

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M4-61

DIST. 4 REGION           

W.P. No. 55-75-09

CONT. No. 81-64

W. O. No.           

STR. SITE No. 9-132

HWY. No. 6 New

LOCATION Sterling St. Underpass

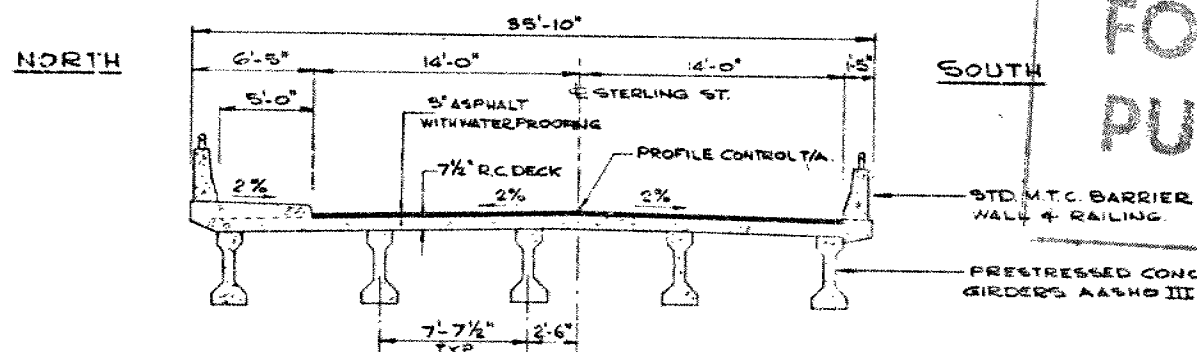
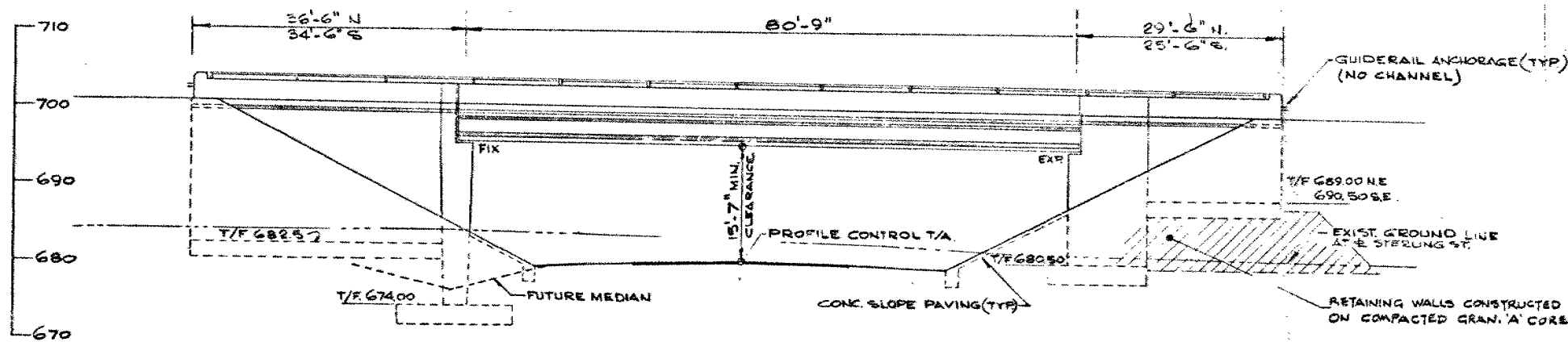
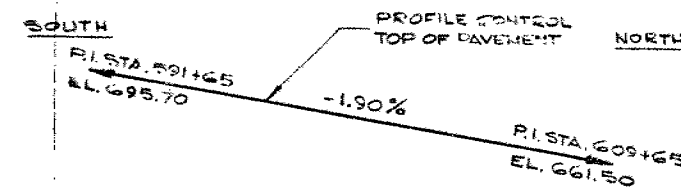
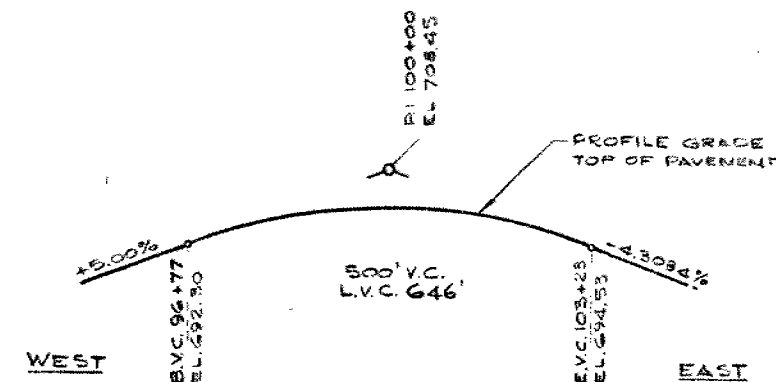
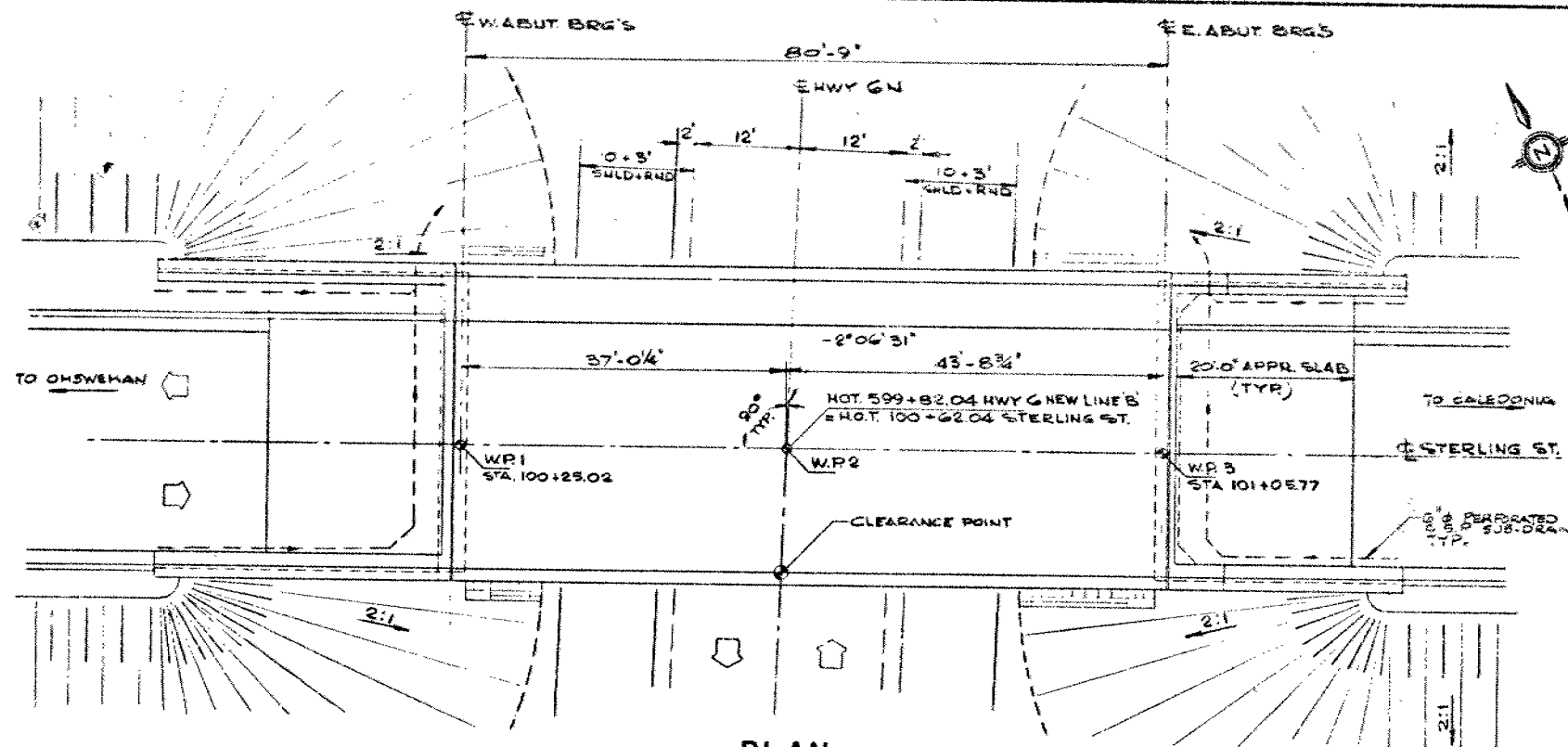
No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.           

REMARKS:

4-72  
ONTARIO  
DB-BR-10



TO BE USED  
FOR ESTIMATING  
PURPOSES ONLY

DATE JUN 2 1977

DIST. No. 4  
CONT. No.  
WP No. 55-75-09

HWY. 6N. UNDERPASS  
AT STERLING STREET  
GENERAL ARRANGEMENT

McCORMICK, RANKIN & ASSOCIATES  
LIMITED  
CONSULTING ENGINEERS  
MISSISSAUGA  
OTTAWA

GBM 65-U-167 EL. 623.900

POLICE STATION, DIRECTLY OPPOSITE POST OFFICE ON NORTH SIDE OF CAITHNESS STREET (HIGHWAY No. 54). TABLET IN SOUTH CONCRETE FOUNDATION WALL 4.0 FEET FROM SOUTH EAST CORNER AND 1.0 FOOT BELOW BRICK. 194' LT. STA. 6+68 PRESENT HWY 6.

#### GENERAL NOTES

##### CLASS OF CONCRETE

DECK, SIDEWALK & BARRIER WALLS 4000 P.S.I.  
PRESTRESSED CONCRETE GIRDERS 6000 P.S.I.  
REMAINDER 3000 P.S.I.

##### REINFORCING STEEL GRADE

FOOTINGS, ABUTMENTS & RETAINING WALLS 50  
DECK, SIDEWALK & BARRIER WALLS 60  
PRESTRESSED CONCRETE GIRDERS 60W

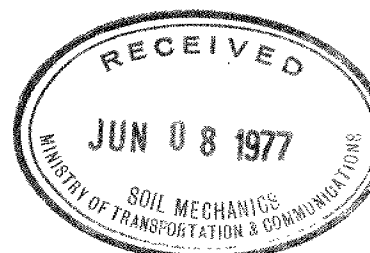
##### CLEAR COVER TO REINFORCING STEEL

DECK 2" TOP, 1 1/2" BOT.  
SIDEWALK & APPROACH SLABS 2"  
BARRIER WALLS 1 1/2"  
REMAINDER 3"

NOTE: TO ACHIEVE THE MIN. CLEAR COVER OF 2" SPECIFIED THE TOP LAYER OF DECK RE BARS SHALL BE PLACED PRIOR TO CONCRETING, WITH A CLEAR COVER OF 2 1/2" ± 1/2" TOLERANCE.

##### CONSTRUCTION NOTES:

- THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE TOLERANCE OF 1/8".
- NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

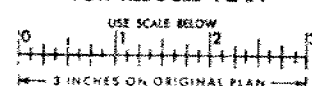


#### CONCRETE QUANTITIES (FOR LUMP SUM CONCRETE ITEMS)

- CONCRETE IN ABUTMENTS, WING WALLS & RETAINING WALLS 264 CY. 3000 P.S.I.  
6 CY. 4000 P.S.I.
- CONCRETE IN DECK & DIAPHRAGMS 98 CY. 4000 P.S.I.
- CONCRETE IN BARRIER WALLS 30 CY. 4000 P.S.I.
- CONCRETE IN APPROACH SLABS 34 CY. 3000 P.S.I.
- CONCRETE IN SLOPE PAVING 18 CY. 3000 P.S.I.

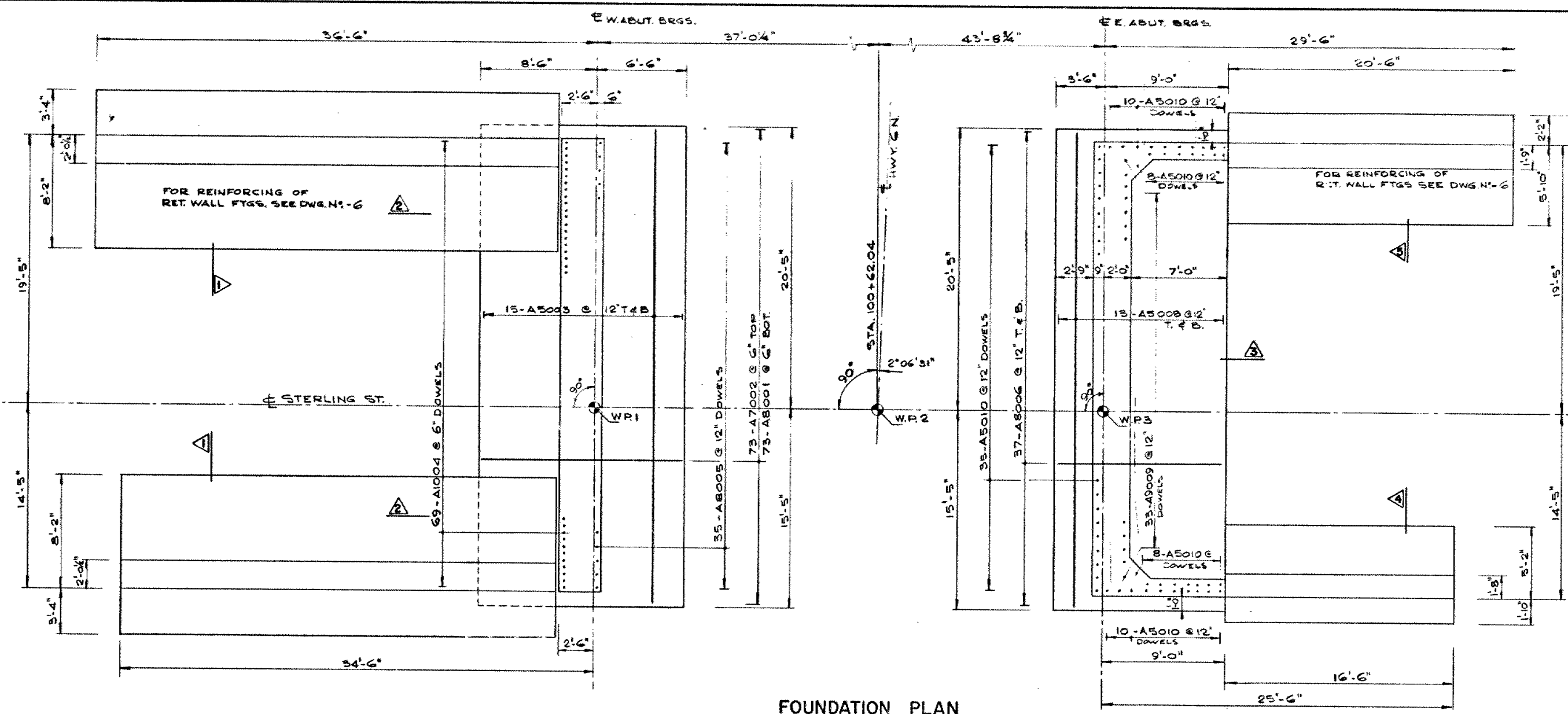


#### FOR REDUCED PLAN



REVISIONS	DATE	BY	DESCRIPTION
DESIGN R 5	CHECK JMT	LOADING HS 20-44	DATE MAY 77
DRAW NGWCD	CHECK JMT	SITE No. 9-132	DWG

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO 88-88-18 4-75



DIST. No. 4  
CONT No  
WP No 55-75-09

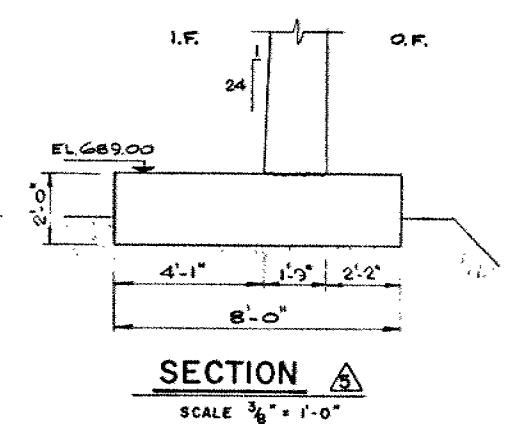
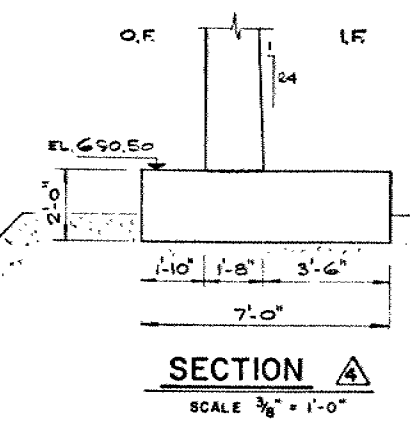
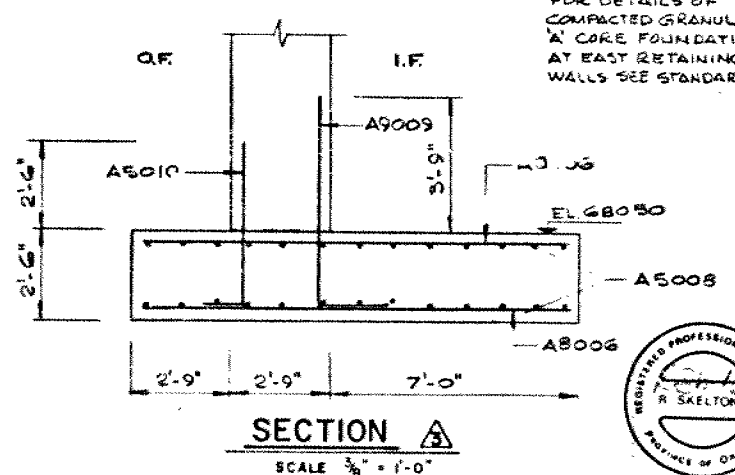
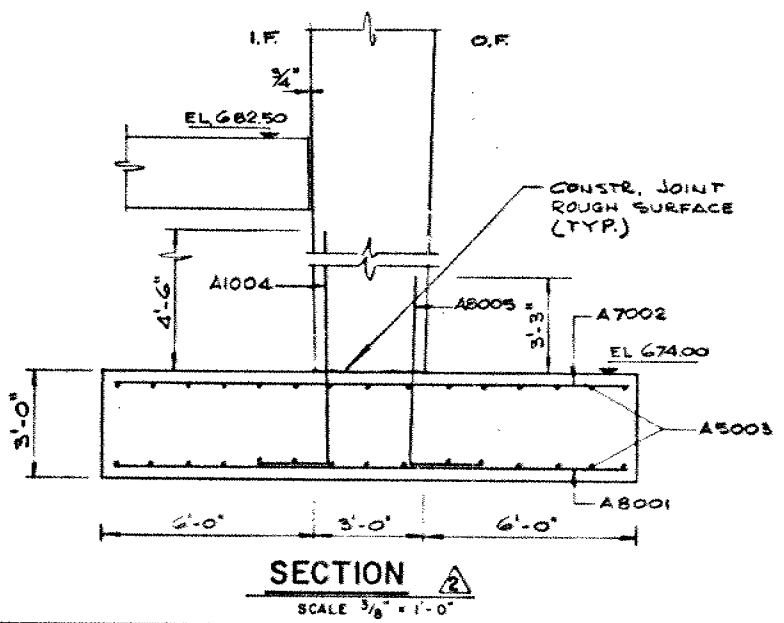
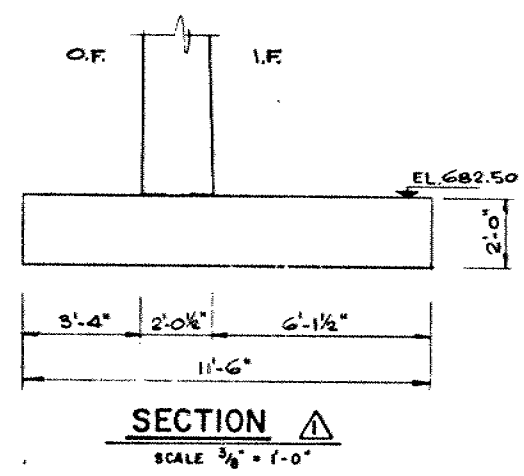
HWY. 6N. UNDERPASS  
AT STERLING STREET  
FOOTING DETAILS

MCCORMICK, RANKIN & ASSOCIATES  
LIMITED  
CONSULTING ENGINEERS  
MISSISSAUGA OTTAWA

SHEET

FOUNDATION PLAN  
SCALE 1/4" = 1'-0"

WORKING POINTS			
POINT No.	STA.	N.	E.
1	100+23.02	15650406.990	873112.260
2	100+62.04	15650392.221	873146.207
3	101+03.77	15650374.775	873186.306

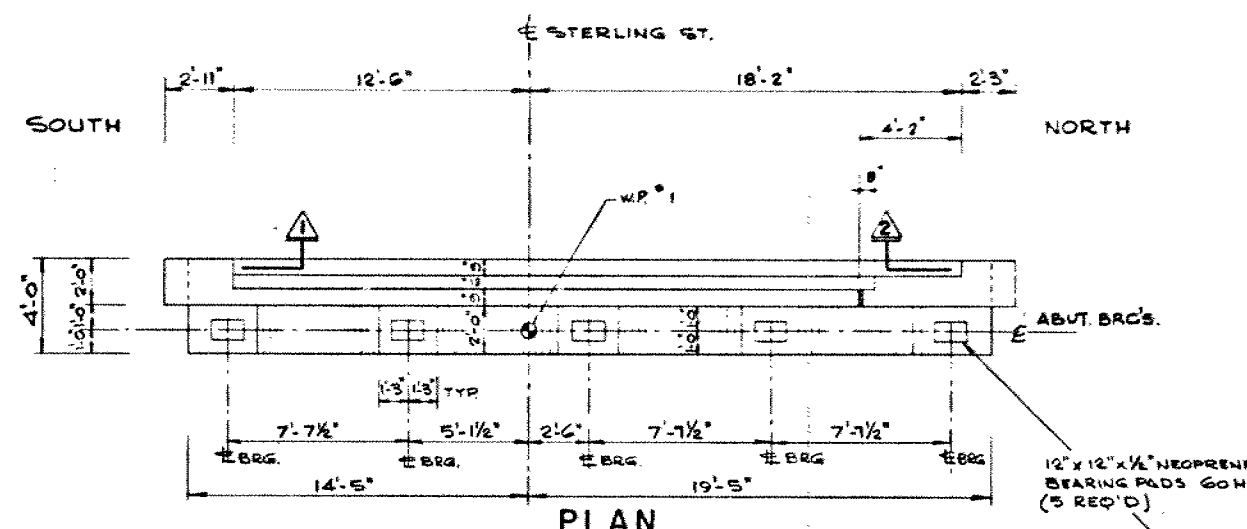


FOR DETAILS OF  
COMPACTED GRANULAR  
'A' CORE FOUNDATION  
AT EAST RETAINING  
WALLS SEE STANDARD

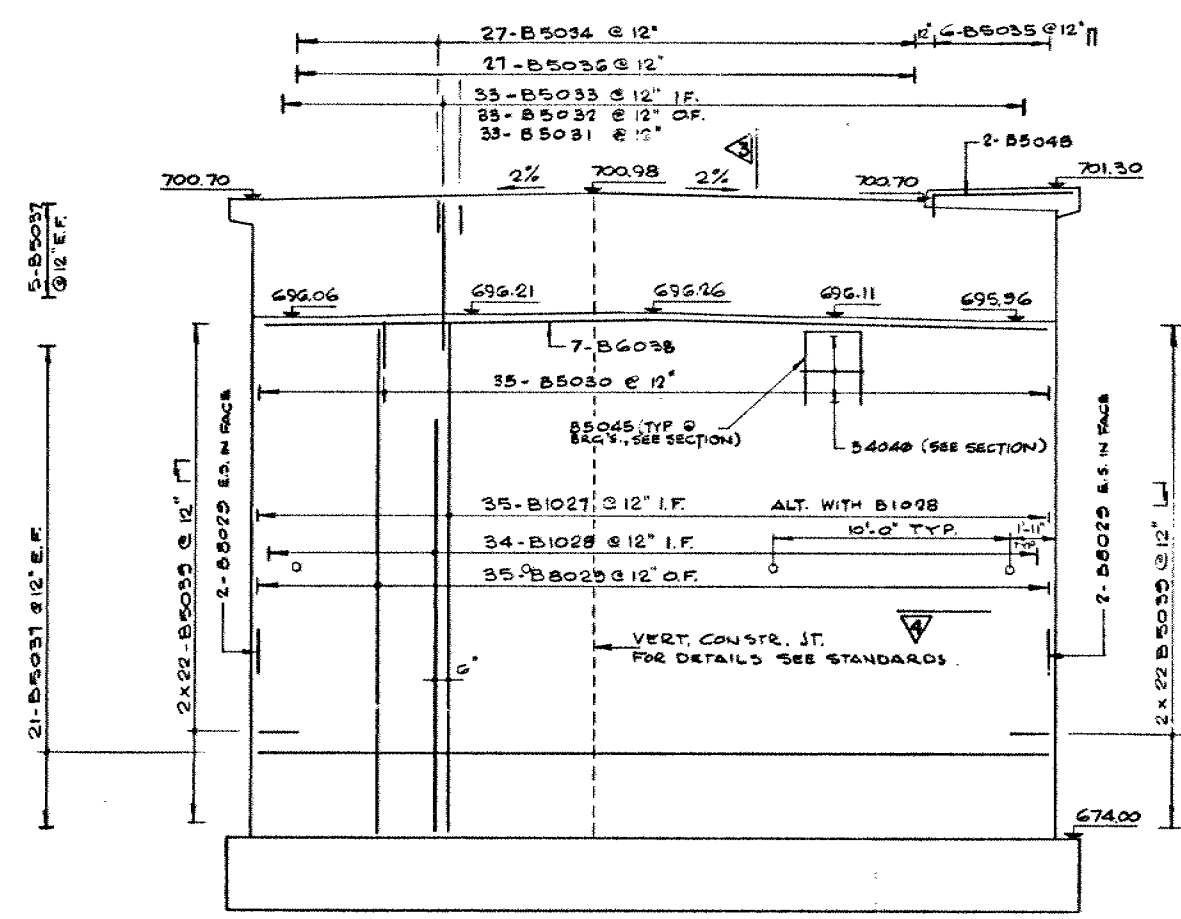


FOR REDUCED PLAN  
USE SCALE BELOW  
0 1 2 3  
1 INCHES ON ORIGINAL PLAN

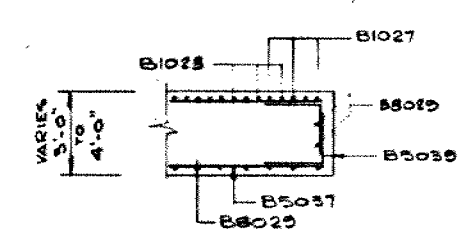
REVISIONS		DATE	BY	DESCRIPTION
DESIGN	R.S.	CHECK J.W.T.	LOADING HS 20-44	DATE MAY, 77
DRAWING	W.D.	CHECK R.S.	SITE No 9-132	DWG 5



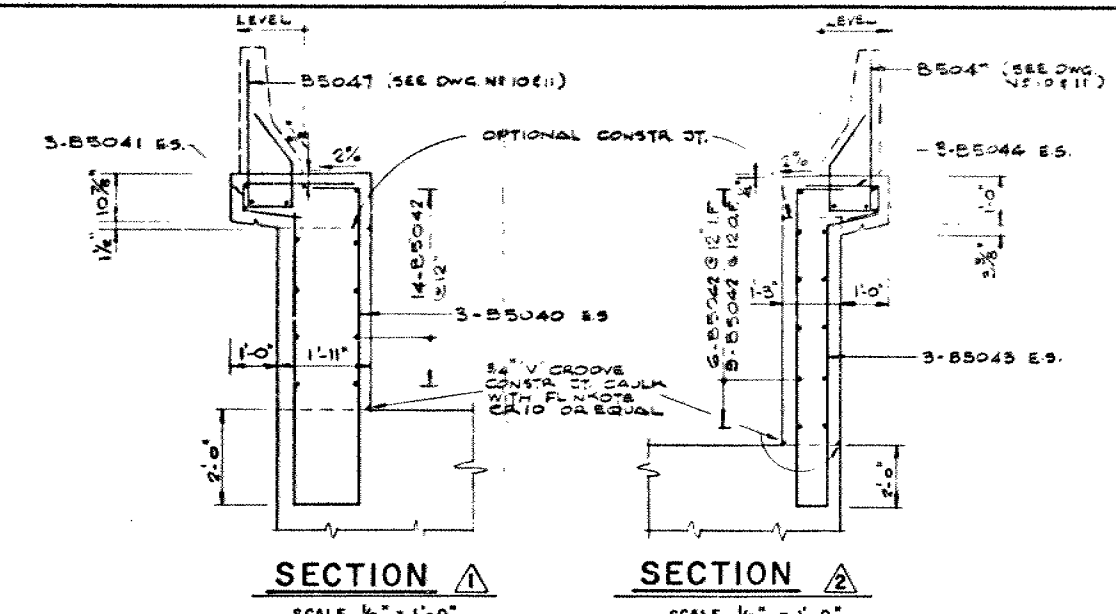
**PLAN**  
SCALE 1/4" = 1'-0"



**ELEVATION**  
SCALE 1/4" = 1'-0"

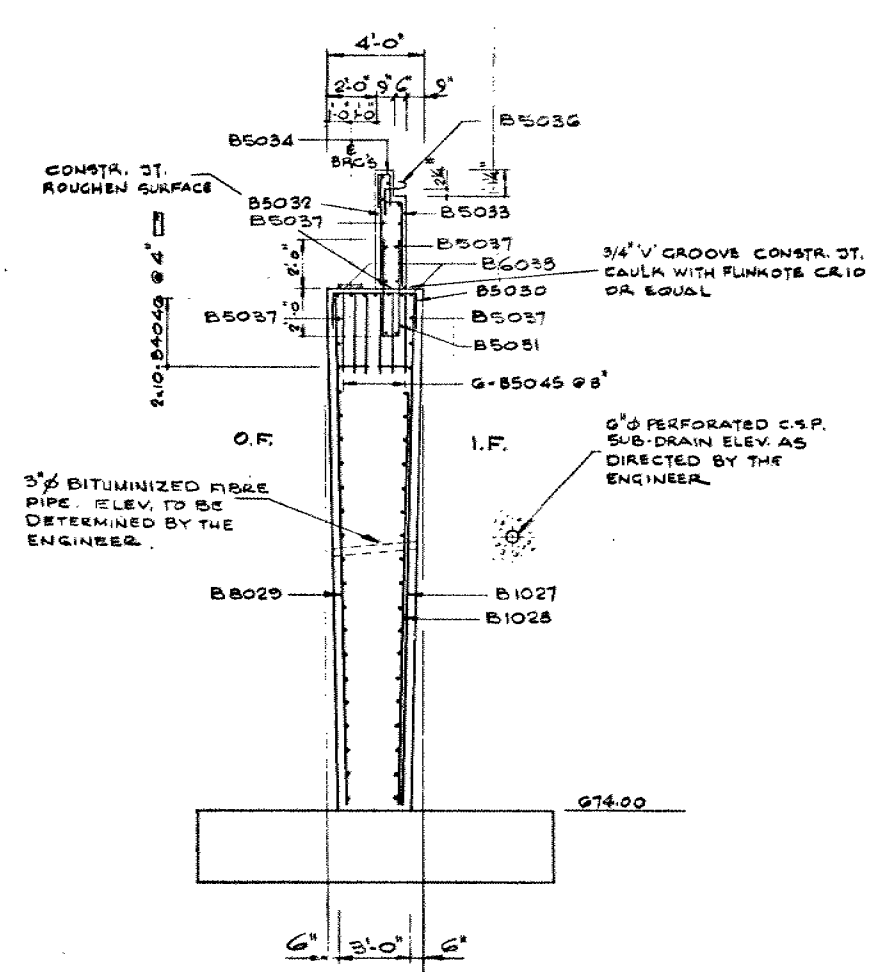


**SECTION A-A**  
SCALE 1/4" = 1'-0"



**SECTION 1**  
SCALE 1/2" = 1'-0"

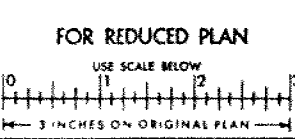
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SCALE 1/2" = 1'-0"



**SECTION A-A**  
SCALE 1/4" = 1'-0"

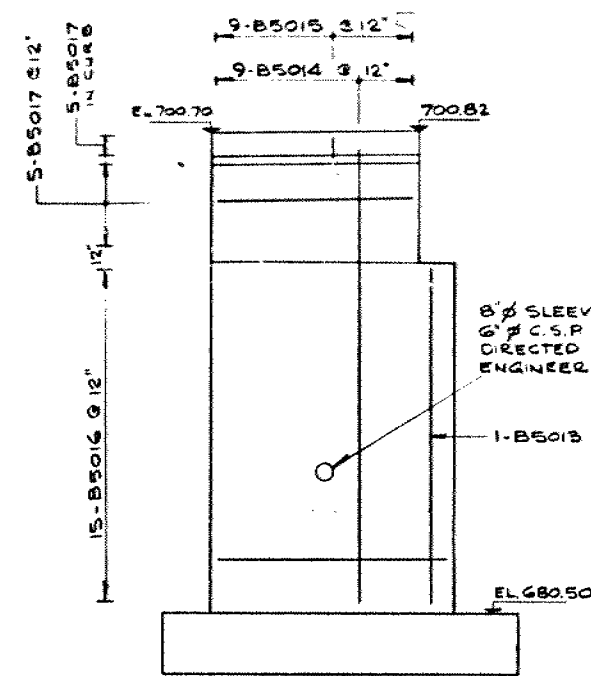
DIST. No. 4		SHEET
CONT. No. WP No. 55-75-09		
HWY. 6N. UNDERPASS AT STERLING STREET WEST ABUTMENT		
McCORMICK, RANKIN & ASSOCIATES LIMITED		
MISSISSAUGA	CONSULTING ENGINEERS	OTTAWA

- NOTES:**
1. FORMWORK BETWEEN THE END OF DECK AND BALLAST WALL AND UNDERSIDE OF DECK AND BEARING SEAT (if expanded POLYSTYRENE) SHALL BE REMOVED.
  2. BALLAST WALL TO BE CAST TO SUIT DECK EXPANSION JOINT
  3. FOR GRANULAR BACKFILL TO ABUTMENT SEE STANDARDS.



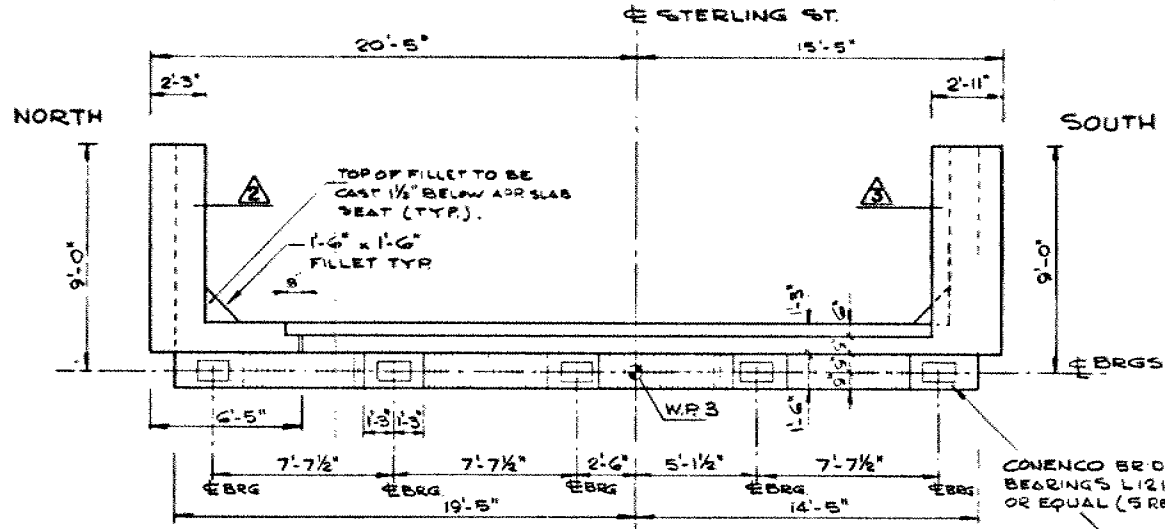
REVISIONS	DATE	BY	DESCRIPTION

DESIGN: R.S. CHECK: JMT. LOADING: HS 20-44. DATE: MAY, 77.  
DRAWING: WCD. CHECK: R.S. SITE: No. 9-132. DWG. 4



N.E. WINGWALL O.F.

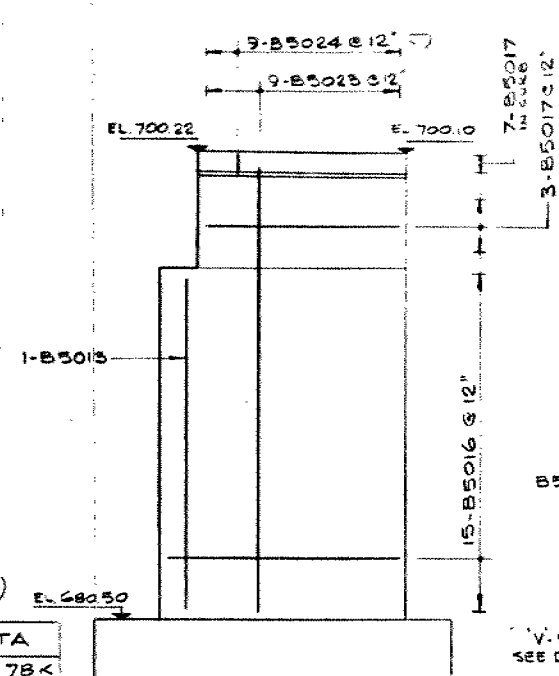
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PLAN

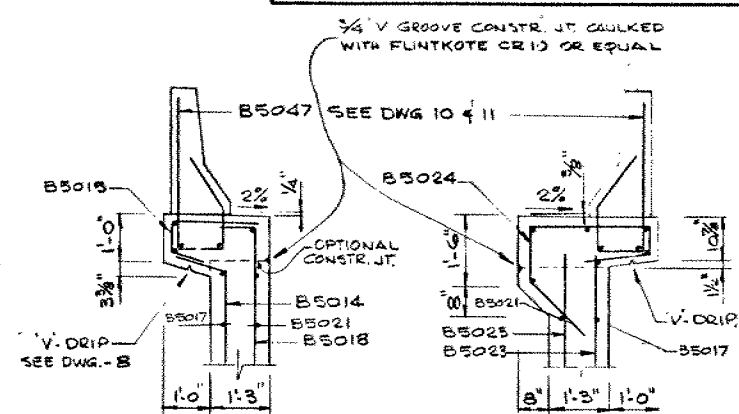
SCALE 1/4" = 1'-0"

BEARING DESIGN DATA	
D.L.	78K
DL+LL+I	133K
MAX. MOVEMENT	-1.66"
MAX. ALLOWABLE SHEAR RATE	0.35%/in.



S.E. WINGWALL O.F.

SCALE 1/4" = 1'-0"

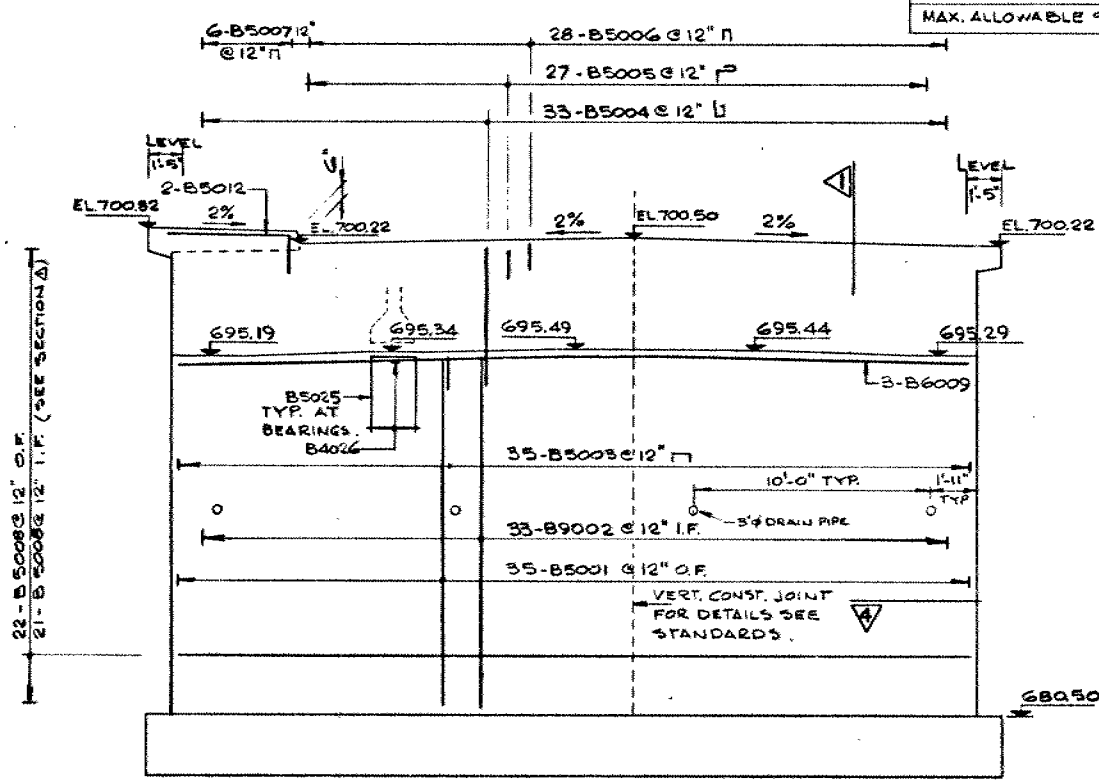


SECTION 2

SCALE 1/2" = 1'-0"

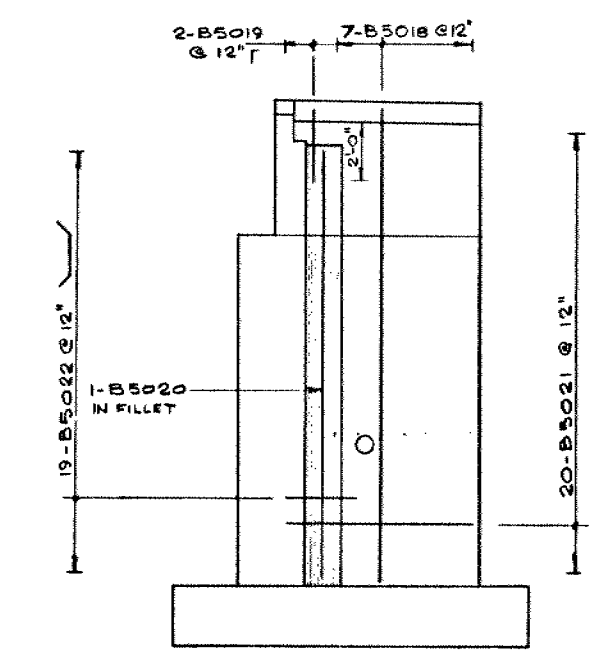
SECTION 3

SCALE 1/2" = 1'-0"



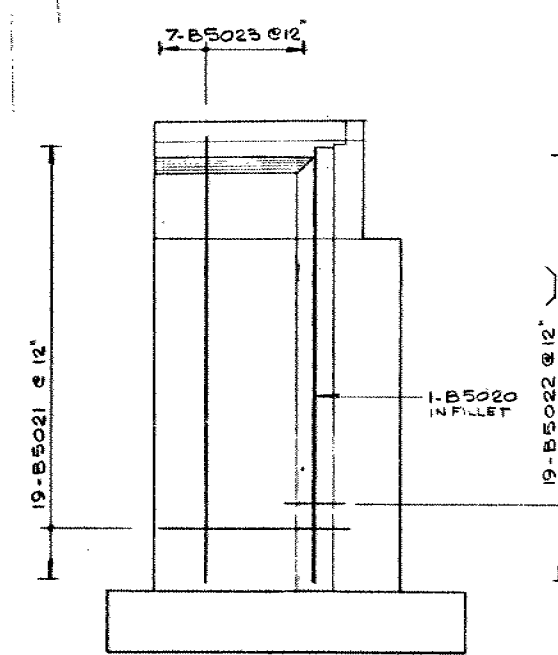
ELEVATION

SCALE 1/4" = 1'-0"



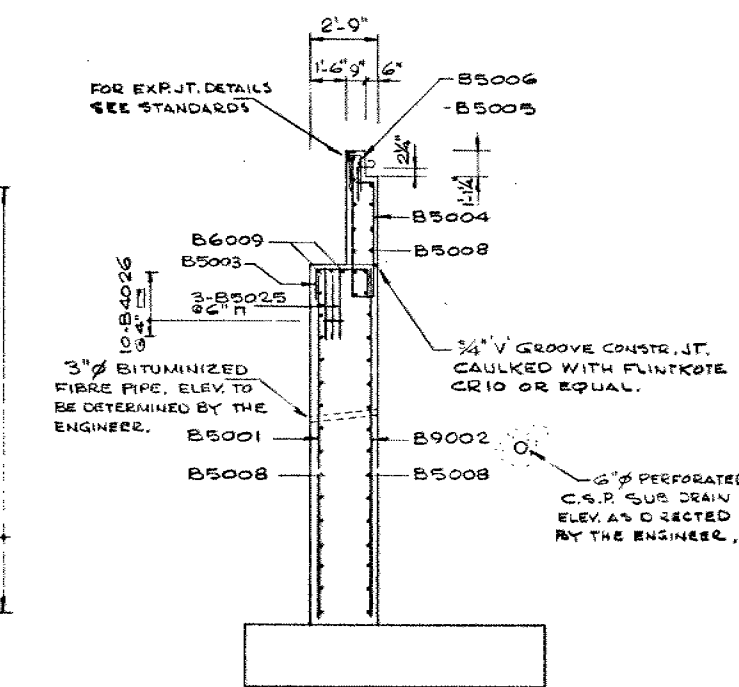
N.E. WINGWALL I.F.

SCALE 1/4" = 1'-0"



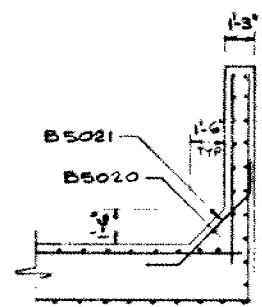
S.E. WINGWALL I.F.

SCALE 1/4" = 1'-0"



SECTION 4

SCALE 1/4" = 1'-0"



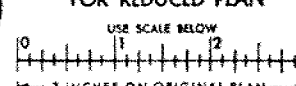
SECTION 5

SCALE 1/4" = 1'-0"

- NOTES:
1. FORMWORK BETWEEN THE END OF DECK AND BALLAST WALL AND UNDERSIDE OF DECK AND BEARING SEAT (E.G. EXPANDED POLYSTYRENE) SHALL BE REMOVED.
  2. BALLAST WALL TO BE CAST TO SUIT DECK EXPANSION JOINT.
  3. FOR GRANULAR BACKFILL TO ABUTMENT SEE STANDARDS.



FOR REDUCED PLAN



REVISIONS	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			

ENGINEERING MATERIALS OFFICE  
SOIL MECHANICS SECTION

WP 55-75-09

DIST 4

HWY 6N

STR SITE 9-132

Sterling Street Underpass  
Over the Caledonia Bypass

DISTRIBUTION

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R. Hore

R. Fitzgibbon }  
J. Anderson } cover only  
G. Sloan }

Files J

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	77-04-26	1288
TUBES	"	1288
ROCK CORES	"	1288

# FOUNDATION INVESTIGATION REPORT

For

Sterling Street Underpass  
Over the Caledonia Bypass  
Highway 6N, District 4, Hamilton  
W.P. 55-75-09, Site 9-132

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## INTRODUCTION

This report details the results of our foundation investigation at the above mentioned site. This investigation was carried out during the period of February 22-28, 1977 utilizing a type II 2 3/4" I.D. hollow stem auger machine mounted on a tracked muskeg vehicle. Bedrock was proven by obtaining BXL size rock core samples.

## SITE DESCRIPTION

This site is located approximately 1 mile due west of the Town of Caledonia and about 1/2 mile south of the Grand River.

The area adjacent to the site is primarily occupied by farming with some re-forestation. Small wooded areas dot the vicinity where farming is not feasible. In general, the overall area may be described as a gently rolling terrain.

This area is located within the physiographic region known as the Haldimand Clay Plain characterized by stratified clay overlying till. Within the general vicinity of the site the till protrudes through this layer in the form of drumlins partially buried within the lacustrine clay beds. The underlying bedrock consisting of Paleozoic beds of dolomite, shale and gypsum tends to dip slightly to the south under Lake Erie.

## SUBSURFACE CONDITIONS

### General

Generally uniform subsoil conditions were found to prevail over the site. The subsoil consists of 10-12.5 foot deep cohesive type deposits (silty clay and/or clayey silt) followed by an 18 to 30 foot thick stratum of glacial till, followed by dolomite type bedrock.

The boundaries between different deposits are shown on the Record of Borehole Sheets contained in the Appendix. The estimated stratigraphical profile of Drawing 557509-A is based upon this information.

From ground level downward, the various strata are described in some detail with regard to soil types and properties as follows:

#### Silty Clay

This deposit was intersected in B.H. #1 only immediately below a thin layer of topsoil to a depth of about 4 feet.

The consistency may be classified as very stiff.

#### Clayey Silt, Traces of Sand

Below the topsoil or the above described silty clay stratum, an 8 to 12 foot thick deposit of clayey silt, traces of sand was encountered. A plot of plasticity index versus liquid limit (Fig. 1) shows the points to fall within the CL zone. Laboratory tests yielded the following ranges: Liquid Limit: 18-34%, Plastic Limit: 11-19%, and Natural Moisture Content: 9-20%.

The overall deposit has a hard consistency; 'N' values ranged from 38-71 blows per foot.

#### Heterogeneous Mixture of Gravel, Sand, Silt and Clay (Glacial Till)

The clayey silt deposit is underlain by a stratum of glacial till at every borehole location. The lower boundary was found to vary between elevation 650± and elevation 658±.

The material in the deposit consists of a heterogeneous mixture of gravel, sand, silt and clay. Laboratory tests indicate a great variety of grain size distributions throughout the overall deposit: Gravel: 8-64%, Sand: 21-57%, Silt and Clay: 12-52%. This glacial till is basically granular in nature. There are random localized zones, however, where the matrix is cohesive. In addition, fragments of shale and gypsum were also found in the lower 10 feet of the stratum.

Standard Penetration Tests carried out within the deposit gave 'N' values to range from 48 to over 100 blows per foot. Based on these results, it is estimated that the relative density is dense to very dense.

The natural moisture content was found to be 10% or less.



Bedrock

The bedrock at this site as described by Z. Koniuszy, M.T.C. geologist, is fine textured, soft to medium hard shaley dolomite with horizontal fractures. The depth at which the bedrock was encountered varies between elevation 649.6 and elevation 657.8.

Groundwater Conditions

No groundwater was observed in any borehole during the field investigation.

## DISCUSSION AND RECOMMENDATIONS

### General

It is proposed to construct in two stages, a two span concrete structure, Stage I consisting of a single 83' long span bridge carrying Sterling Street over the future northbound lane of Hwy. 6N. Eventually, Stage II of the construction sequence will consist of converting the initial west abutment into a pier and adding an abutment and span to the west to carry Sterling Street over the future southbound lane.

The profile grade of Sterling Street is proposed to be some 15 to 19 feet above the existing roadway level (elev. 687± - Elev. 683±).

The grade of the future median is set at elevation 677± which is about 5 feet lower than the profile grade (elev. 682±) of the south and northbound lanes (Hwy. 6N).

### Structure Foundations

Spread footings in original ground: The proposed structure may be founded on spread footings placed within the hard clayey silt or the dense to very dense glacial till deposits using allowable bearing values as shown, at or below the following elevations:

East Abutment:	Elev. 678	Net Safe Pressure 3.5 T.S.F.
Future West Abutment:	Elev. 677±	Net Safe Pressure 3.5 T.S.F.
Initial Abutment (Future Pier):	Elev. 673	Net Safe Pressure 4.0 T.S.F.

A frictional resistance to sliding for the abutment (east and future west) footing bases of 2000 PSF is recommended for design purposes. A value of 0.5 (coefficient of friction) is recommended to compute resistance against sliding of the future pier footing base.

### Approaches

Fills up to 19 feet and cuts up to 10 feet deep will be required to achieve the grades of Sterling Street and Hwy. 6N (median). No stability problems are anticipated provided 2:1 slopes (cut and fill) are constructed.

### Other Considerations

All footings should be protected against frost action by at least 4 feet of earth cover.

No dewatering problems are anticipated.

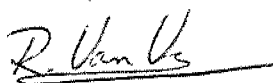
It is estimated that total settlements of about 1 inch will take place at all the footing locations. Differential settlements should be of a negligible order.

To construct the future southbound lane at a later date, it will be necessary to remove about 25 feet of fill and original soil from behind the initial abutment. This may cause a small lateral yield of the abutment wall. The magnitude of this yield is partly dependent on the stiffness of the wall and partly on the properties of the foundation soil and backfill material, and could be in the order of  $\frac{1}{2}$  to  $\frac{3}{4}$  inch. The designer should take this into account.

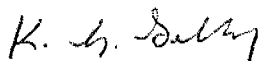
The bases of all spread footing excavations should be protected against softening (run-off water) by a suitable concrete slab poured immediately upon exposure.

#### MISCELLANEOUS

The field investigation was carried out by P.V.K. and Sons Drilling Ltd. under the supervision of Mr. A. Ma, Trainee Engineer.



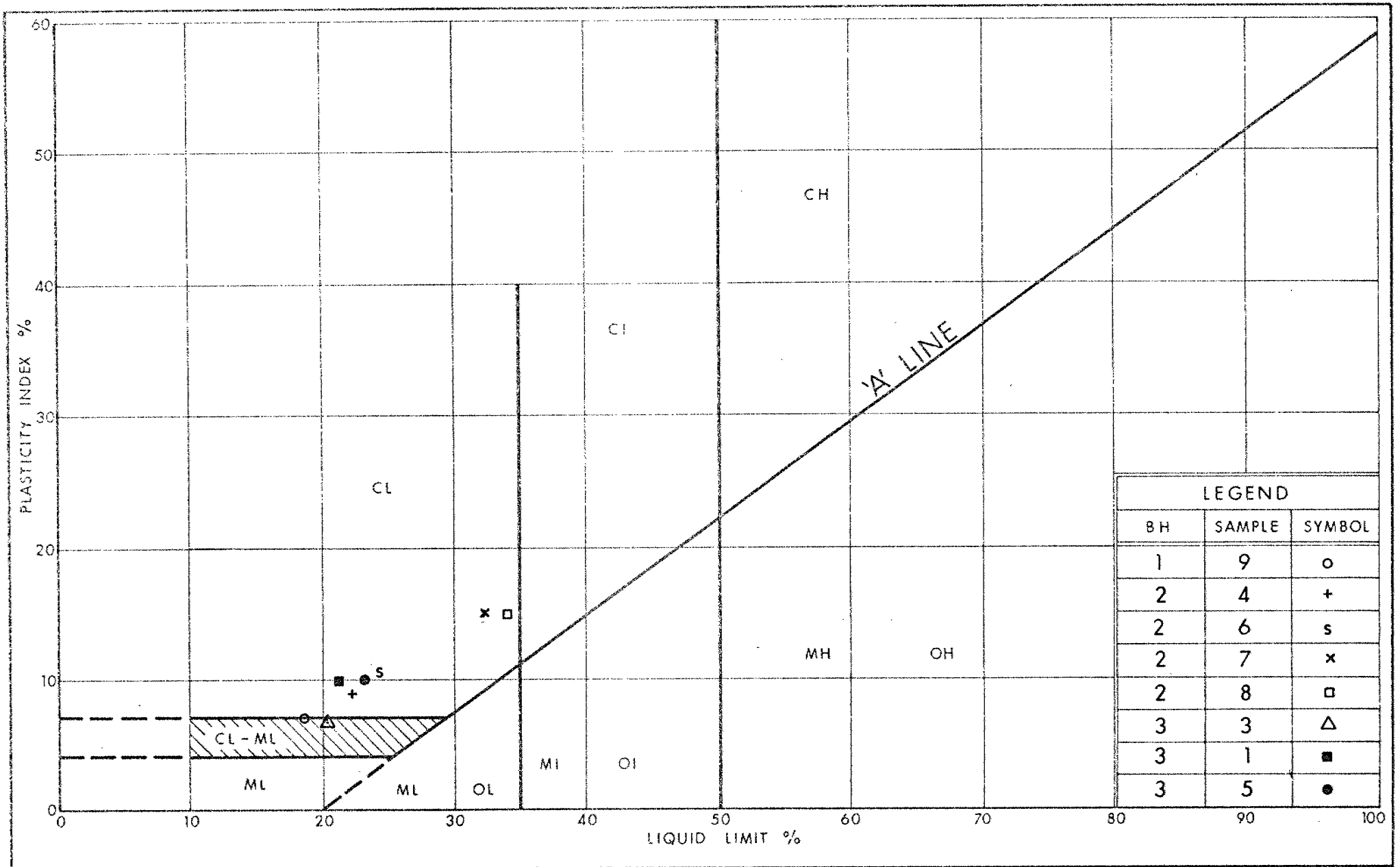
R. Van Veen  
Project Engineer



K.G. Selby, P. Eng.  
Supervising Engineer

KGS/RVV/gs  
April, 1977

## APPENDIX



Ministry of  
Transportation and  
Communications

# PLASTICITY CHART CLAYEY SILT. TRACE OF SAND

FIG No 1

W P 55-75-09

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 55-75-09 LOCATION Sta. 599+53 51' RT C/L Line 'B'  
 DIST 4 HWY 6 N BORING DATE February 25, 1977  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger BXL Rock Core & Cone Test  
 ORIGINATED BY A.M.  
 COMPILED BY A.M.  
 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT —WL PLASTIC LIMIT —Wp WATER CONTENT —w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	Wp	w	WL	
682.2	Ground Level														
0.0	Silty Clay					680									
678.2	Very Stiff		1	SS	26										
4.0	Clayey Silt, Traces of Sand		2	SS	49										
	Hard		3	SS	53										
669.7			4	SS	55										
12.5	Heterogeneous Mixture of Gravel, Sand, Silt & Clay (Glacial Till) Occ. Clayey silt layers		5	SS	85/9"	670									
			6	SS	103										
			7	SS	69										
			8	SS	76/6"	660									
			9	SS	100/5"										
649.7	Very Dense					650									
32.5	Bedrock Weathered Dolomite Sound		10	RC BXL	REC 60%										
644.7	(Shaly)														
37.5	End of Borehole Water Level Not Established														

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 55-75-09 LOCATION Sta. 600+06 34' Lt. C/L Line 'B' ORIGINATED BY A.M.  
 DIST 4 HWY 6 N BORING DATE 22 - 23 February 1977. COMPILED BY A.M.  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
689.6	Ground Level															
0.0	Clayey Silt Traces of Sand		1	SS	30	Borehole Dry 680										
			2	SS	43											
			3	SS	46											
679.6	Hard		4	SS	154											
10.0	Heterogenous Mixture of Gravel, Sand, Silt & Clay		5	SS	161	10"										
			6	SS	85	6"										
	Occ. Clayey Silt Layers (Glacial Till) Dense to Very Dense		7	SS	105	6"										
			8	SS	84	6"										
			9	SS	110	6"										
	Fragments of Shale & Gypsum		10	SS	48	660										
			11	SS	100	1"										
649.6			12	SS	50	10" 650										
40.0	Refusal Probable Bedrock End of Borehole															

20  
15  
10  
5  
% STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 55-75-09 LOCATION Sta. 599+52 113' LT C/L Line "B" ORIGINATED BY A.M.  
 DIST 4 HWY 6 N BORING DATE 28 February 1977 COMPILED BY A.M.  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core CHECKED BY u.f.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
687.8	Ground Level															
0.0	Clayey Silt Trace of Sand		1	SS	94											
	Hard		2	SS	71	680										
			3	SS	42											
675.8			4	SS	38											
12.0	Heterogeneous Mixture of Gravel, Sand, Silt & Clay (Glacial Till)		5	SS	57											
			6	SS	120/2"	670										
			7	SS	-											
	Fragments of Shale & Gypsum		8	SS	57											
			9	SS	75/1/2"											
657.8	Very Dense		10	AS		660										
30.0	Dolomite Bedrock (Shaly)		11	SS	75/0"											
652.8	Sound		12	RC BX	REC 90%											
35.0	End of Borehole Water Level not Established															



## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### PENETRATION RESISTANCE

'N'-STANDARD PENETRATION RESISTANCE - 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>c LB./SQ. FT</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10 % , SOME 10-25 % , WITH 25-40 % , > 40 % SILTY, SANDY, GRAVELLY, CLAYEY ETC

### TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.T	SLOTTED TUBE SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE

P.H SAMPLE ADVANCED HYDRAULICALLY

P.M SAMPLE ADVANCED MANUALLY

### SOIL TESTS

U	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$w_s$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_i$	SENSITIVITY

### GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

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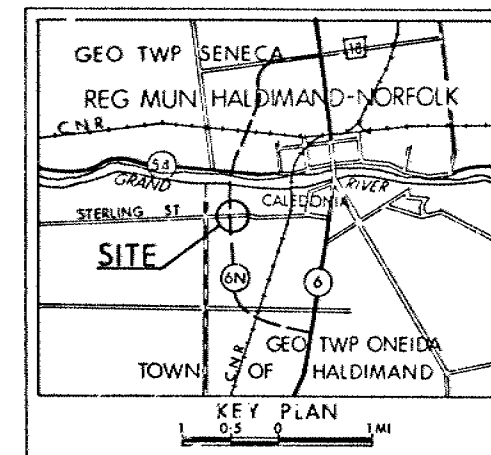
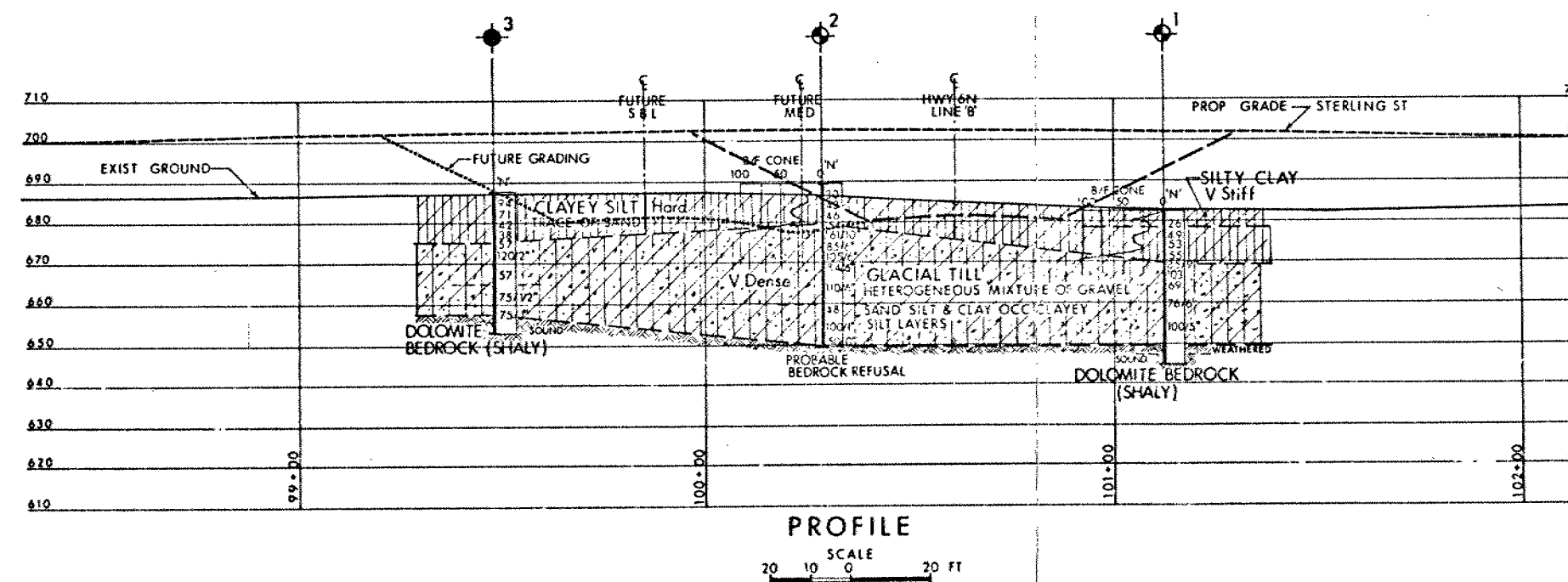
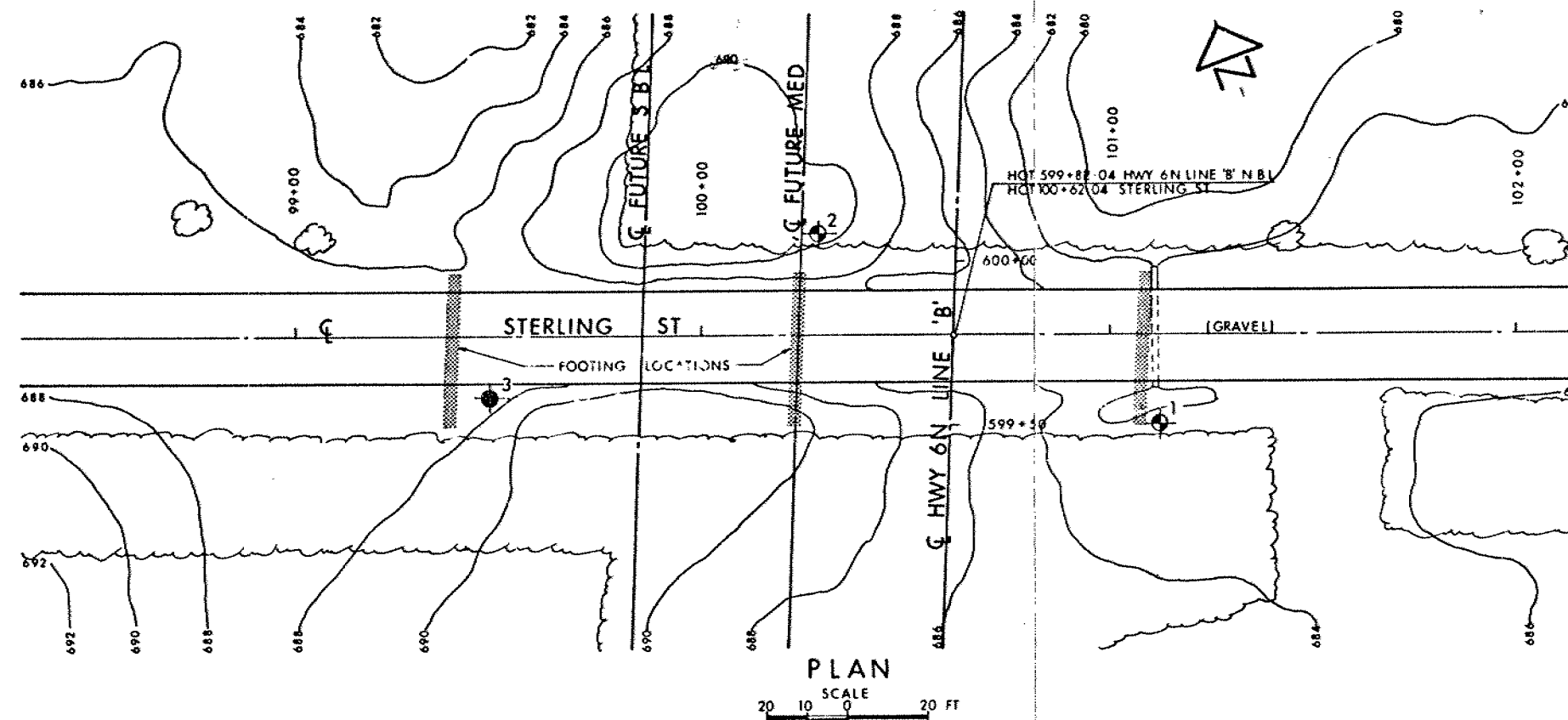
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STERLING ST UNDERPASS

SHEET

BORE HOLE LOCATIONS & SOIL STRATA



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- "N" Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W/L at time of investigation
- NO W! established

No	ELEVATION	STATION	OFFSET LINE 'B'
1	682.2	599+53	51' RT
2	689.6	600+06	34' LT
3	687.8	599+52	113' LT

**NOTE**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

GEOCREs No 30M4-61  
REF No E-5438-1 NOV 1976

HWY No 6 NEW  
DATE APR 19 1977  
DRAWN BY  
CHECKED  
DATE 5/5/75