 14, 1969

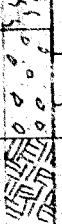
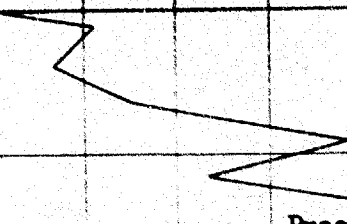
COMPILED BY BTB

DATUM Geodetic

BOREHOLE TYPE

Washboring-BX Casing-BXT Rock Core; Cone Test

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. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		WATER CONTENT % w_p — w — w_L			
328.9	Ground Level											
0.0	Clayey silt (topsoil)		1	SS	21							
1.0	Clayey silt (glacial till) - fragments of shale.		2	SS	56							
325.1	Very stiff to hard											
3.8	Shale Bedrock Black		3	BXT	17%							
321.9	Fractured											
7.0			4	BXT	85%							
317.1	Sound											
11.8	End of Borehole											

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 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_s	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

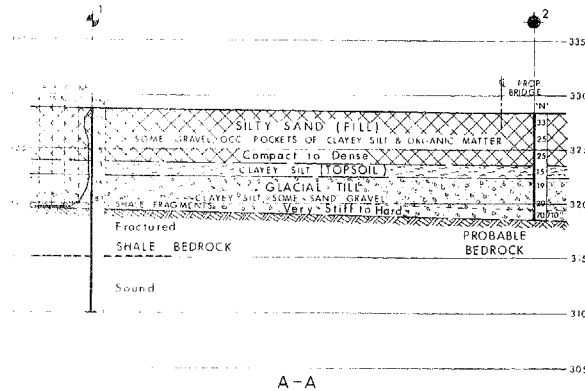
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

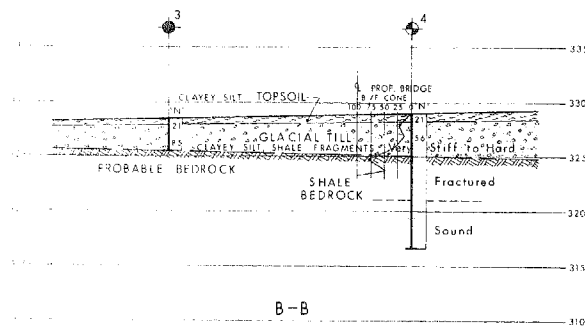
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



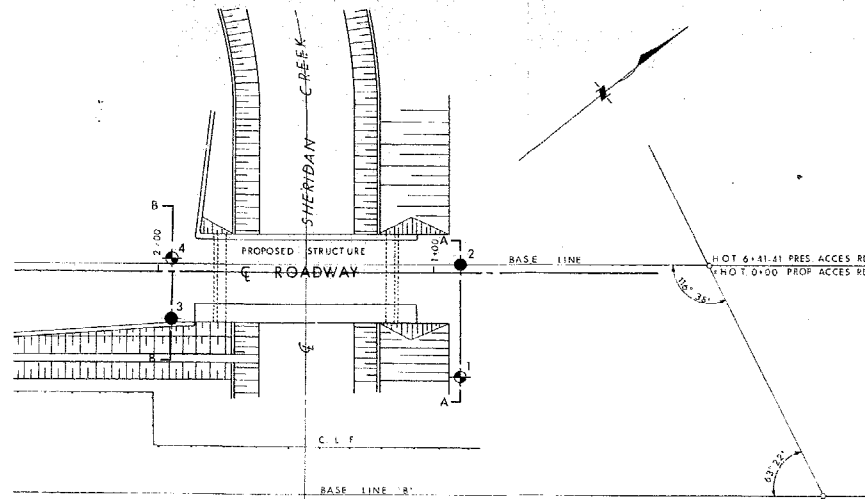
A-A



B-B

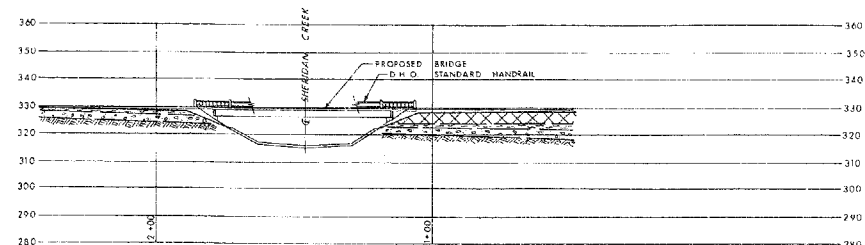
SECTIONS

SCALE 1" = 10 FT



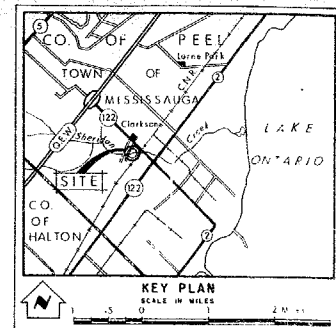
PLAN

SCALE 1" = 40 FT



PROFILE

SCALE 1" = 40 FT



LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊕ Bore & Cone Penetration Hole
- Water Levels established at time of field investigation.

NO.	ELEVATION	STATION	OFFSET
1	328.7	0+	shown
2	328.4	"	"
3	328.4	"	"
4	328.9	"	"

- 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.

DATE	BY	DESCRIPTION

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

GO TRANSIT STATION
(AT CLARKSON)

KING'S HIGHWAY NO. _____ DIST. NO. 6
CO. PEEL TOWN OF MISSISSAUGA
TWP. _____ LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRATA

BOREHOLE S.T.O. CHECKED: _____ M.P. NO. 23-69-2 M.B.T. DRAWING NO. 69-F-66A
DRAWN G.P. CHECKED: _____ JOB NO. 69-1-6A

DATE Aug. 25, 1969 SITE NO. _____ BRIDGE DRAWING NO. _____
APPROVED: _____ CONT. NO. _____

MEMORANDUM

IN REPLY TO

69-F-66

[illegible]

MEMORANDUM

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

FROM: W.S. Melinyshyn,
Bridge Office.

DATE: August 11th, 1969.

Our File Ref.

IN REPLY TO

SUBJECT: Vehicular Structure for Go-Transit
Parking lot at Clarkson Station,
W.P. 23-69-2, District 6.

We request that your office undertake a minimum foundation investigation at the above site as necessary to complete the design of the structure. A soils investigation done by Mr. Kovich for the parking lot indicated rock as being very close to the surface.


We enclose site and bridge preliminary plans.

This project is extremely rush and your recommendations are requested as soon as possible.

WSM/cew

Encl.

cc E. Cross
W. Lin
T. Kovich


W.S. Melinyshyn,
REGIONAL BRIDGE PLANNING ENGINEER.

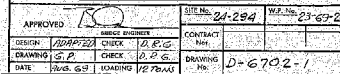
19 F-66

#69-F-66

W.P. 23-69-2

CLARKSON

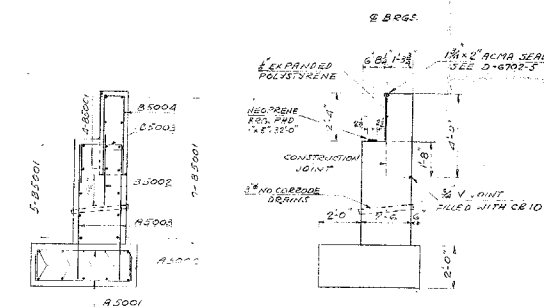
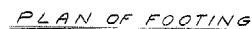
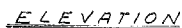
GO TRASIT BRIDGE



USE SCALE BELOW

0 1 2

3 INCHES ON ORIGINAL PLAN



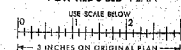
REINFORCING STEEL

DIMENSIONS

ALL SCALES: $\frac{3}{8}" = 1'-0"$



FOR REDUCED PLAN

[illegible]

69-1-66

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

GO TRANSIT BRIDGE
(AT CLARKSON STATION)

KING'S HIGHWAY No. _____ DIST. No. G
CO. PEEL
TWP. MISSISSAUGA LOT _____ CON. _____

ABUTMENTS & WINGWALLS

APPROVED <u>TKO</u>				SHEET No. <u>24-294</u>	W.P. No. <u>23-69</u>
BRIDGE ENGINEER				CONTRACT No.	
DESIGN	D. R. G.	CHECK	R. K.		
DRAWING	G. P.	CHECK	D. R. G.		
DATE	8/15/68	12/14/68	12/27/68	DRAWING No.	D-6702-2