

GEOCRES No. 30M12-189DIST. 6 REGION W.P. No. 54-82-11CONT. No. 88-48W. O. No. STR. SITE No. 24-325HWY. No. 401/410LOCATION Hwy 401/410 Interchange
Ramp N-E (Bridge #32)No. of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

HORIZONTAL CURVE DATA				
CURVE	#303	#304	#305	#314
Δ	—	41° 31' 20"	—	9° 52' 32"
R	—	350.000	—	1500.000
L	—	275.386	—	258.000
EXT.	—	26.588	—	5.588
T	—	124.053	—	129.593
LS	54.568	—	41.768	—
ΔS	4° 53' 43"	—	4° 20' 43"	—
PARAMETER	160.0	—	160.0	—

WP	STATION	T/A ELEV.	LOCATION
1	1+221.249	193.390	W. ABUT. BRG.
2	1+251.249	192.773	PIER 1
3	1+296.249	191.511	PIER 2
4	1+341.249	189.814	PIER 3
5	1+406.249	186.720	PIER 4
6	1+466.249	183.214	PIER 5
7	1+506.249	181.105	E. ABUT. BRG.

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DISTRICT 6

CONT No

WP No 54-82-11

N-E RAMP STRUCTURE (BR. 32)

HWY. 401/HWY. 410 INTERCHANGE

GENERAL ARRANGEMENT

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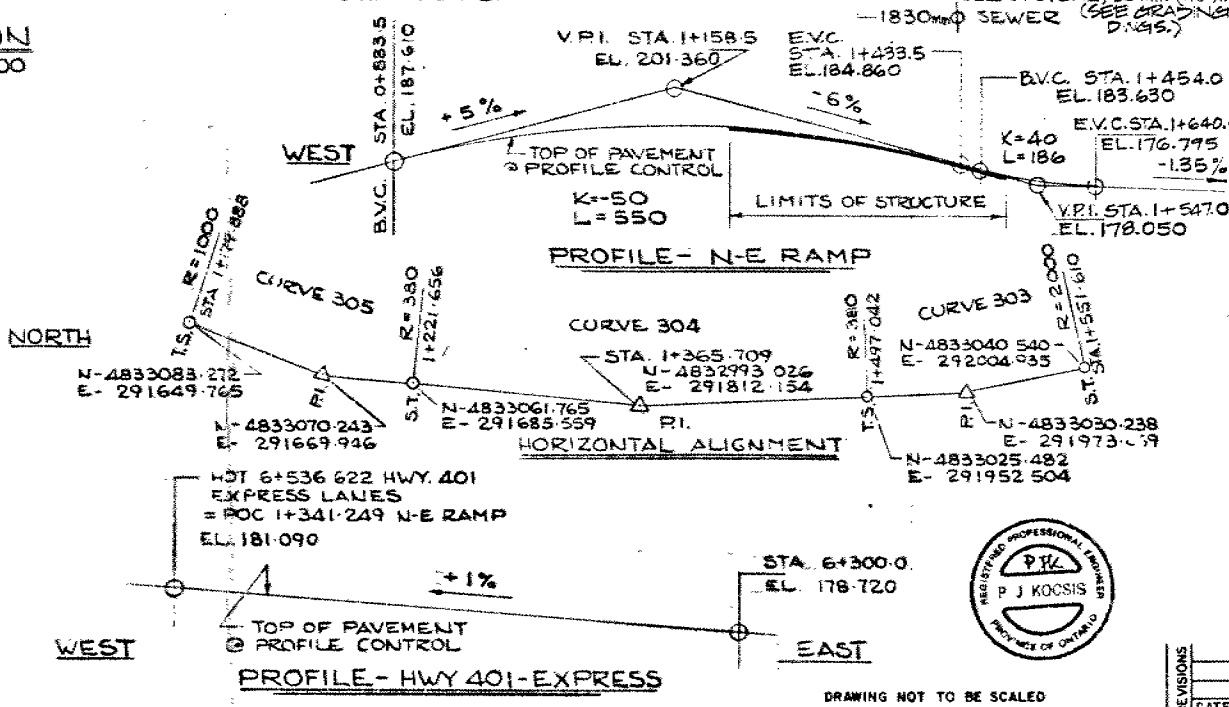
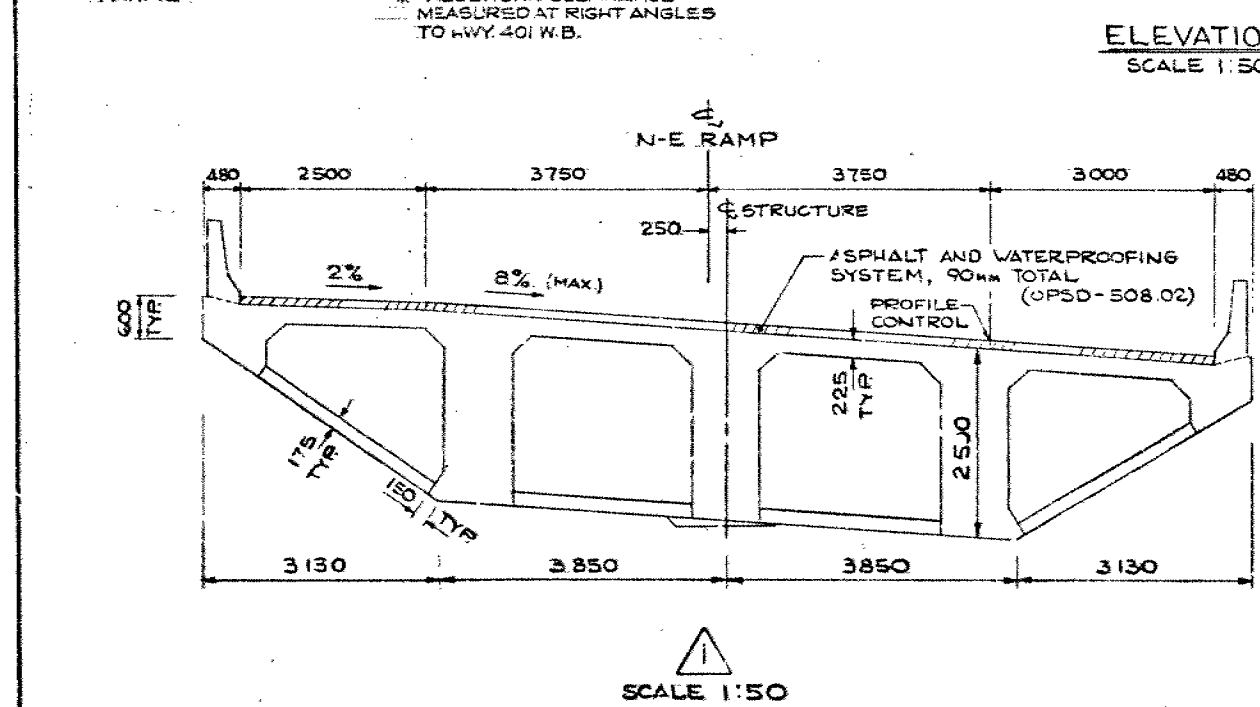
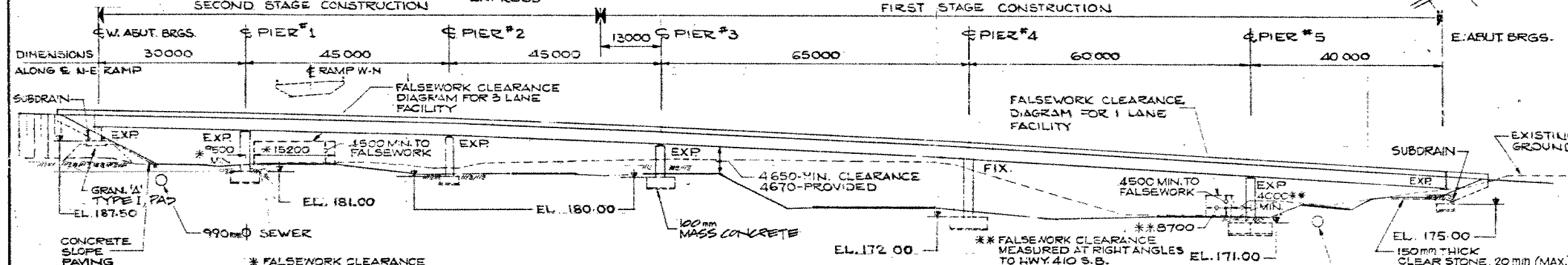
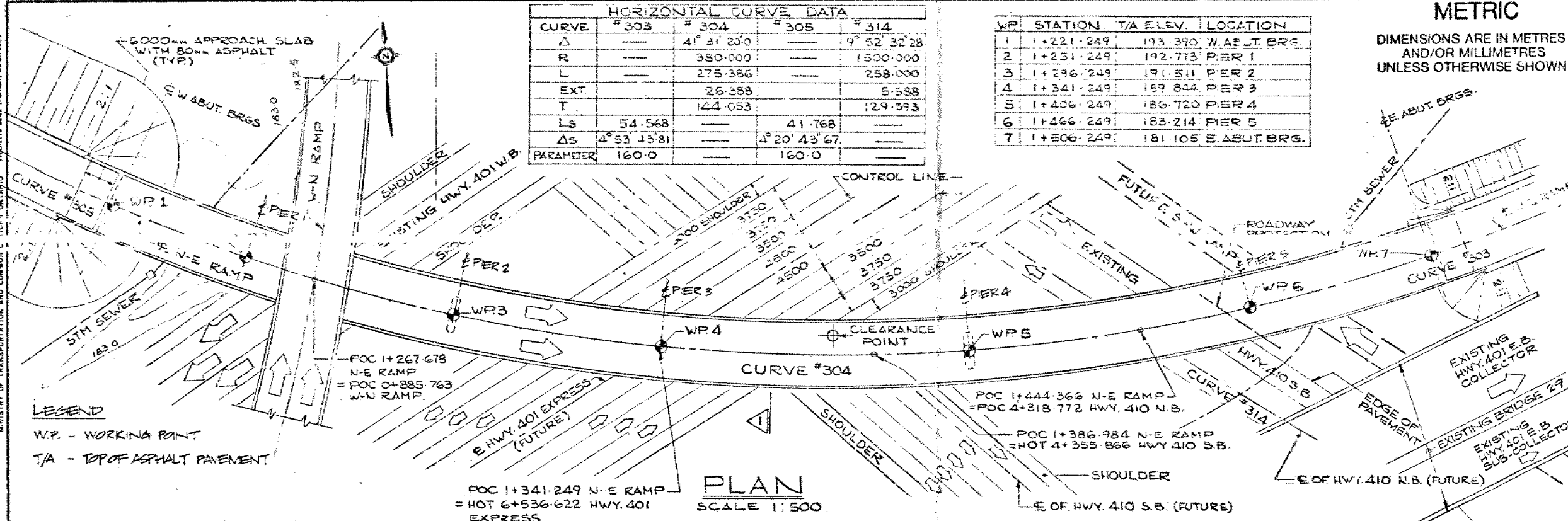
GENERAL NOTES

CLASS - CONCRETE

- FOOTINGS, ABUTMENTS AND WINGWALLS: 20 MPa
- DECK: 35 MPa
- BARRIER WALLS: 30 MPa
- APPROACH SLABS: 30 MPa
- SLOPE PAVING: 20 MPa

CLEAR COVER TO REINFORCING STEEL

- FOOTINGS: 100 ± 25 mm
- ABUTMENTS AND WINGWALLS: 80 ± 20 mm (FRONT FACE), 70 ± 20 mm (BACK FACE)
- PIERS: 80 ± 20 mm
- DECK TOP SLAB: 70 ± 20 mm (TOP), 40 ± 10 mm (BOTTOM)
- BOTTOM SLAB: 40 ± 10 mm (TOP), 50 ± 10 mm (BOTTOM)
- WEB SIDES: 40 ± 10 mm
- BARRIER WALLS: 70 ± 20 mm
- APPROACH SLABS: 70 ± 20 mm



REINFORCING STEEL
REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BARS MARKED WITH SUFFIX 'C' SHALL BE COATED BARS.

CONSTRUCTION NOTES
THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm.
THE SUPERSTRUCTURE SHALL BE BUILT IN TWO CONSTR. STAGES AS SHOWN.

- LIST OF DRAWINGS**
- GENERAL ARRANGEMENT
 - BOREHOLE LOCATIONS & SOIL STRATA
 - FOUNDATION LAYOUT
 - FOUNDATION DETAILS
 - WEST ABUTMENT DETAILS
 - WEST ABUTMENT WINGWALL DETAILS
 - EAST ABUTMENT DETAILS
 - EAST ABUTMENT WINGWALL DETAILS
 - PIER DETAILS - I
 - PIER DETAILS - II
 - BEARING DETAILS - I
 - BEARING DETAILS - II
 - VOID LAYOUT
 - DECK DETAILS
 - LONGIT. CABLE DETAILS - STAGE I
 - LONGIT. CABLE DETAILS - STAGE II
 - CABLE DETAILS AT ABUTMENTS
 - FIRST & SECOND STAGE JOINT DETAILS
 - TRANSVERSE CABLE DETAILS - I
 - TRANSVERSE CABLE DETAILS - II
 - DECK REINFORCING - W. ABUT. TO PIER 1
 - DECK REINFORCING - PIER 1 TO PIER 2
 - DECK REINFORCING - PIER 2 TO PIER 3
 - DECK REINFORCING - PIER 3 TO PIER 4
 - DECK REINFORCING - PIER 4 TO PIER 5
 - DECK REINFORCING - PIER 5 TO E. ABUT.
 - DECK REINFORCING SECTION
 - END BEAM REINF. - WEST ABUTMENT
 - PIER BEAM REINF. - PIER 1
 - PIER BEAM REINF. - PIER 2
 - PIER BEAM REINF. - PIERS 3 & 5
 - PIER BEAM REINF. - PIER 4
 - END BEAM REINF. - EAST ABUTMENT
 - BARRIER WALL NORTH SIDE
 - BARRIER WALL SOUTH SIDE
 - EXPANSION JOINT DETAILS
 - 6000mm APPROACH SLAB
 - DETAILS OF CONC. SLOPE PAVING
 - BRIDGE DATA & SITE NUMBER DATA
 - AS CONSTRUCTED ELEV. & DIM.
 - 41 & 42. QUANTITIES - STRUCTURE



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	P.J.K.	CHECK	S.E.L.
DRAWING	J.E.	CHECK	S.E.L.
LOADING	DMBDC-A-83	DATE	83-07
SITE No	24-81-325	DWG	1

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 54-82-11

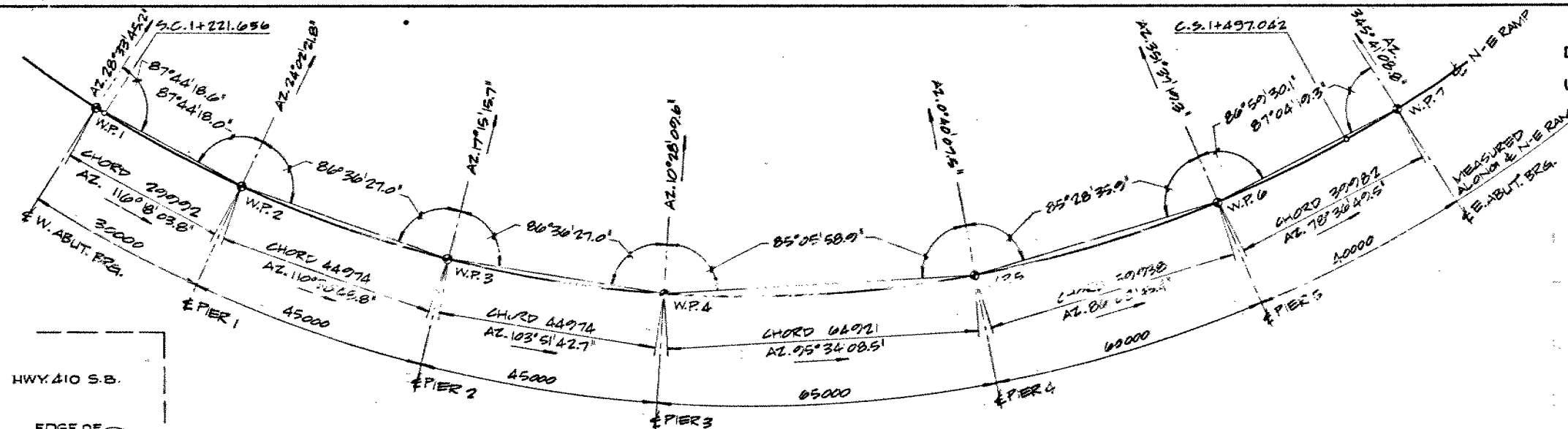
N-E RAMP STRUCTURE (BR. 32)
HWY. 401/HWY. 410 INTERCHANGE
FOUNDATION LAYOUT

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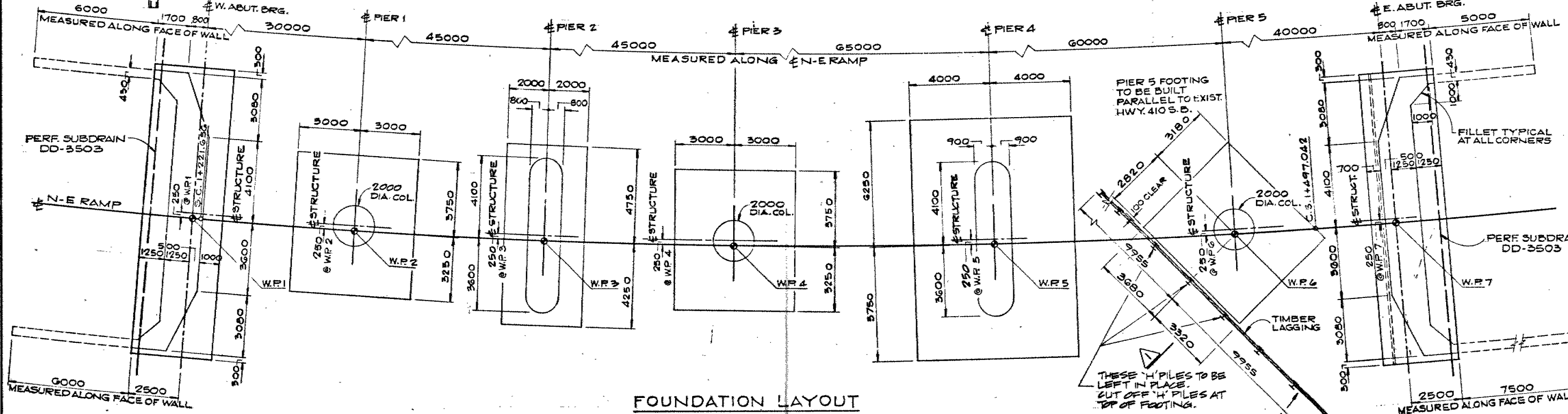
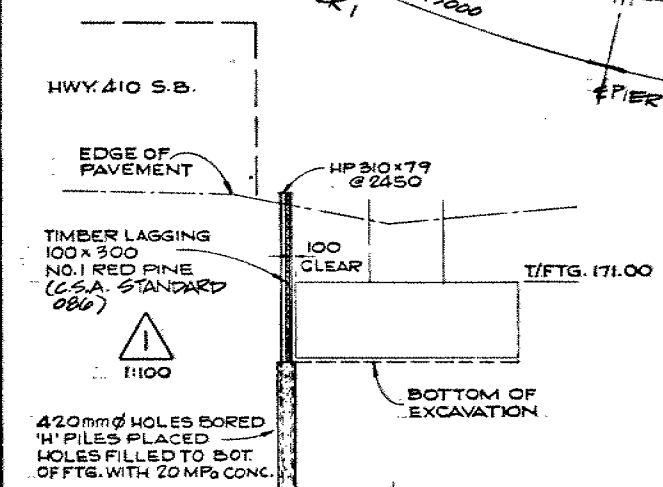


SHEET

POINT	STATION	COORDINATES	
		NORTH	EAST
W.P.1	1+221.220	4833041.040	291385.202
W.P.2	1+251.220	4833048.671	291712.080
W.P.3	1+296.220	4833032.813	291754.174
W.P.4	1+341.220	4833022.038	291797.838
W.P.5	1+406.220	4833015.738	291802.452
W.P.6	1+466.220	4833010.767	291922.254
W.P.7	1+506.220	4833027.600	291961.440
S.C.	1+221.656	4833061.765	291685.559
C.S.	1+497.042	4833025.482	291952.504



ALIGNMENT LAYOUT
N.T.S.



FOUNDATION LAYOUT
1:100

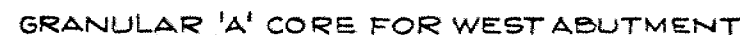


DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	J.C.L.	CHECK P.J.K.	LOADING OHBDC-A-83
DRAWING	G.S.N.	CHECK J.C.L.	SITE No 24-81-325
			DATE 85-07
			DWG 3

EXPOSED GRADE BEARING
FOOTINGS REQUIRES PROTECTION
FROM SOFTENING. PLACE MASS
CONCRETE WITHIN 12 HOURS OF
EXCAVATION.

O.F. - OUTSIDE FACE
I.F. - INSIDE FACE
T/FTG. - TOP OF FOOTING
E.E. - EACH END
E.F. - EACH FACE
T & B - TOP & BOTTOM



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS						
DATE	BY	DESCRIPTION				
DESIGN	JCL	CHECK	P.L.	LOADING	OH90C-A-83	DATE 85-07
DRAWING	G.S.N.	CHECK		SUP'S N.	74-61-228	DATE 85-07



Ontario

Ministry of
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foundation investigation and design report

**ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION**

WP 54-82-11

DIST 6

HWY 401/410

STR SITE 24-325

Bridge #32 Ramp N-E 401/410 Interchange

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FOUNDATION INVESTIGATION REPORT

For

Bridge #32, Ramp N-E 401/410 Interchange

W.P. 54-82-11; Site 24-325

District 6, Toronto

INTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation carried out between 84-09-28 and 84-10-10 at the structure site mentioned above. The fieldwork consisted of 9 sampled boreholes advanced by means of solid stem augers or washing boring BX casing. The boreholes ranged in depth from 2.0 to 5.7 m with bedrock being proven in 8 of the boreholes. Bedrock was sampled by coring up to 4.3 m of rock using either a BQ or NXL core barrel.

SITE DESCRIPTION AND GEOLOGY

The site is located at the existing partial interchange of Highway 401 and Highway 410 in the City of Mississauga, Regional Municipality of Peel.

Land use in the area is predominantly industrial subdivisions. The ground surface in the investigated area is generally level and tends to slope down gently to the east. At the eastern limit of the site is a 10 m cut in which the existing Highway 410 southbound lane is located.

The site is located in the physiographic region known as the "Peel Plain". This region is characterized by a level to undulating "till or boulder clay" plain underlain by shale or limestone bedrock. In the vicinity of this site the overburden is very shallow with shale bedrock very close to the surface.

SUBSURFACE CONDITIONS

General

The subsurface conditions across the site are quite uniform with a surficial deposit of a heterogeneous mixture of silty clay some sand. This cohesive deposit varies in thickness from 0.4 to 2.0 m and is underlain by shale bedrock which is generally very weathered in the upper 1 to 2 m. At one borehole location on the south side of westbound Highway 401 a 1.4 m stratum of silt of slight plasticity was encountered overlying the deposit of silty clay.

The boundaries between the various soil types, in-situ and laboratory test results are shown on the attached Record of Borehole Sheets. The elevations and locations of the boreholes along with an estimated stratigraphical profile based on borehole data, are shown on Drawing No. 548211-A.

The various soil types encountered are described in the following paragraphs.

Silt, some Sand, Trace of Clay

This 1.4 m thick surficial deposit was encountered in only one borehole located on the south side of the Highway 401 westbound lanes (BH 4). The silt was found to be of slight plasticity with the deposit being assessed as cohesive.

Grain size distribution testing carried out on a sample from this stratum indicates that the deposit is predominantly silt. Results of the testing are plotted on Fig. 1.

Based on interpretation of an 'N' value of 101 the consistency of this generally cohesive deposit is assessed to be hard.

Heterogeneous Mixture of Silty Clay some Sand

This cohesive deposit was encountered across the site and varies in thickness from 0.4 to 2.0 m.

Atterberg Limits testing carried out on two samples from this stratum indicate the deposit to vary from a silty clay of low plasticity (CL-ML zone) to a silty clay of intermediate plasticity (CI zone). The results of these tests are plotted on Fig. 2.

The consistency of this layer varies from stiff to hard based on 'N' values ranging from 11 to 60 blows per 0.3 m.

Shale Bedrock

Bedrock was encountered in all boreholes with the top of rock elevation varying from 172.2 at the bottom of the existing Highway 410 cut to 183.0 on the generally level plain.

Bedrock was proven by obtaining up to 4.3 m of BQ or NXL rock core. Bedrock is of the Georgian Bay Formation and is generally a grey shale with occasional limestone layers 10 to 500 mm thick. The limestone layers generally tend to comprise 20% of the bedrock mass with occasional zones where 50% of the rock is limestone. The upper bedrock is weathered to varying degrees and becomes less weathered with depth (see borehole logs). Rock core recovery rates varied from 25 to 100%. Based on rock quality designation (RQD) values ranging from 0 to 81%, the quality of the bedrock is assessed to be very poor to good, but generally being very poor to poor. For a detailed description of the bedrock see Description of Rock Core in the Appendix.

Not in Appendix (add to contract report)

Groundwater

The water table varies considerably across the site. In the existing Highway 410 cut the water table appears to be at an elevation of 172.7 which corresponds to the bottom of the ditch. Outside of the Highway 410 cut the water table varies from an elevation of 180.6 adjacent to Highway 410 (BH 6) to 183.0 in the vicinity of the existing Highway 401 westbound lanes.

DISCUSSION & RECOMMENDATIONS

General

The existing partially completed Highway 401/410 interchange is to be upgraded to a high speed 4 level interchange. In order to provide high speed access from the Highway 410 southbound lanes to the Highway 401 eastbound lanes a 6 or 7 span structure is contemplated. The proposed structure will require approach fills in the order of 9 m at the north abutment and 1 to 2 m cuts at the southeast abutment.

The predominant subsurface conditions generally consist of a shallow deposit of a heterogeneous mixture of silty clay some sand. Underlying this thin stratum is shale bedrock.

The following paragraphs outline our recommendations pertaining to the design and construction of the structure foundations and related earthworks.

Structure Foundations

North Abutment

It may be contemplated to use a perched abutment in which case it may be founded on steel 'H' piles driven into the shale bedrock. A steel HP 310 x 110 pile may be designed for a factored axial capacity at the U.L.S. of 1600 kN and a bearing capacity at the S.L.S. Type II of 1150 kN. An estimated pile tip elevation of 181.5 may be used for estimating purposes.

Alternatively, the abutment may be founded on spread footings located within the shale bedrock. The spread footing may be founded either in the weathered or unweathered bedrock with elevations and the applicable bearing capacities listed below.

Founding Elevation	Factored Bearing Capacity at the U.L.S. (kPa)	Bearing Capacity at the S.L.S. Type II (kPa)
181.5	1,000	670
180.7	1,500	1,000

Piers and South Abutment

The piers and south abutment may be placed on spread footings founded within the shale bedrock or the overlying hard soils. The founding elevations along with corresponding bearing capacities are provided in tabular form on the following page.

Structure Element	Reference Borehole	Founding Elevation	Factored Bearing Capacity at the U.L.S. (kPa)	Bearing Capacity at the S.L.S. Type II (kPa)
Pier 1	3	181.0*	1,000	670
		180.0	1,500	1,000
Pier 2	4	181.4+	600	400
		180.0	1,500	1,000
Pier 3	5	182.0*	800	550
		181.0*	1,000	670
		180.0	1,500	1,000
Pier 4	6	182.0*	1,000	670
		181.5	1,500	1,000
Pier 5	6&7	172.0	1,500	1,000
Pier 6	8	171.6	1,500	1,000
South-East Abutment	9	176.8	1,500	1,000

NOTE: * Footing is founded within moderately weathered bedrock.
 x Footing is founded within highly weathered bedrock.
 + Footing is founded on hard silty clay (till).
 All other footings are founded on unweathered bedrock.

The least expensive foundation alternative should be chosen.

Resistance to Lateral Forces

The following unfactored friction coefficients or adhesion values may be used for design of sliding between the base of the footing and the founding stratum.

Hardy Silty Clay (Till)	100 kPa
Weathered Shale	$\tan 18^\circ$
Unweathered Shale	$\tan 24^\circ$

If adequate resistance to sliding is not obtained using the above values, please contact this office for suggested alternatives.

General Foundation Requirements

A lean concrete working pad should be placed over the exposed shale bedrock within 12 hours of completion of the footing excavation. This is required to prevent degradation of the founding shale surface.

All footing elements should be provided with a minimum of 1.3 m of earth cover for frost protection purposes.

All spread footings founded on a 2:1 cut slope should be provided with a minimum 2 m horizontal distance from the footing edge to the slope. If the slope is steeper than 2:1 the footing should be located outside the limits of a line drawn at 2 horizontal to 1 vertical from the toe of slope.

Pile tips should be equipped with standard tip reinforcement.

The maximum gradation of all fill placed within the zone of pile penetration should be restricted to 75 mm.

The abutments should be backfilled with a free draining granular material as per SP 121 and earth pressures against the abutment wall should be computed as per Subsection 6.6.1.2 of the O.H.B.D.C. Manual. The soil properties to be used in earth pressure calculations are as follows:

	ϕ	(kN/m ³)
Granular 'A'	35°	22
Granular 'B'	30°	21.2

The abutment footings should be assumed to be unyielding and therefore should be designed for the at rest (K_0) condition.

No dewatering difficulties are anticipated for the footing excavations due to the nature of the soils and bedrock. Localized seepage into the excavations can be controlled by pumping from sumps.

Slope Stability and Settlement

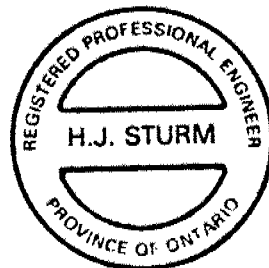
The 9 m high approach fills at the north abutment should be stable if constructed with standard 2:1 slopes.

Settlement of the underlying subsoils should be less than 25 mm, but the approach fill itself can be expected to settle up to 1 percent of the fill height. The contract should be scheduled such that these high fills are placed in the early stages of construction to allow for a minimum of 6 months of settlement prior to paving operations.

The 1 to 2 m rock cuts at the south-east abutment should be cut to a 2:1 slope to ensure long term stability of the shale.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. D. Thanasse, Student Specialist, utilizing equipment owned and operated by Longyear Canada Inc., Toronto. This report was written by Mr. H. J. Sturm, Project Foundations Engineer and reviewed by Mr. D. Dundas, Foundation Engineer.



A handwritten signature in cursive script, appearing to read "H.J. Sturm".

H. J. Sturm, P. Eng.
Project Foundations Engineer

A handwritten signature in cursive script, appearing to read "D.H. Dundas".

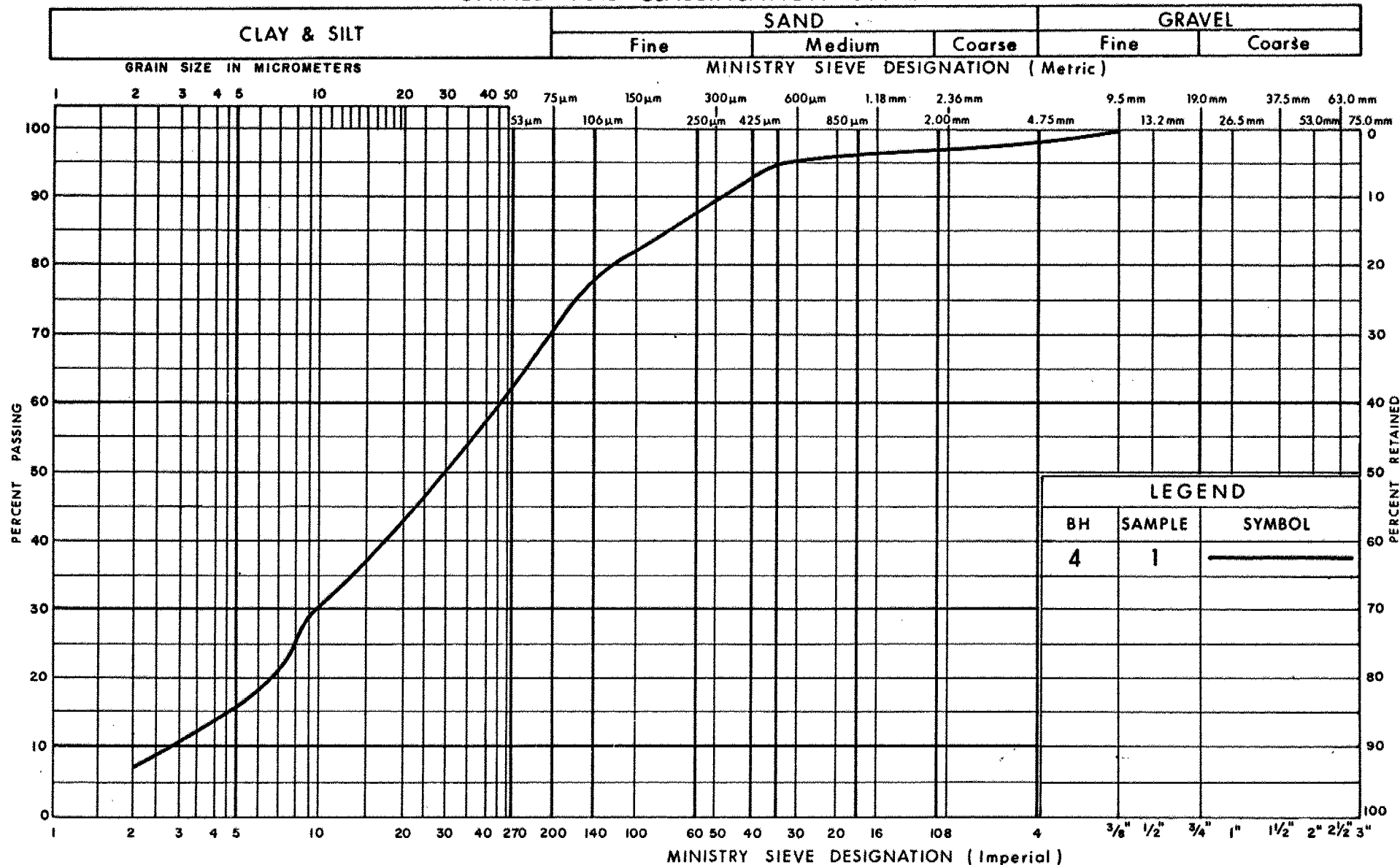
D. Dundas, P. Eng.
Foundation Engineer

for

M. Devata, P. Eng.
Chief Foundations Engineer (East)

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM

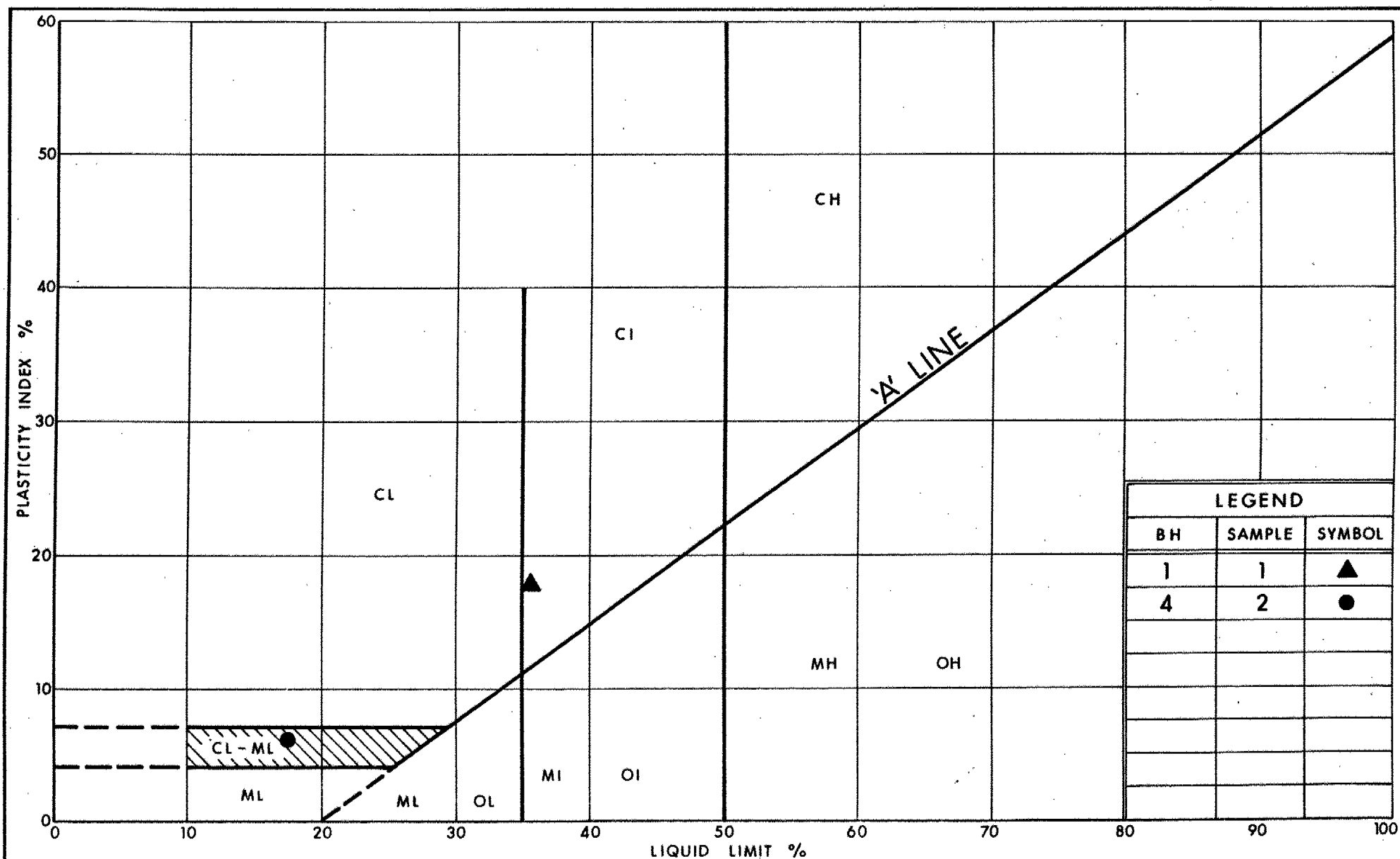


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GRAIN SIZE DISTRIBUTION
SILT, SOME SAND TRACE OF CLAY

FIG No 1

W/P 54-82-11



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PLASTICITY CHART HET MIXTURE OF SILTY CLAY, SOME SAND

FIG No 2

W P 54-82-11

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ³	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No 1

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 074.3; E 291 663.8 ORIGINATED BY DT
 DIST 6 HWY 410/401 BOREHOLE TYPE Solid Stem Auger COMPILED BY HS
 DATUM Geodetic DATE 84 10 03 CHECKED BY GP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _p	W	W _L		
184.5	Ground Surface															
0.0	Heterogeneous Mixture of Silty Clay some sand Occasional pieces of shale		1	SS	11	*										
	stiff															
	hard		2	SS	57											
182.5	End of Borehole Refusal to Auger Probable Bedrock															
2.0	* Note: Water table not obtained.															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE


RECORD OF BOREHOLE No 2										METRIC							
W P 54-82-11		LOCATION Co-ords. N 4 833 058.8; E 291 687.5		ORIGINATED BY DT													
DIST 6 HWY 410/401		BOREHOLE TYPE Wash Bore BX Casing, BQ Rock Core		COMPILED BY HS													
DATUM Geodetic		DATE 84 10 03		CHECKED BY <i>[Signature]</i>													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
183.9	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay some sand																
183.0	Occasional shale slabs																
0.9																	
	Gray Shale Bedrock with Limestone Bands		1	RC BQ													
			2	RC BQ													
			3	RC BQ													
			4	RC BQ													
	Gray Limestone Bedrock with Shale Bands		5	RC													
			6	BQ													
178.7																	
5.2	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 048.5; E 291 711.2 ORIGINATED BY DT
DIST 6 HWY 410/401 BOREHOLE TYPE Wash Bore BX Casing, BQ Rock Core COMPILED BY HS
DATUM Geodetic DATE 84 10 03 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80						100
182.0	Ground Surface																
0.0	Heterogeneous Mixture					*											
181.6	of Silty Clay some sand																
0.4	Grey Shale Bedrock with Limestone Bands		1	RC BQ			181-	58%	11%	Weathering Moderately to Slightly							
			2	RC BQ		180-	100%	21%	Highly Slightly								
179.7	Grey Limestone Bedrock																
2.3	End of Borehole																
	* Note: Water table not obtained																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4										METRIC				
W P 54-82-11		LOCATION Co-ords. N 4 833 035.5; E 291 743.6				ORIGINATED BY DT								
DIST 6 HWY 410/401		BOREHOLE TYPE Solid Stem Auger, NXL Rock Core				COMPILED BY HS								
DATUM Geodetic		DATE 84 10 10				CHECKED BY								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	IN VALUES			20	40					
182.8	Ground Surface													
0.0	Silt some sand trace clay Hard		1	SS	101									1 28 64 7
181.4	Heterogeneous Mixture of Silty Clay some sand some shale fragments Hard		2	SS	60									
180.5			3	SS	20	5 cm								
2.3	Grey Limestone Bedrock Occasional Shale Seams		4	RC NXL										
	Grey Shale Bedrock with Limestone Layers 2 to 50 cm thick		5	RC NXL										
177.1	End of Borehole													
5.7	* Note: Water level not obtained													

RECORD OF BOREHOLE No 5

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 021.5; E 291 796.4 ORIGINATED BY DT
 DIST 6 HWY 410/401 BOREHOLE TYPE Solid Stem Auger, BQ Rock Core COMPILED BY HS
 DATUM Geodetic DATE 84 10 05 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
183.9	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay with sand Occasional Rock Slabs Very Stiff		1	SS	14/	8 cm spoon bouncing	183										
182.6								REC	RQD	Weathering							
1.3	Grey Shale Bedrock with Limestone Layers 5 to 20 cm thick		2	RC BQ			182	61%	0	Highly to Moderately							
180.9			3	RC BQ			181	83%	0								
3.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6										METRIC				
W P 54-82-11		LOCATION Co-ords. N 4 833 015.0; E 291 856.2				ORIGINATED BY DT								
DIST 6 HWY 410/401		BOREHOLE TYPE Solid Stem Auger, BQ Rock Core				COMPILED BY BS								
DATUM Geodetic		DATE 84 10 05				CHECKED BY [Signature]								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
183.4 0.0	Ground Surface													
182.5 0.9	Heterogeneous Mixture of Silty Clay some sand													
	Gray Limestone		1	RC										
	Gray Shale Bedrock			BQ										
	Gray Limestone Bedrock Occasional Shale Seams		2	RC										
				BQ										
	Gray Shale Bedrock Occasional Limestone Layers 2 cm thick		3	RC										
				BQ										
179.3 4.1	End of Borehole													

RECORD OF BOREHOLE No 7

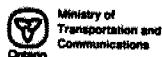
METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 016.2; E 291 897.0 ORIGINATED BY DT
 DIST 6 HWY 410/401 BOREHOLE TYPE Solid Stem Auger, BQ Rock Core COMPILED BY HS
 DATUM Geodetic DATE 84 10 01 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W _n	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
172.7	Ground Surface																
0.0	Heterogeneous Mixture					*		REC	RQD	Weathering							
172.2	of Silty Clay some sand									Highly							
0.5			1	RC BQ			172	69%	21%	Slightly to Unweathered							
	Gray Shale Bedrock with Limestone Layers 4 to 20 cm thick		2	RC BQ			171	100%	14%								
			3	RC BQ			170	100%	25%								
169.4	End of Borehole																
3.3	* Note: Water level not obtained																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8										METRIC							
W P 54-82-11		LOCATION Co-ords. N 4 833 019.2; E 291 923.0		ORIGINATED BY DT													
DIST 6 HWY 410/401		BOREHOLE TYPE Wash BX Casing, BQ Rock Core		COMPILED BY HS													
DATUM Geodetic		DATE 84 09 28		CHECKED BY <i>CP</i>													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	Wp	W	Wl	γ	GR	SA	SI	CL	
172.7	Ground Surface																
0.0	Topsoil																
172.3	Silty Clay some sand																
0.4																	
	Gray Shale Bedrock with Limestone Layers 1 to 20 cm thick		1	RC BQ			172	54%	0								
			2	RC BQ			171	90%	40%								
			3	RC BQ			170	88%	39%								
169.2	End of Borehole																
3.5																	



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 9

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 028.5; E 291 965.7 ORIGINATED BY DT
DIST 6 HWY 410/401 BOREHOLE TYPE Wash BX Casing, BQ Rock Core COMPILED BY HS
DATUM Geodetic DATE 84 09 28 CHECKED BY GP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
178.1	Ground Surface															
0.0	Heterogeneous Mixture of Silty Clay some sand					178										
177.2							REC	RQD	Weathering							
0.9			1	RC BQ	*	177	100%	0%	Moderately							
	Grey Shale Bedrock with Limestone Layers 1 to 15 cm thick		2	RC BQ		176	100%	50%	Unweathered							
			3	RC BQ			88%	80%								
175.0																
3.1	End of Borehole															
	* Note: Water table not encountered.															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

memorandum



To: File

Date: 1988 12 21

From: Foundation Design Section
Room 315, Central Building

RE: Pier #3 Footing
Bridge #32
Contract 88-48
W.P. 54-82-11, Site 24-325
Hwy. 401/410 IC, District 6, Toronto

Further to B. Barsalou's memo dated 88 12 20, we have reviewed the foundation recommendations related to the above mentioned footing. As part of this process, we have reviewed the most recent survey data provided by the construction staff.


The survey data indicates that the present elevations at Pier 3 are as follows:

NE corner	177.45
SE corner	179.36
SW corner	180.21
NW corner	178.57

A profile from the crest of the embankment (401 level) to the toe (410 level) was also provided.

The following comments and recommendations were provided to the Central Region Structural Section (B. Barsalou) and the project supervisor (Kelly Saarits) on 88 12 21.

- 1) In our opinion, the over excavations and incorrect footing elevation problems at this project are a direct result of the Contractor layout and inspection approach. The designer relies upon the correct implementation of his design, and without this assurance there will be increasing concern about professional liability.
- 2) At some locations, the bedrock has been excavated below the recommended footing elevation of 177.7 m. It is noted that 177.7 m is already a revised elevation due to previously reported overexcavation problems. In view of our concerns regarding deterioration of the shale bedrock when it is exposed to weather, the footing elevation should be revised to a minimum of 0.3m below existing ground.
- 3) In order to avoid a reduction in bearing capacity, the base of the footing should be a minimum of 3m from a 2H:IV slope. This requirement would place the base of the footing at elevation 177.0m or below.
- 4) In view of uncertainties, elev. 176.5 is recommended and was discussed with K. Saarits on 88 12 21 at 12.00.


D. Dundas, P. Eng.
Sr. Foundation Engineer

MINISTRY OF TRANSPORTATION

M E M O R A N D U M

TO: Mr. M.S. Devata
Chief Foundation Engineer, East
Foundation Design Section
Central Building

DATE: 1988-12-20

Attention Mr. D. Dundas

FROM: Structural Section
Central Region

RE: W.P. 54-82-¹¹~~00~~, Contract 88-48
Hwy 401/410 Interchange, Bridge #32
District 6, Toronto

Further to our recent discussions, and field survey data forwarded directly to you by construction staff, we would request that the Foundation Section evaluate the existing conditions at the Pier No. 3 location and provide recommendations for site preparation prior to pier construction.

As discussed, over-excavation under a previous Contract has left the site of this pier at about proposed grade. Your office was advised of this in October, and remedial measures were developed and presented by Mr. Dundas at an October 19, '88 project team meeting. Recommendations at that time were to excavate an additional .3m to ensure the exposure of unweathered rock. It has now been observed that in fact the excavation at one corner of the pier footing is already at about the extra .3m depth and that even further excavation will be required to ascertain unweathered rock.

We would appreciate recommendations at your earliest possible convenience as construction staff have terminated work at this location pending resolution of this matter.

We trust you will find this satisfactory.



Robert R. Barsalou
Structural Engineer
for:
G.C.E. Burkhardt
Head, Structural Section

RRB/

c.c. G. Al-Bazi
K. Pilgrim

MINISTRY OF TRANSPORTATION

M E M O R A N D U M



TO: Mr. S. Gwartz
Quality Assurance
Central Region

DATE: 1988-12-02

FROM: Structural Section
Central Region

RE: Highway 401/410 Interchange
Bridge #32, Cont. 88-48
District 6, Toronto

Further to recent consultations with the Foundation and Design Offices, a revision to the bearing design on Pier 3 of the above structure is hereby being implemented.

This change will allow the bridge sub-structure to accommodate the possible horizontal displacement of the pier anticipated under excavation for bridge #30, as discussed at a project team meeting held on October 19, 1988.

We trust you will find this satisfactory and will proceed to have these changes implemented by construction staff. Please do not hesitate to contact the undersigned for additional information or clarification on the above.

A handwritten signature in cursive script that reads "Bob Barsalou".

Bob Barsalou
Structural Engineer
for:
G.C.E. Burkhardt
Head, Structural Section

GCEB:jlk
c.c.: G. Al-Bazi
D. Dundas
K. Pilgrim

memorandum



To: W.L. Lin
Design Engineer
Structural Office

Date: 85 09 27

From: Foundation Design Section
Rm. 315, Central Building

Re: N.E. Ramp (Bridge #32)
WP 54-82-11, Site 24-81-325
Hwy. 401/410 Interchange
District 6

This Section has reviewed the submitted final drawings and special provisions for this project.

Our comments are as follows:

- 1) The mass concrete working pad required to prevent degradation of the shale bedrock in excavations at this site should be placed as soon as possible after completion of the footing excavations -- preferably within 6 hours.

If there are any questions, please contact this office.

A handwritten signature in dark ink, reading "D.H. Dundas".

D.H. Dundas, P. Eng.
Foundations Engineer

FOR

M. Devata, P. Eng.
Chief Foundations Engineer
(East)

DD/ta

memorandum



To: W.L. Lin
Design Engineer (Central)
Structural Office

Date: 1985 02 18

From: Foundation Design Section
Room 315, Central Building

RE: N-E Ramp Structure, Bridge #32
Hwy. 401/410 Interchange
W.P. 54-82-11, Site 24-81-325

We have reviewed the preliminary General Arrangement Drawing #24-81-325-P1 for the above-noted structure and provide the following comments.

The west abutment may alternatively be founded on a granular 'A' pad which is probably more economical than driving short piles to bedrock. The subsoils should be subexcavated down to bedrock (approximate elevation 183.0) and the granular 'A' core founded at this elevation. See attached drawing for design details. The spread footing founded on the granular 'A' pad may be designed for a factored bearing capacity of 900 kPa at the U.L.S. and a bearing capacity of 350 kPa at the S.L.S. Type II.

We note that all spread footings are founded within the unweathered shale.

The angle of the cut and fill slopes should be indicated on either the plan or elevation. All slopes should be 2:1 or flatter.

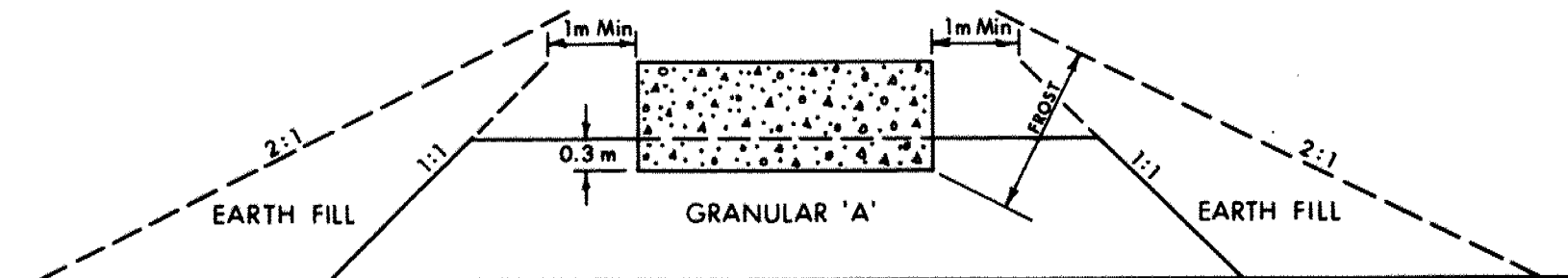
A general note should be provided on the General Arrangement Drawing indicating a lean concrete working pad is to be placed over the exposed shale bedrock within 12 hours of completion of the footing excavation.

A handwritten signature in black ink, appearing to read "H. Sturm".

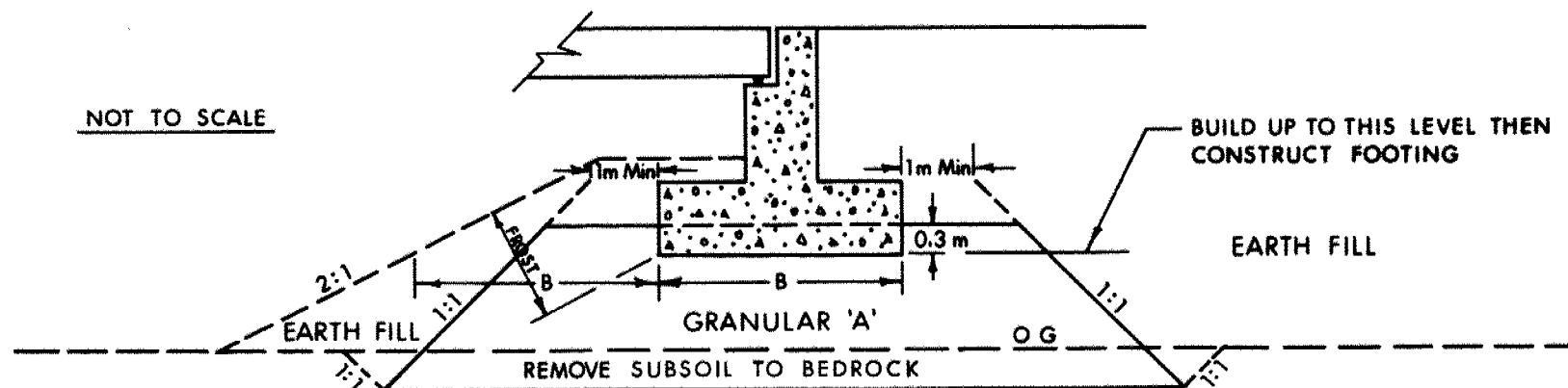
H. Sturm, P. Eng.
Project Foundations Engineer

HS/mmj

c.c. - G.C.E. Burkhardt



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1- SUBEXCAVATE DOWN TO BEDROCK UNDER AREA OF COMPACTED GRANULAR 'A'
- 2- PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T C STANDARDS.
- 3- CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



Ministry of
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Communications

ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

FIG No 1

W P 54-82-11

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
2	0.92 - 1.53	25	0	0.92 - 2.69	Shale and limestone, highly weathered, high core loss
	- 2.16	25	0	- 3.15	Limestone (60%), grey, moderately weathered, with shale (40%), highly weathered (assumed from high core loss), very closely spaced fractures
	- 3.05	63	26		
	- 4.66	65	16		
	- 4.83	100	0	- 5.22	Limestone (80%), light grey, unweathered, with shale (20%), slightly to unweathered, very closely spaced fractures
	- 5.22	93	0		
3	0.43 - 1.35	58	11	0.43 - 1.35	Shale (50%), brownish grey, moderately weathered, with limestone (50%), brownish grey, slightly weathered
	- 2.34	100	21	- 1.98	Shale (100%), grey, moist, highly weathered, very closely spaced fractures
				- 2.34	Limestone (100%), light grey, slightly weathered, closely spaced joints
4	2.37 - 3.84	71	0	2.37 - 3.91	Limestone (90%), grey, unweathered, closely spaced joints with occasional shale (10%), slightly weathered
	- 5.67	100	37	- 5.67	Shale (60%), grey, unweathered, closely spaced joints with limestone (40%), light grey, unweathered, moderately spaced joints, 2 to 50 cm thick layers
5	1.35 - 2.37	61	0	1.35 - 2.98	Shale (50%), grey, moderately to highly weathered, with limestone (50%), light grey, slightly weathered, from 5 to 20 cm thick layers
	- 2.98	83	0		

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
6	0.92 - 1.76	64	0	0.92 - 1.14	Limestone (100%), light grey, slightly weathered, closely spaced joints
	- 3.41	100	9		
	- 4.12	93	21	--1.76	Shale (100%), grey, highly weathered and clayey
				- 3.41	Limestone (98%), light grey, slightly weathered to unweathered, with occasional shale (2%), moderately weathered
				- 4.12	Shale (95%), grey, slightly weathered to unweathered, with occasional limestone layers (5%), 2 cm thick layers
7	0.46 - 1.45	69	21	0.46 - 0.84	Shale, highly weathered, high core loss
	- 2.34	100	14		
	- 3.25	100	25	- 3.25	Shale (75%), slightly weathered to unweathered, closely spaced joints, with limestone layers (25%), unweathered, closely spaced joints, 4 to 20 cm thick layers
8	0.41 - 1.47	54	0	0.41 - 0.99	Shale, highly weathered with limestone layers, slightly weathered (high core loss zone)
	- 2.29	90	40		
	- 3.54	88	39	- 3.54	Shale (60%), grey, unweathered, closely spaced joints, with limestone (40%), unweathered, 1 to 20 cm thick layers

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

54-82-09

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
9	0.74 - 1.32 - 2.44 - 3.10	100 100 88	0 50 81	0.74 - 0.92 - 1.32 - 3.10	Soil Shale (50%), grey, moderately weathered, very closely spaced joints, with limestone (50%), slightly weathered, 1 to 6 cm thick layers Shale (50%), grey, unweathered, moderately spaced, with limestone (50%), light grey, unweathered, 2 to 15 cm thick layers

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

memorandum



H. Sturms

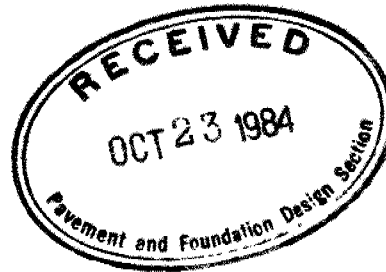
To: Mr. M. Devata
Senior Foundation Engineer
Foundation Design Section
Room 315, Central Building

Date: 84 10 19

File No.: 3162-2-4-113

Attn: Mr. H. Sturms ✓
Mr. D. Dundas

From: Soils & Aggregates Section
Engineering Materials Office
Room 311, Central Building



Re: Borehole Core Descriptions
Hwy. 401/410
W.P. 54-82-09
NE and NW Ramps

As requested by your Section, core from twenty-five (25) boreholes was logged. Descriptions are appended. Recommended founding levels in these boreholes are indicated in Table 1. Core recoveries in certain boreholes (5NE, 10NE, 15A-NW, 17NW, 18NW) were particularly poor, and the assessment of founding depths in these cases was difficult. See comments on Table 1. It can be assumed that the high losses are a result of poor drilling in weathered shale. Consideration could be given to spreading the load at the founding depths indicated to compensate for the lower strength of this material.

If you have any questions, please contact me.

A handwritten signature in dark ink, appearing to read "E. R. Magni".

E.R. Magni,
Geologist.

pc: K.D. Zasitko

ERM/jlo
Attachments

BOREHOLE NUMBER	RECOMMENDED FOUNDING LEVEL (depth below ground surface in metres)	COMMENTS
2NE	3.15	insufficient core to assess founding level
3NE	1.98	
4NE	2.59	
5NE	(2.83)	
6NE	1.76 —	
8NE	0.84 —	Shale moderately weathered
9NE	0.99	
10NE	1.32	
2NW	3.91	
3NW	4.35	
4NW	4.47	Weathered shale beneath upper limestone layer high core loss moderately weathered shale and high core loss
6NW	3.46	
7NW	3.66	
8NW	2.44	
9NW	3.00	
10NW	2.00	
11NW	1.30	
12NW	1.88	
13NW	2.59	
13 (A) NW	2.46	
14NW	0.46	
15NW	3.44	
15 (A) NW	3.41	
17NW	not predictable	
18NW	(3.29)	