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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

CONT 94-22
ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 121-87-03 DIST 9
HWY 416 STR SITE 3-538
SE Ramp Over Hwy. 417 West to Acres Road
Ramp (Structure #11)

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FOUNDATION INVESTIGATION REPORT
For
SE Ramp over Hwy. 417 West to Acres Road
Ramp (Structure #11)
W.P. 121-87-03, Site 3-538
Hwy. 416, District 9, Ottawa, Nepean

INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned site. A two lane single span structure has been proposed to carry the SE Ramp over Hwy. 417 West to Acres Road Ramp (Structure #11). This report contains factual information obtained from this investigation pertaining to structural foundations and related earth works.

SITE DESCRIPTION

The site is located just south of Hwy. 417 West of Acres Road in the City of Nepean, Region of Ottawa-Carlton. The area consists of farmers field to the East and West.

Acres Road is a narrow paved two lane road with drainage ditches beside both shoulders. The terrain surrounding the site is generally flat to gently rolling with short wild grasslands.

Physiographically, the site lies in the area known as the Ottawa Valley Clay Plains founded in the lowlands of the St. Lawrence, which are characterized by clay plains interrupted by ridges of rock or sand and gravel. The bedrock in the area is of the Gull River Formation of the Middle Ordovician Period. It consists of silty dolostone with interbedded dolomitic shale layers. The overburden was deposited during and immediately following the Wisconsinan Glaciation at which time the area was depressed from the effect of the glaciation. Following the retreat of the glacier, the brackish waters of the Champlain Sea flooded the area and then gradually receded as the land rebounded with the deposition of sediments to its present level.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by the in situ and laboratory testing. The procedures employed are discussed below.

FIELD INVESTIGATION

The field work for the investigation was carried out between 90 12 17 to 90 12 19 and consisted of a total of five sampled boreholes which were advanced to depths up to 12.2 m below natural ground surface. Three boreholes were advanced at the approach embankments with two holes at abutment locations.

One borehole (BH 11-1) was located East of Acres Road with an elevation of 66.5 m and four other boreholes were located west of Acres Road within the farmers field with elevations ranging from 66.4 m to 67.6 m.

The boreholes were advanced using conventional hollow stem augering techniques. A track mounted continuous flight auger drill rig was employed for the operation. Conventional rock coring methods were applied in retrieving rock core samples. Standard BXL core barrels within BW casing was used. In general, subsoil samples were retrieved at 0.7 m intervals for the surficial 6 m and at 1.5 m intervals, thereafter, disturbed subsoil samples were retrieved by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). Relatively undisturbed samples also randomly retrieved using a shelby tube sampler in accordance with Standard Practice (ASTM D1587). In situ vane tests were also conducted in sequence between the aforementioned sampling intervals to determine the undisturbed and remolded undrain shear strengths of soil. The test was conducted employing the Standard MTO 'N' vane in accordance with ASTM D2573.

All subsoil samples were identified in the field and returned to the laboratory for further examination and applicable testing.

Water levels monitored throughout the duration of the investigation were obtained in the open boreholes. All boreholes were backfilled upon completion of the field work.

Survey information related to the location and elevation of boreholes was provided by the Eastern Region Surveys and Plans.

LABORATORY ANALYSIS

The following laboratory tests were carried out on select soil samples.

- 1) Atterberg Limit Tests
- 2) Grain Size Distributions
- 3) Unit Weights
- 4) Natural Moisture Contents

Laboratory test results are given in the following section of this report and are illustrated on figures and borehole logs included in the Appendix.

SUBSURFACE CONDITIONS

General

The subsoil stratigraphy at the site consists of a surficial cohesive clayey silt with interbedded seams of sandy-silt, underlain by sand and gravel (Glacial Till) with occasional boulders. The surficial clayey-silt with interbedded seams of sandy-silt was not encountered in the most southern borehole. Bedrock lies beneath the heterogeneous mixture of silt, sand and gravel (Glacial Till) initially at an elevation of 53.3 m then rising to reach a relatively shallow depth of 2.0 m beneath the surface. Out crops of bedrock can be seen further South of the site. Elevations of bedrock slope to the surface towards the south west similar stratigraphy was encountered for foundation investigations for structures 15 and 12 located South-West.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole Sheets in the Appendix. A plan of the site illustrating the locations and elevations of the boreholes and subsoil stratigraphical sections are provided on DWG. No. 1218703-A.

A brief description of the subsurface conditions encountered is given below.

Clayey Silt with Interbedded Seams of Sandy Silt

A cohesive material composed of clayey silt with interbedded seams of sandy silt constitutes the surficial deposit. The thickness of this material is in the order of 2.1 to 5.6 m, with none of this material encountered at the southerly approach hole. The depth of this deposit basically followed the slope of the bedrock upwards towards the South-West until it was no longer encountered.

Grain Size Distribution Test results are shown on Figure 1 in the Appendix, in an envelope form. The deposit is comprised of 0% gravel, 14-43% sand, and 47-54% silt and 10-32% clay.

The result from the Atterberg Limit Test performed on the fine fraction of this material is summarized as follows:

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	25-31	3
Liquid Limit (w_L)	25-36	3
Plastic Limit (w_p)	15-16	3
Plasticity Index (I_p)	10-21	3

From the Plasticity Chart (Figure 2), the layer can be classified as having low to medium plasticity.

The 'N' values obtained from the Standard Penetration Test ranged from 0 to 13 blows/10.3 m indicating the material to have a soft to stiff consistency, the deposit was primarily firm. In situ Vane Tests ranged from 60-74 kPa with sensitivities of 10-27. This confirmed that the material had a stiff consistency with a sensitivity classification of very sensitive to slightly quick.

Heterogeneous mixture of Silt, Sand and Gravel (Glacial Till) Occasional Boulders

A non-cohesive heterogeneous mixture of silt, sand and gravel (Glacial Till) occasional boulders was encountered below the surficial deposit. The thickness of this layer ranges from 2.1 m to 9.3 m with it following the slope of the underlying bedrock. This material was encountered at the surface of the most southern borehole as the bedrock surface also rises towards the South-West.

Results of Grain Size Distribution Tests on this deposit are shown on Figure 3 in the Appendix, in an envelope form. The deposit is comprised primarily of 0-5% gravel, 88-97% sand, 5-53% silt and 1-10% clay.

In situ Vane Tests ranged from 60-74 kPa with sensitivities of 10-27. This confirmed that the material had a stiff consistency with a sensitivity classification of very sensitive to slightly quick.

The result from the Atterberg Limit Test performed on the fine fraction of this material is summarized as follows:

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	25-31	3
Liquid Limit (w _L)	25-36	3
Plastic Limit (w _p)	15-16	3
Plasticity Index (I _p)	10-21	3

From the Plasticity Chart (Figure 4) the layer can be classified as having slight plasticity.

In this stratum, the 'N' values ranged from 2 to >100 blows/10.3 m indicating the material to have a very loose to very dense state of relative density, but primarily compact.

Bedrock

The above material is underlain by bedrock of the march formation and was cored at the two abutment locations by obtaining up to 3.0 m of sound rock core samples. Confirmed bedrock was found at depths of 9.0-9.3 m at abutments with probable bedrock ranging from 8.1 to 2.0 m sloping upwards towards the South-West. This is confirmed by previous investigations in the area. Further South-West of the area bedrock could be seen outcropping at the surface. The bedrock consisted mainly of a dolostone sandstone with a layer of quartz sandstone encountered at a depth of approximately 10 m. In one location the bedrock returned to a dolomitic sandstone at a 11.7 m depth detailed descriptions of the rock are attached in the appendix entitled "Rock-Core Description".

Core recoveries and Rock Quality Designation (RQD) were determined in situ and also in the laboratory to evaluate the competence and integrity of the rock. Based on these results, the dolostone can be classified as very light to medium grey, fine to medium grained, medium strong, unweathered to slightly weathered.

GROUNDWATER CONDITIONS

Observations of the groundwater level was carried out by measuring the water level in the open boreholes. The water level varied from 65.5 to 66.3 m. Trapped drilling water may have a noticeable affect on water table heights.

Groundwater levels, in general, are subject to seasonal fluctuations and hence can vary from values given in this report.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a one span overpass structure that will carry the SE Ramp over the EBL-A Ramp. Within the proposed Hwy. 416/Hwy. 417 interchange complex. This Ramp Structure is identified as structure #11.

The width of the Ramp Structure (S-E Ramp) is 11.5 m comprised of two lanes of traffic with adjoining shoulders. The EBL-A Ramp is 8.25 m in width and is comprised of one traffic lane and adjoining shoulders.

The proposed profile grade of the S-E Ramp Structure is approximately 71.4 m and the elevation of the EBL-A ramp is approximately 65 m. The existing natural ground surface elevation is 66.4 m and 66.6 m at abutment locations with the elevation to the south approaches going up to 67.6 m. Consequently, a 1.5 m cut will be necessary down to the profile grade of the EBL-A Ramp with fills in the order of magnitude of 6.5 m will be required at the immediate structure. This decreases to 3.8-5 m further away from the structure.

A plan illustrating the proposed structure and profile grade is illustrated on DWG. No. 1218703-A in the Appendix.

To facilitate the design and construction of the proposed structure foundations and related earthworks, the following foundation and geotechnical recommendations are provided in the scope of this report.

- 1) Structure Foundation
- 2) Lateral Earth Pressure
- 3) Slope Stability
- 5) Construction Consideration

1) Structure Foundations

The surficial soils at the site are unsuitable for the support of conventional, shallow spread footings. Consequently it is recommended that abutment foundations be founded on end-bearing steel H-piles driven to the bedrock surface. Major consideration should be given to "perching" the abutments within

the approach fill or as high as possible within the native clayey silt. Fill material employed in this option should not exceed a grain size of 75 mm to prevent pile driving impediment. For purposes of the O.H.B.D.C., the steel H-piles can be design using the axial capacities tabulated below:

Axial Capacities - Driven Steel H-Piles

<u>Pile Type</u>	<u>Structure</u>	<u>Factored Capacity At U.L.S. (kN)</u>	<u>Bearing Capacity At S.L.S. Type II</u>	<u>Estimated Pile Tip El. (m)</u>
HP310x110	N. Abutment	1600	1150	57.4±
	S. Abutment	1600	1150	57.3±
HP310x79	N. Abutment	1150	890	57.4±
	S. Abutment	1150	890	57.4±

The capacities pertain to vertical piles only and reductions to account for inclined loading shall conform to factors provided in Section 6.8.3.4.3 of the O.H.B.D.C.

The elevation of the bedrock may vary due to its sloping incline, downwards towards the north. Batter piles may encounter bedrock at varying depths further away from borehole locations.

In view of the variable nature of the bedrock surface, it is recommended that pile installation be carefully controlled and monitored employing the hiley dynamic driving formula in accordance with MTO Standards SS103-10 or SS103-11 and assuming an ultimate capacity as tabulated below:

Ultimate Capacity Employing
Hiley Dynamic Formula

<u>Pile Type</u>	<u>Ultimate Capacity (kN)</u>
HP310x110	3450
HP310x79	2670

To facilitate pile penetration through the heterogeneous mixture of silt, sand and gravel with occasional boulders deposit, it is recommended that the steel H-piles be equipped with reinforced tips.

Pile spacing shall conform with Section 6.8.3.10 of the O.H.B.D.C. for centrally loaded piles equal load sharing of the deep foundation units can be assumed. The design of eccentric loaded deep foundation units shall comply with Section 6.8.3.4.2 of the O.H.B.D.C.

All pile caps shall be protected against frost penetration by providing a minimum 1.8 m earth cover or equivalent frost protection. Placing pile caps within the native cohesive clayey silt with interbedded silty sand or perched within the fill would not require any dewatering schemes.

2) Lateral Earth Pressure on Structure

Free draining material such as Granular 'A' or Granular 'B' shall be used within a wedge behind the abutments and retaining walls bounded by a plane rising at 60° to the horizontal as shown in Figure 6-9.6.1 of the O.H.B.D.C. The application of granular material combined with weep holes in the abutment walls to drain any accumulation of water in the backfill will prevent hydrostatic pressure build-up. Design parameters of the soil are given in the table below:

Backfill Properties

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction (ϕ unfact)	35°	30°
Unit Weight (kN/m ³)	22.8	21.2
*Coefficient of Active Earth Pressure (K _a)		
- S.L.S.	0.27	0.33
- U.L.S.	0.33	0.4
*Coefficient of Earth Pressure at Rest (K _o)		
- S.L.S.	0.43	0.5
- U.L.S.	0.5	0.58

*These earth pressure coefficients apply to horizontal backfill surfaces only. The appropriate consideration shall be given to account for sloping backfill.

3) Slope Stability

No stability problems are anticipated for the proposed 6.5 m fill embankment (forwarded slopes) at the abutment structure constructed with 2H:1V slopes side slopes would be at a maximum of 5 m for which 2H:1V would also be adequate.

All exposed slopes should be protected from erosional forces by providing an effective erosional control protection scheme.

Settlements in the order of magnitude of 60 mm are anticipated due to elastic recompression of the native subsoil and settlements within the fills under its own weight.

4) Construction Considerations

In the construction of the embankment fills, all softened and/or organic material should be excavated for their full depth within the plan limits prior to fill placement.

Embankment fills should be placed and compacted as specified in OPSS 206.07.07 and OPSS 501 series.

Heavy compaction equipment should not be used behind the abutment/retaining walls within a lateral distance equal to the current height of fill above the wall footing in order to avoid imposing damage or deflection to the wall during the fill placement.

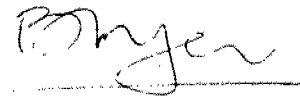
No dewatering should be necessary for excavation within the surficial cohesive clayey silt. But if the excavation goes down into the heterogeneous mixture of silt, sand and gravel (Glacial Till) a dewatering scheme would then become necessary. Consideration should be given to perching the pile caps as high as possible either within the cohesive clayey-silt or within the fill. For more detail concerning a dewatering scheme please contact this office.

Even though boulders were encountered in the boreholes carried out at this site, based on geological evidence cobbles and boulders could be encountered in the Glacial Till deposits.

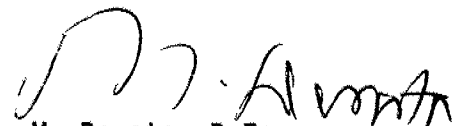
MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Michalek, Junior Foundation Engineer and F. Tannos, Engineer Trainer. Utilizing equipment owned and operated by Marathon Drilling Ltd.

The project was carried out under the general supervision of Dr. B. Iyer, Senior Foundation Engineer. The report was written by M. Michalek, reviewed by Dr. B. Iyer and approved by Mr. M. Devata, Chief Foundation Engineer.



for
M. Michalek
Junior Foundation Engineer



M. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX

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 (RQD), 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

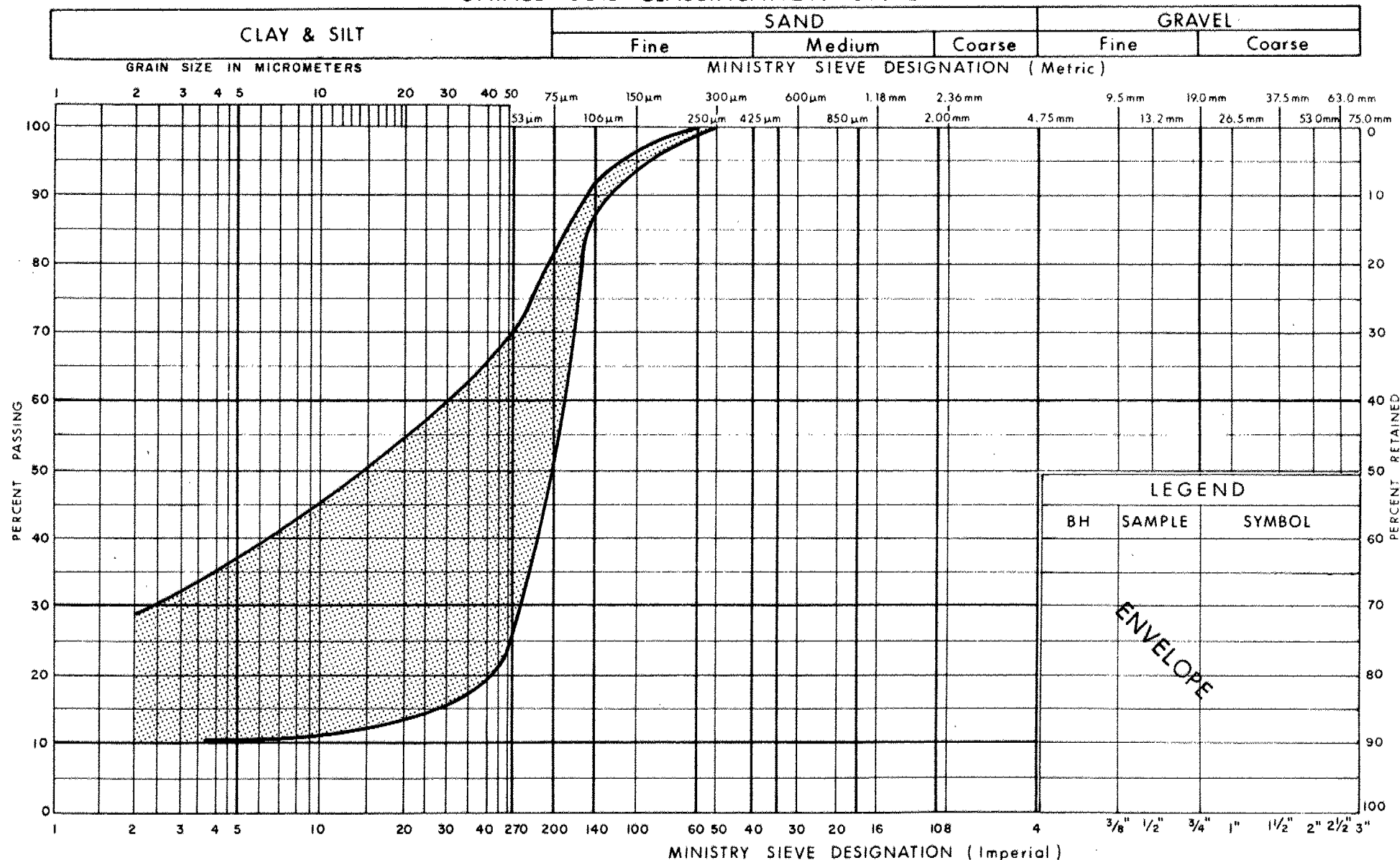
MECHANICAL PROPERTIES OF SOIL

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						

UNIFIED SOIL CLASSIFICATION SYSTEM



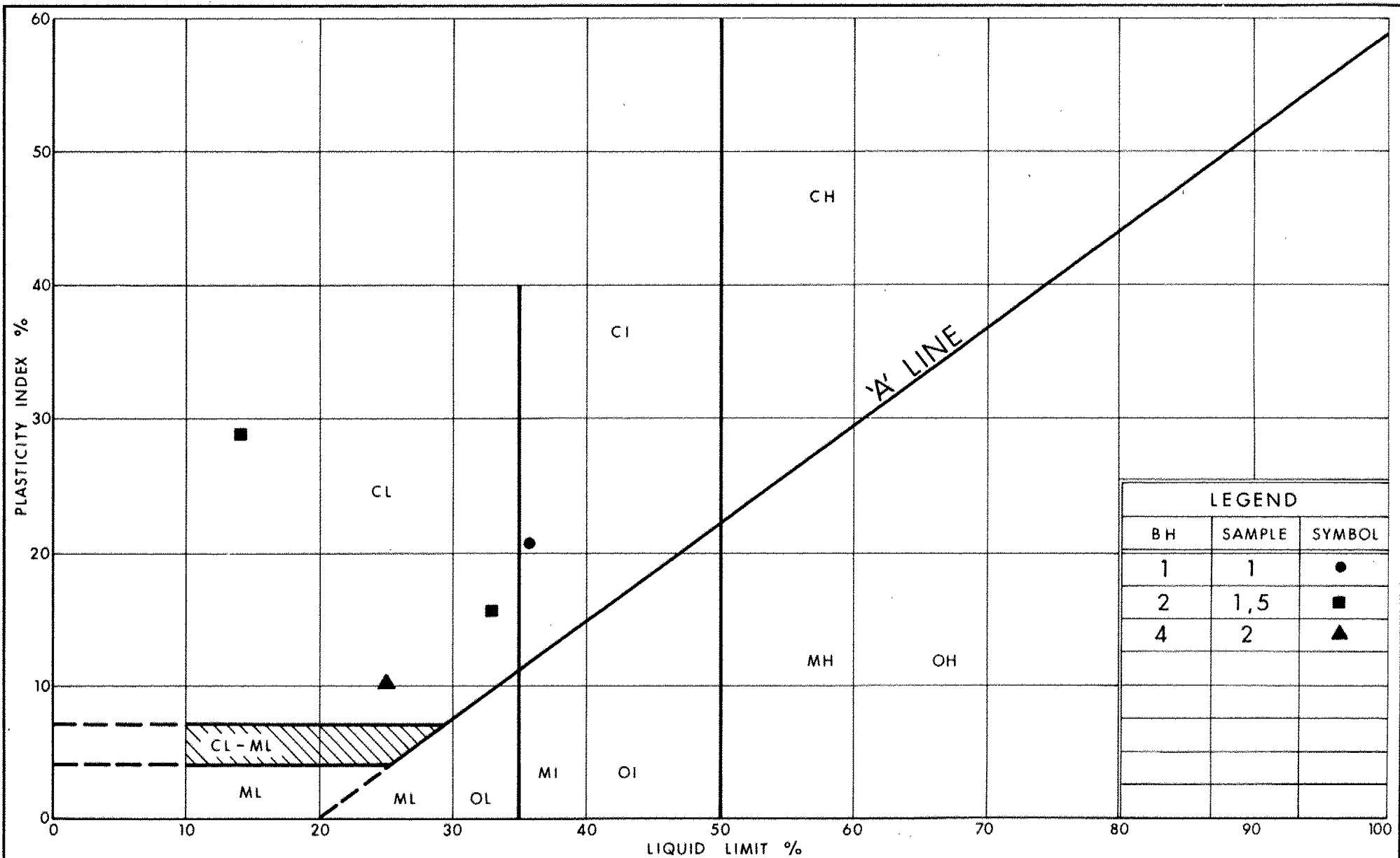
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GRAIN SIZE DISTRIBUTION

CLAYEY SILT WITH INTERBEDDED SEAMS OF SANDY SILT

FIG No 1

W P 121-87-03



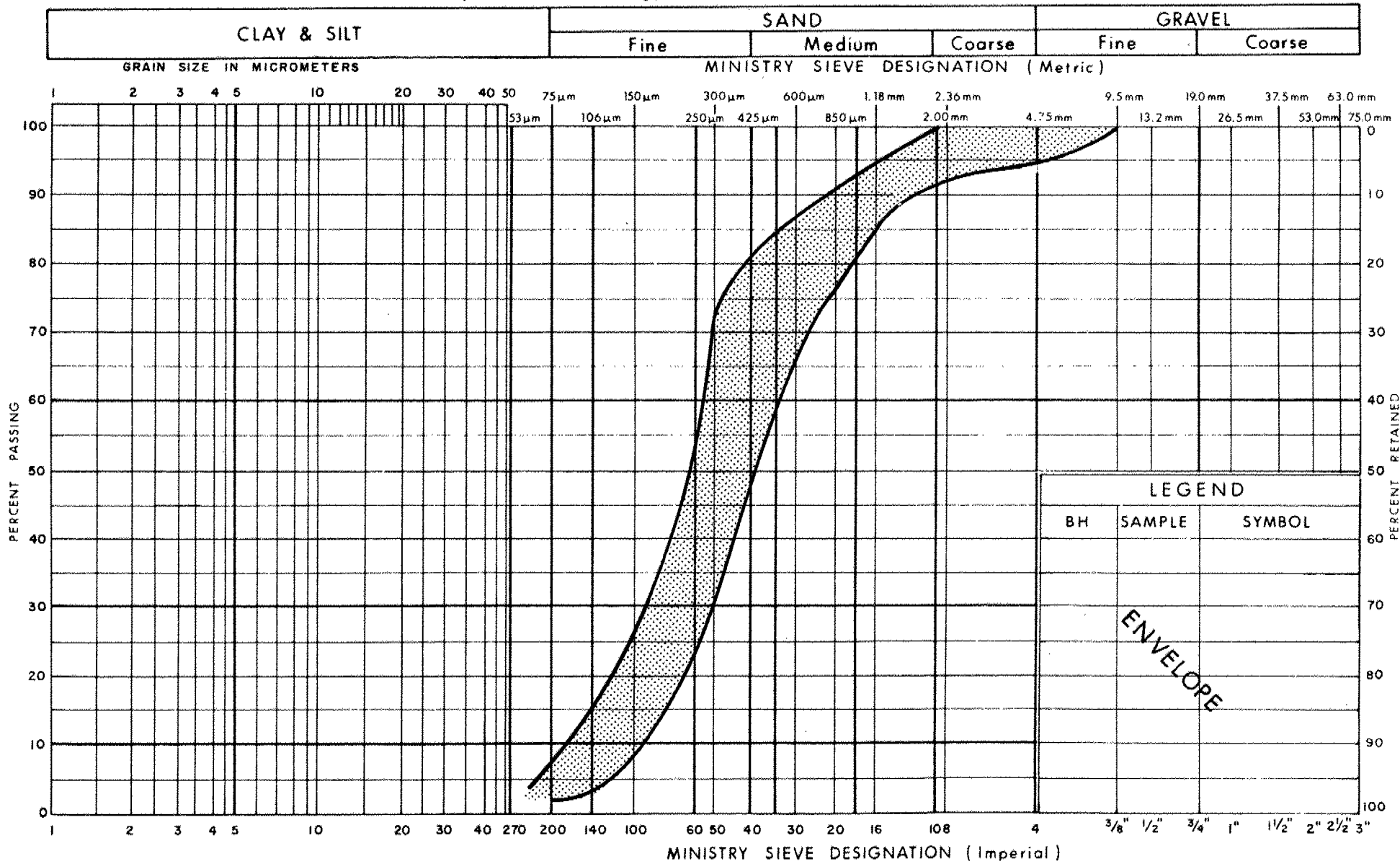
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PLASTICITY CHART CLAYEY SILT WITH INTERBEDDED SEAMS OF SANDY SILT

FIG No 2

W P 121-87-03

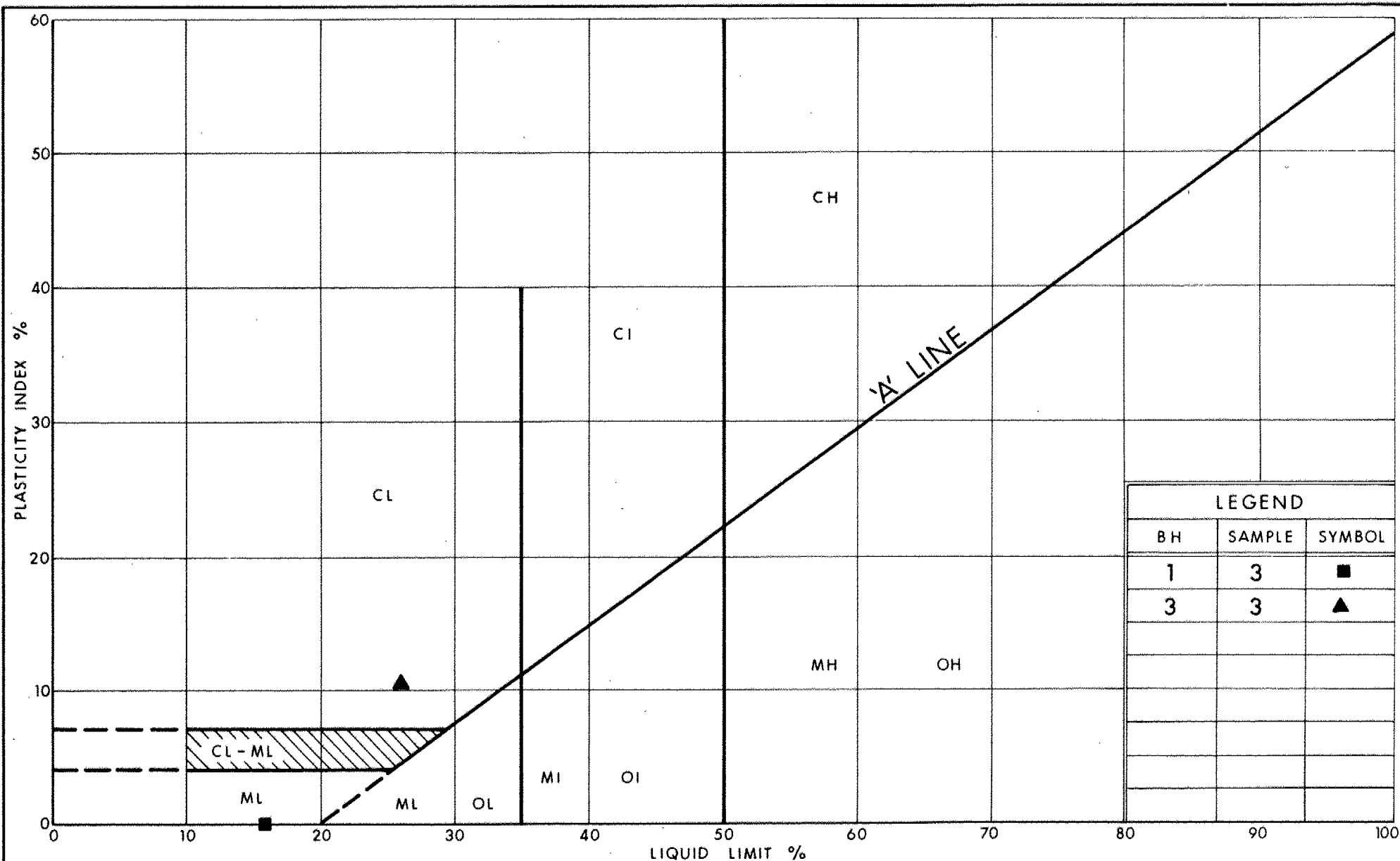
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GRAIN SIZE DISTRIBUTION
HET MIXTURE OF SILT, SAND & GRAVEL
OCCASIONAL BOULDERS (GLACIAL TILL)

FIG No 3

W P 121-87-03



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PLASTICITY CHART
HETEROGENEOUS MIXTURE OF SILT, SAND & GRAVEL
OCCASIONAL BOULDERS (GLACIAL TILL)

FIG No 4

W P 121-87-03

1 OF 1

LOCATION

Coords: N 5 022 517.1, E 358 542.0

ORIGINATED BY M.M.

DIST 9 HWY 416

BOREHOLE TYPE Hollow Stem Auger, Rock core

COMPILED BY M.M.

DATUM Geodetic

DATE 90-12-17

CHECKED BY B.I.

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 11-2 1 OF 1 METRIC

W.P. 121-87-03 LOCATION Coords: N 5 022 473.0, E 358 519.0 ORIGINATED BY M.M.
 DIST 9 HWY 416 BOREHOLE TYPE Hollow Stem Auger, Rock Core, Wash boring COMPILED BY M.M.
 DATUM Geodetic DATE 90-12-18 CHECKED BY B.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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa						
66.4	Ground Surface							20 40 60 80 100	10 20 30 40 50	10 20 30				
0.0	Clayey Silt with interbedded seams of Sandy Silt Very Loose to stiff Brown Grey		1	SS	4		66							0 21 64 15
			2	SS	2		65							
			3	SS	1		64							
			4	SS	1		63							
			5	TW	PH		62						0 43 47 10	
			6	SS	0		61							
60.8							60							
5.6	Heterogeneous mixture of Silt, Sand and Gravel occasional Boulders (Glacial Till) Very Loose to Compact		7	SS	5		59						5 88 5 2	
			8	SS	30		58							
			9	SS	120		57							
57.4							56							
9.0	Bedrock Dolomitic Sandstone Weathered to Slightly Unweathered, Medium Strong Quartz Sandstone		10	RC	REC 92%		55							RQD 87%
			11	RC	REC 100%									RQD 100%
54.4														
12.0	End of Borehole													

RECORD OF BOREHOLE No 11-3 1 OF 1 METRIC

W.P. 128-87-03 LOCATION Coords: N 5 022 460.0, E 358 509.0 ORIGINATED BY M.M.
 DIST 9 HWY 416 BOREHOLE TYPE Hollow Stem Auger, Rock core, Wash Boring COMPILED BY M.M.
 DATUM Geodetic DATE 90-12-19 CHECKED BY B.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 (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
66.6	Ground Surface																
0.0	Clayey Silt with interbedded seams of Sandy Silt Soft to Stiff		1	SS	5		66										
			2	SS	3		65										0 25 49 26
63.7			3	SS	3		64										
2.9	Brown Grey Heterogeneous mixture of Silt, Sand and Gravel occasional Boulders (Glacial Till) Compact		4	SS	1		63										
			5	SS	3		62										
			6	SS	12		61										
			7	SS	20		60										0 97 2 1
			8	SS	1		59										
57.3							58										
9.3	Bedrock Dolomitic Sandstone Medium Strong, Unweathered to Slightly Weathered Quartz Sandstone Medium Strong, Unweathered to Slightly Weathered		9	RC	REC 100%		57										RQD 91%
			10	RC	REC 100%		56										RQD 100%
54.4							55										
12.2	End of Borehole																

RECORD OF BOREHOLE No 11-4 1 OF 1 METRIC

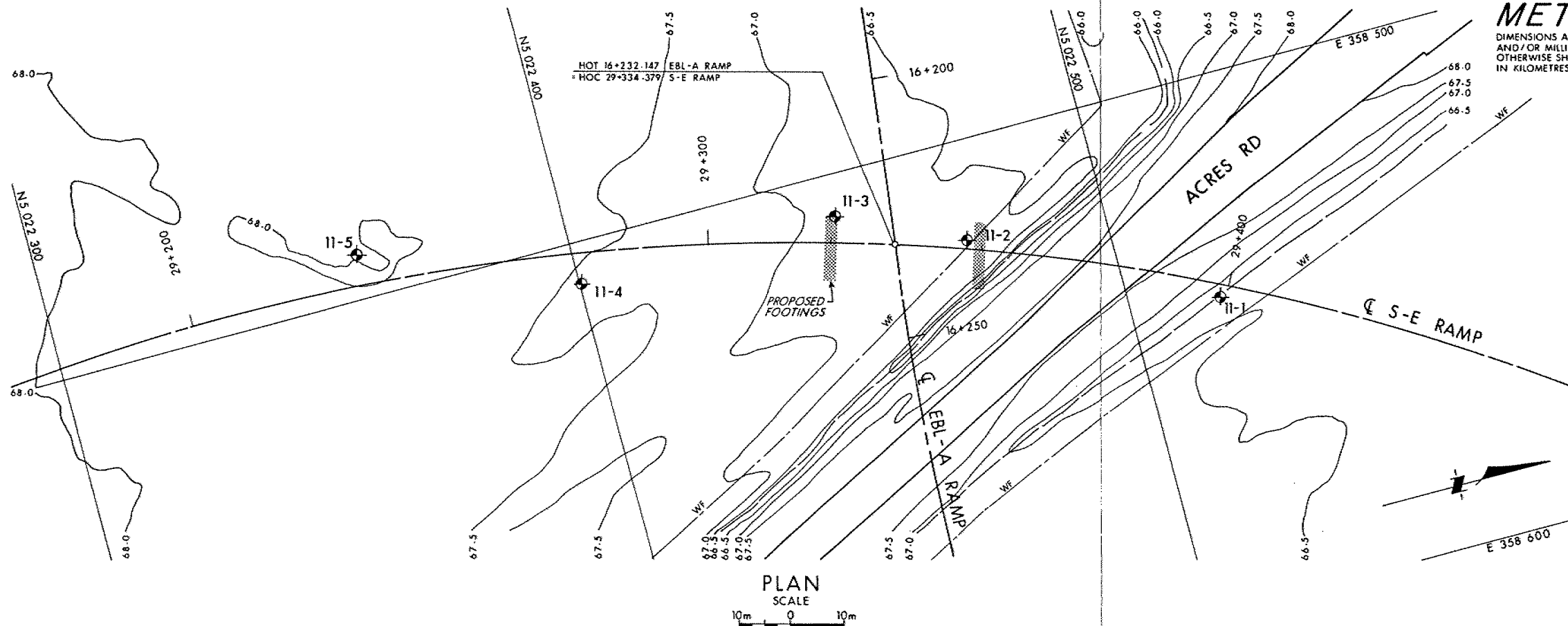
W.P. 121-87-03 LOCATION Coords: N 5 022 400.0, E 358 508.0 ORIGINATED BY M.M.
 DIST 9 HWY 416 BOREHOLE TYPE Hollow Stem Auger COMPILED BY M.M.
 DATUM Geodetic DATE 90-12-12 CHECKED BY B.I.

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES			20	40	60	80	100					
67.3	Ground Surface																
0.0	Clayey Silt with interbedded seams of Sandy Silt Soft		1	SS	3		67										
			2	SS	4		66										
65.2	Heterogeneous mixture of Silt, Sand and Gravel occasional Boulders (Glacial Till) Compact		3	SS	17		65										
2.1			4	SS	21		64										
			5	SS	12		63										
			6	SS	13												
62.2																	
5.1	End of Borehole • Probable Bedrock, Auger Refusal																

RECORD OF BOREHOLE No 11-5 1 OF 1 METRIC

W.P. 121-87-03 LOCATION Coords: N 5 022 360.0, E 358 492.0 ORIGINATED BY M.M.
 DIST 9 HWY 416 BOREHOLE TYPE Hollow Stem Auger COMPILED BY M.M.
 DATUM Geodetic DATE 90-12-12 CHECKED BY B.L.

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			20	40	60	80	100				
67.6	Ground Surface														
0.0	Heterogeneous mixture of Silt, Sand and Gravel (Glacial Till) Very Loose														
65.6															
2.0	End of Borehole • Probable Bedrock, Auger Refusal														



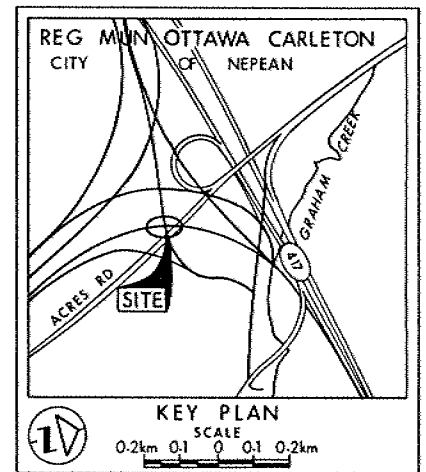
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 121-87-03



S-E RAMP OVER HWY 417 WEST
TO ACRES RD RAMP
(STRUCTURE -11)
BORE HOLE LOCATIONS & SOIL STRATA

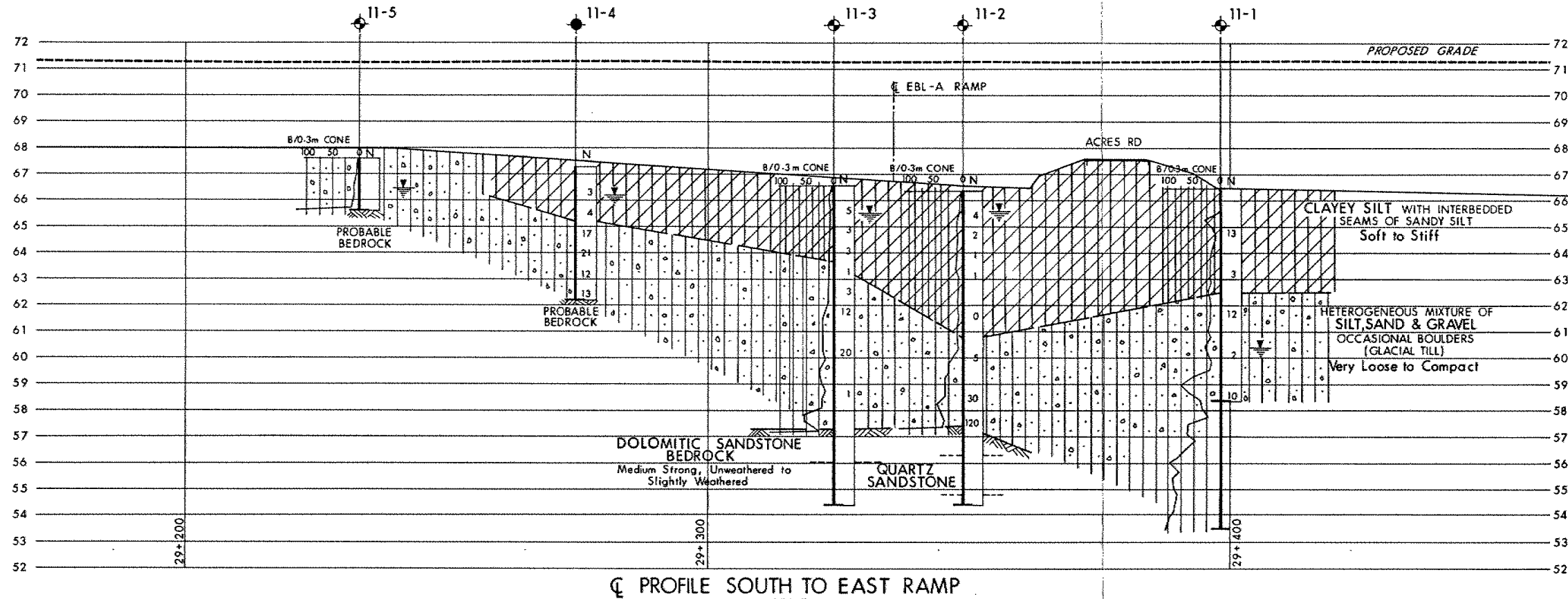
SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 90 12

No	ELEVATION	CO-ORDINATES NORTH	EAST
11-1	66.5	5 022 517.1	358 542.0
11-2	66.4	5 022 473.0	358 519.0
11-3	66.6	5 022 450.0	358 509.0
11-4	67.3	5 022 400.0	358 508.0
11-5	67.6	5 022 360.0	358 492.0



PROFILE SOUTH TO EAST RAMP

NOTE


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

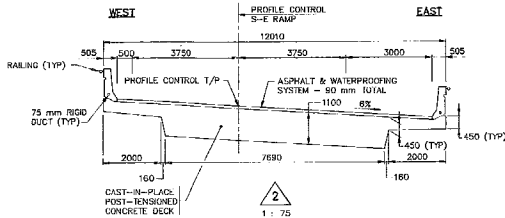
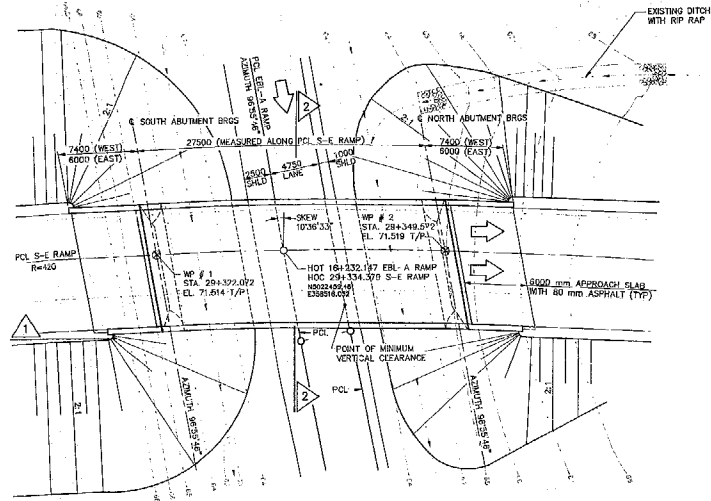
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION

Geocres No 31G5-178

HWY No 417	DIST 9
SUBMD MM CHECKED	DATE 91 05 09
DRAWN DT CHECKED	APPROVED
	SITE 3-538
	DWG 1218703-A

<p>METRIC</p> <p>DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN</p> <p>PARKER CONSULTANTS</p>	<p>DIST No 9</p> <p>CONT No</p> <p>WP No 121-87-03</p> <p>S-E RAMP OVER EBL-A RAMP HIGHWAY 416/417 INTERCHANGE</p> <p>GENERAL ARRANGEMENT</p>	 <p>SHEET</p>



GENERAL NOTES:

- CLASS OF CONCRETE
 - DECK 35 MPa
 - REMAINDER 30 MPa
- CLEAR COVER TO REINFORCING STEEL
- FOOTINGS 100 ± 25
- ABUTMENTS AND WINGWALLS
 - FRONT FACE 80 ± 20
 - BACK FACE 70 ± 20
 - DECK TOP 70 ± 20
 - BOTTOM 50 ± 10
 - REMAINDER (UNLESS NOTED OTHERWISE) 70 ± 20
- REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400 UNLESS NOTED OTHERWISE. BAR MARKS WITH SUFFIX "C" DENOTE COATED BARS.
- CONSTRUCTION NOTES

THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.

LIST OF DRAWINGS:

- GENERAL ARRANGEMENT
- BRIDGE LOCATION AND SOIL STRATA
- FOUNDATION LAYOUT
- FOOTING REINFORCEMENT
- NORTH ABUTMENT
- SOUTH ABUTMENT
- BEARINGS
- DECK DETAILS
- LONGITUDINAL TENDONS
- TRANSVERSE TENDONS
- DECK REINFORCEMENT I
- DECK REINFORCEMENT II
- JOINT ANCHORAGE AND ARMOURING
- BARRIER WALLS
- RAILING FOR BARRIER WALL
- 6000 mm APPROACH SLAB
- DETAILS OF CONCRETE SLOPE PAVING
- AS CONSTRUCTED ELEVATIONS AND DIMENSIONS
- PILE DRIVING - VIBRAM AND DIESEL HAMMERS
- STANDARD DETAILS
- QUANTITIES - STRUCTURE I
- QUANTITIES - STRUCTURE II

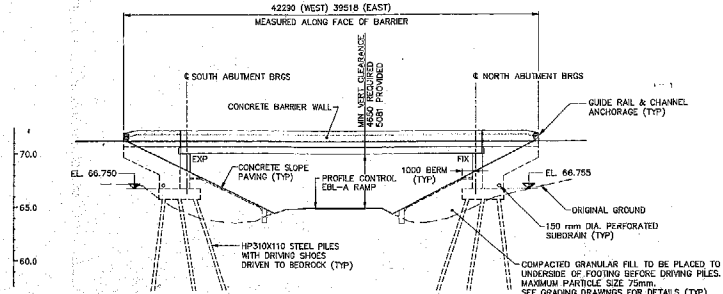
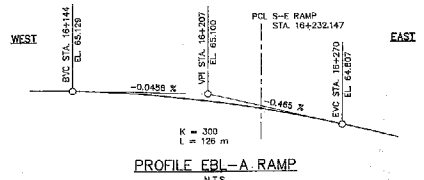
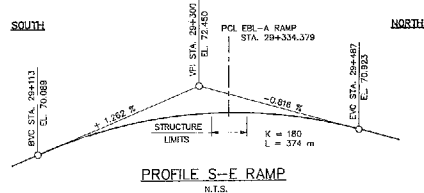
LEGEND:

- T/P DENOTES TOP OF PAVEMENT
WP DENOTES WORKING POINT
PCL DENOTES PROFILE CONTROL LINE

APPLICABLE STANDARD DRAWINGS:

- 0F50-3501.00 GRANULAR BACKFILL REQUIREMENTS
ABUTMENTS
0F40-4502 (MODIFIED) FALSEWORK CLEARANCES

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION



BM ELEV 69.303
MIN IN ROW OF 1.80 LANE
6.44 RT 294+337.8 S-E RAMP

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING