

G.I.-30 SEPT. 1976

GEOCRES No. 40 I 14 -67DIST. 2 REGION                     W.P. No. 88-69-06CONT. No. 73 - 138W. O. No.                     STR. SITE No. 5-218HWY. No.                     LOCATION St. Thomas ExpresswayNo of PAGES -=====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     REMARKS:

Ontario  
Department of Transportation and Communications  
XXXXXXXXXXXXXXXXXXXX

MEMORANDUM

#01-67

TO: Mr. A. P. Watt, (2)  
Regional Bridge Planning Engineer,  
Southwestern Region,  
London, Ontario.

FROM: Foundations Office,  
Design Services Branch,  
Central Bldg., Downsview.

ATTENTION:

DATE: September 22, 1971.

OUR FILE REF.

IN REPLY TO

SEP 28 1971

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For

Proposed Crossing at  
Balaclava St. and St. Thomas Expwy.  
City of St. Thomas; County of Elgin  
District #2 (London, Ont.)  
W.O. 71-11065 -- W.P. 88-69-06



73-138

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

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

AGS/ao  
Attach.

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER.

cc: Messrs. B. R. Davis  
A. Rutka  
W. A. Zonnenberg  
L. E. Walker  
B. J. Giroux  
J. R. Roy  
G. A. Wrong  
B. A. Singh

Foundations Files  
Documents

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# FOUNDATION INVESTIGATION REPORT

For  
Proposed Crossing at  
Balaclava Street and St. Thomas Expressway  
City of St. Thomas; County of Elgin  
District #2 (London, Ont.)  
W.O. 71-11065 -- W.P. 88-69-06

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## 1. INTRODUCTION:

A request for a foundation investigation at the crossing of the proposed St. Thomas Expressway and Balaclava Street was received from Mr. T. P. Hodgson, Regional Bridge Location Engineer, in a memorandum dated June 23, 1971.

Following this request, a field investigation was carried out by the Foundation Section to determine the subsoil conditions existing at the site. This report contains the results of this investigation and our recommendations pertaining to the design of the proposed structure foundations and approach embankments.

## 2. DESCRIPTION OF THE SITE:

The site of the proposed underpass structure is located in the city of St. Thomas, in the vicinity of the intersection of Balaclava St. and Hammond St.

Topographically the proposed bridge site is situated in an approx. 230 ft. wide and approx. 28 ft. deep valley. At the present time an approx. 10-12 ft. high embankment is spanning this ravine. A small creek or brook is meandering through the valley. A 3' x 3' concrete box culvert is provided for the passage of the water underneath the embankment. The valley walls appear to be in good condition and have an approx. slope (natural) of 2:1. Some part of the valley adjacent to the existing embankment is filled up with industrial waste.

Physiographically, the site is located in the region referred to as the Mount Elgin Ridges.

### 3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of six sampled boreholes and eight dynamic cone penetration tests was carried out during the course of the field work. Boring was achieved by means of continuous flight auger machines adapted for soil sampling purposes. During the field work, disturbed samples were obtained by means of a standard split-spoon sampler; the energy used in driving it, conformed to the requirements of the Standard Penetration Test.

Dynamic Cone penetration tests were carried out adjacent to each borehole. Driving energy to advance the cone was 350 ft.-lbs. per blow. 'Undisturbed' samples were recovered using 2 inch I.D. Shelby Tubes which were pushed into the soil hydraulically or by hand.

All boreholes were surveyed in the field by personnel from London Region Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 71-11065 A which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection laboratory tests were carried out on selected samples to determine the following physical properties:

- Atterberg Limits
- Moisture Content
- Grain-size Distribution
- Effective Stress Parameters
- Undrained Shear Strength
- Bulk Density
- Consolidation Characteristics

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

### 4. SOIL TYPES AND SOIL CONDITIONS:

#### 4.1) General:

Apart from the fill material, generally uniform subsoil conditions were found to prevail over the site area.

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

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

The subsoil consists of a deep deposit of occasionally stratified clayey silt containing some sand and traces of gravel. The estimated stratigraphical profile is shown on Drawing 71-11065A.

A more detailed description of the subsoil with regard to soil types and soil properties follows:

4.2) Fill Material:

This material was encountered in B.H. #1 from the existing ground level (El. 743) to approx. El. 723. The material in the deposit consists of various mixtures of soils and industrial waste, such as cinders and debris from old buildings. Since the material consists of such a heterogeneous mixture of soils and rubble, no general description of soil types and properties is applicable. Based on visual observation of the existing embankment the material appears to consist of mixtures of soils and broken building materials.

4.3) Clayey Silt with Some Sand and Trace of Gravel:

This deposit was intersected in all borings and extends from immediately below the topsoil, or the above-mentioned fill material, down to El. 649 where the borings were terminated. The material in the deposit consists mainly of clayey silt with some sand and traces of gravel with the following average proportions: gravel - 3%, sand - 16%, silt - 47% and clay - 34%. Occasional pockets and seams of silt and layers of silty clay were also discovered within the main deposit. A plot of plasticity index versus liquid limit (Fig. 1) shows the majority of the points to fall within the CL zone.

Physical properties of the overall deposit, as determined from field and laboratory tests, are as follows:

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

4.3) Clayey Silt with Some Sand and Trace of Gravel: (cont'd) ...

	<u>Min.</u>	<u>Max.</u>	<u>Average</u>
Natural Moisture Content (%)	8	42	19.9
Liquid Limit (%)	16	34	26.9
Plastic Limit (%)	10	18	14.2
Unconfined Compression Test (PSF)	596	4550	2580
Quick Triaxial Test (PSF)	675	3160	2160
Bulk Density (PCF)	110	142	131.5
'N' Values (blows/ft.)	7	>100	

Grain size distribution curves are included in the Appendix of this report (Fig. 2).

The undrained shear strength of the material with some random variations, increases with depth being in the order of 1600 PSF in the upper region and in excess of 3000 PSF below El. 700. However, the undrained shear strength is somewhat less in boreholes put down at the valley floor (B.H.'s No. 5 and 6). Laboratory tests indicated that the undrained shear strength of the deposit in the upper 10-15 ft. zone is only about 600 PSF below El. 720. The consistency appears to be the same as the remainder of the site investigated. At or below El. 670 the material becomes very hard, the 'N' values being in excess of 100 blows per foot.

The consistency of the overall deposit may be described as firm to hard.

In order to provide information for stability analyses for the long term case, laboratory tests were performed to determine effective stress parameters  $C'$  and  $\phi'$ . The results of these tests are as follows:

$C'$  (PSF)            270 to 320  
 $\phi'$                     26° to 28°

For design purposes the following values are recommended:

$C' = 300$  PSF  
 $\phi' = 27^\circ$

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

4.3) Clayey Silt with Some Sand and Trace of Gravel: (cont'd) ...

The results of consolidation tests carried out on selected samples indicate that the preconsolidation pressure of the deposit is approximately 1.0 to 2.0 t.s.f.

5. GROUNDWATER CONDITIONS:

The following groundwater levels were observed during the field investigation:

B.H. #1	El. (Not Established)
B.H. #2	El. 708.4'
B.H. #3	El. 716.1'
B.H. #4	El. Borehole Dry
B.H. #5	El. 725.8'
B.H. #6	El. 724.8'

It is pointed out that the foregoing quoted figures may not represent the true groundwater levels due to the relatively impermeable nature of the subsoil and the short duration of the field work.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to build an expressway along the bottom of the above described valley. The traffic of Balaclava St. will be carried over the St. Thomas Expressway by means of a four-span (35' - 71' - 64' - 35') structure. This will necessitate the partial removal of the existing 10-12 ft. high Balaclava St. embankment together with the existing culvert. The new centreline of Balaclava St. will coincide with the existing centreline, but the new profile grade will be higher by 0 to 13 ft. at Sta. 101+75 and Sta. 98+00 respectively (Balaclava St. chainage) than the present one.

The profile grade of the proposed expressway is at El. 733 which is approx. 5-6 ft. higher than the level of the valley floor.

Due to the geometry and the position of the expressway, up to 17 ft. deep cuts will be required for the new roadway and some 25 ft. high fill for one of the approaches.



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

In addition to the construction of a bridge, cuts and fills it will be also necessary to construct some form of a waterway for the creek and the surface run-off water.

The engineering problems which can be seen at this time are the structure foundations, the stability of the forward slopes of the structure approaches, the stability of the side slopes of the various cut and fill sections, and the settlements under the various fill sections. These various aspects are discussed below under the appropriate heading.

6.1) Structure Foundations:

In view of varying bearing capacity of the subsoil, the following footing types are recommended:

South Abutment, South and Centre Piers: At these locations the bearing capacity of the subsoil is competent to provide support for spread footing type foundations. In the case of the south abutment, a safe design load of 2.5 t.s.f. may be achieved at or below elevation 750. The same design value (2.5 t.s.f.) could be applied for the centre and south piers if the footings are placed at or below elevation 728.

North Abutment and North Pier: Due to the presence of the somewhat softer clayey silt in this area, piled foundations are recommended. For 12 BP 74 Steel 'H' piles a safe design load of 95 tons could be achieved at elevation 665±.

As an alternative the entire structure may be supported on piled foundations driven to El. 665. For 12 BP 74 Steel 'H' piles a safe design load of 95 tons may be used. The pile driving should be controlled by means of the Hiley formula.

It is pointed out that the existing roadway embankment may contain large size boulders or debris from old buildings; therefore the excavation of the footings down to the original material is recommended before driving the piles.

No dewatering problems are anticipated due to the impervious nature of the subsoil.

Working slab should be provided under footings.

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

6.2) Structure Approaches:

Construction of the proposed expressway and a structure will require cut and fill sections.

No stability problems are anticipated for the proposed cuts in the original subsoil provided with 2:1 slopes.

In the case of embankments, special considerations should be given in the vicinity of the north abutment. As described in the above paragraphs the upper 20 ft. of the subsoil consists of industrial waste which is expected to settle excessively under load.

To avoid the possible harmful effects on the structure abutment (north) caused by this excessive settlement it is recommended that industrial waste material be removed to its full depth for a distance of 25 ft. behind the centreline of bearings under the fill limits and/or 10 ft. past the outlet of new culvert on the west side. On the east side of the north approach, the existing low lying areas should be filled up to the level of the expressway (El. 733) prior to constructing the embankment. No stability problems are anticipated if the above recommended procedures are carried out and the embankments are constructed with 2:1 slopes.

7. MISCELLANEOUS:

The field work was carried out during the period of July 16-20, 1971, under the supervision of Mr. P. Payer, Project Foundation Engineer, who also prepared this report.

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

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

September, 1971.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11065

LOCATION Co-Ord's 15,549,101 N. 1,353,551 E.

ORIGINATED BY P.P.

W.P. 88-69-06

BORING DATE July 15 &amp; 16, 1971

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Auger

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT.	NUMBER	TYPE		25	50	75	100	125	WATER CONTENT % $w_p$ ——— $w$ ——— $w_L$				
742.9	Ground level.														
0.0	Industrial Waste.	X	1	SS	8	740									
		X	2	SS	20										
		X	3	SS	7										
		X	4	SS	23	730									
		X	5	SS	26										
722.9		X	6	SS	11										
20.0	Clayey silt with sand and some gravel.		7	SS	19	720									
			8	SS	14										
			9	TW	PM	710								133	8 20 41 31
	Stiff to hard.		10	SS	22										
			11	TW	PH	700								135	
			12	SS	30	690									
			13	SS	32	680									
						670									
666.4			14	SS	99/6"										3 30 50 17
76.5	End of borehole.					660									W.L. not established

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-11065 LOCATION Co-Ord's 15,548,983 N. 1,353,559 E.  
W.P. 88-69-06 BORING DATE July 15 & 16, 1971  
DATUM Geodetic BOREHOLE TYPE Continuous Flight AugerORIGINATED BY P.P.  
COMPILED BY P.P.  
CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		25	50	75	100	125	$w_p$	$w$	$w_L$		
745.6	Ground level.															
0.0																
	Clayey silt with sand and trace of gravel.		1	SS	19											
			2	SS	11	740										
			3	SS	15											
			4	SS	10											
			5	SS	11											
	Occ. pockets and seams of silt.		6	TW	PH	730									136	
	Layers of silty clay.		7	SS	27											
			8	SS	23	720										
			9	SS	23											
	Stiff to hard.		10	SS	15	710										
			11	SS	10											
			12	TW	PH										136	708.4
			13	SS	26	700										
			14	TW	PH										137	
						690										
			15	SS	30	680										
						670										
666.6			16	SS	130											
79.0	End of borehole.					660										



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11065

LOCATION Co-Ord's 15,548,870 N. 1,353,555 E

ORIGINATED BY P.P.

W.P. 88-69-06

BORING DATE July 16 &amp; 19, 1971

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							25	50	75	100	125	UNCONFINED ● QUICK TRIAXIAL	FIELD VANE + LAB. VANE x	$w_p$		
755.6	Ground level						2000		4000			10	20	30	P.C.F.	GR, SA, SI, CL
0.0																
	Clayey silt with		1	SS	40											
	sand and trace of		2	SS	31	750										
	gravel.		3	SS	27											
			4	SS	22											
	Occ. pockets and		5	SS	19	740										
	seams of silt,		6	TW	PH											
	layers of silty		7	SS	15											
	clay.		8	TW	PH	730										
			9	SS	24											
	Very stiff to		10	TW	PH											
	hard.		11	SS	30	720										
			12	TW	PH											
						710										
			13	SS	20											
						700										
			14	TW	PH											
						690										
			15	SS	28											
						680										
			16	TW	PH											
						670										
			17	SS	17 1/9"											
						660										
			18	SS	166	650										
649.1																
106.5	End of borehole.															

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 71-11065

LOCATION Co-Ord's 15,548.941 N. 1,353,624 E.

ORIGINATED BY P.P.

W.P. 88-69-06

BORING DATE July 19, 1971

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH: P.S.F.					WATER CONTENT %					
							<div><div>○ UNCONFINED</div><div>● QUICK TRIAXIAL</div><div>+ FIELD VANE</div><div>x LAB. VANE</div></div>					<div><div><math>w_p</math></div><div><math>w</math></div><div><math>w_L</math></div></div>					
						25	50	75	100	125	10 20 30						
750.5	Ground level.																
0.0	Clayey silt with sand and trace of gravel.  Occ. pockets and seams of silt, layers of silty clay.  Stiff to hard.		1	TW	PH	750									125		
			2	TW	PH	740											0 0 50 50
			3	TW	PH											123.5	
			4	TW	PH											140	
			5	TW	PH											137	
			6	TW	PH											137	
			7	TW	PH											128	
			8	TW	PH											121	
			9	TW	PH											126	5 31 46 18 0 0 47 53
701.6					10	TW	PH									137	B.H. dry
49.0	End of borehole.					700											



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 71-11065

LOCATION Co-Ord's 15,549,079 N. 1,353,644 E.

ORIGINATED BY P.P.

W.P. 88-69-06

BORING DATE July 20, 1971

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Auger.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
731.1	Ground level.						2000	4000				10	20	30		
0.0	Clayey silt with some sand and trace of gravel.  Occ. pockets and seams of silt, Layers of silty clay.  Firm to hard.		1	SS	15	730										725.8'
			2	TW	PH											
			3	TW	PH											
			4	TW	PH	720										
			5	SS	7											
			6	TW	PH	710										
			7	SS	18											
			8	TW	PH	700										
			9	SS	23											
			10	TW	PH	690										
			11	SS	19	680										
667.1			12	SS	70	670										
64.0	End of borehole.					660										



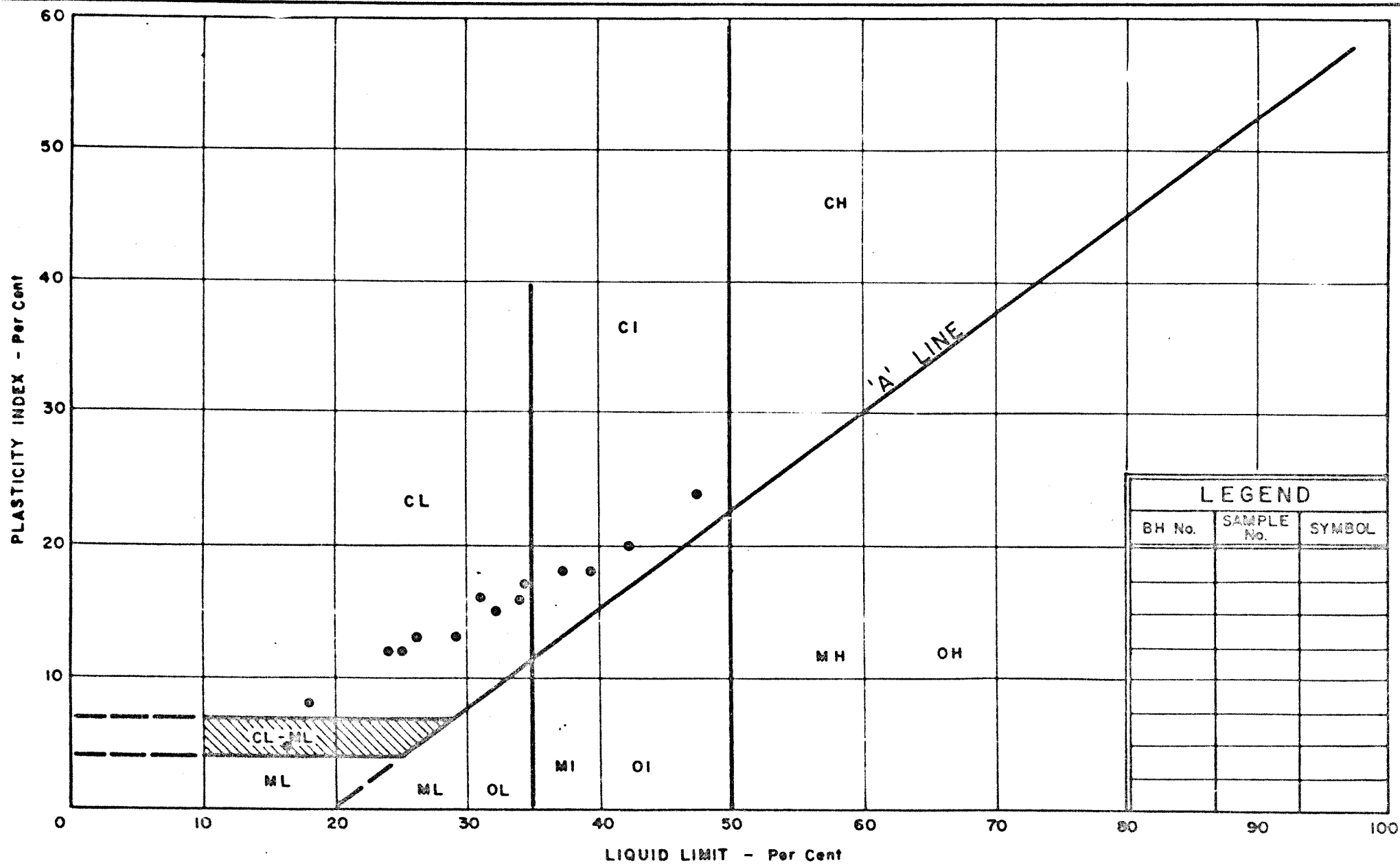
FOUNDATION SECTION

CHECKED BY \_\_\_\_\_

20  
10  
5  
0

10 20 30 40 50 60 70 80 90 100

% STRAIN AT FAILURE



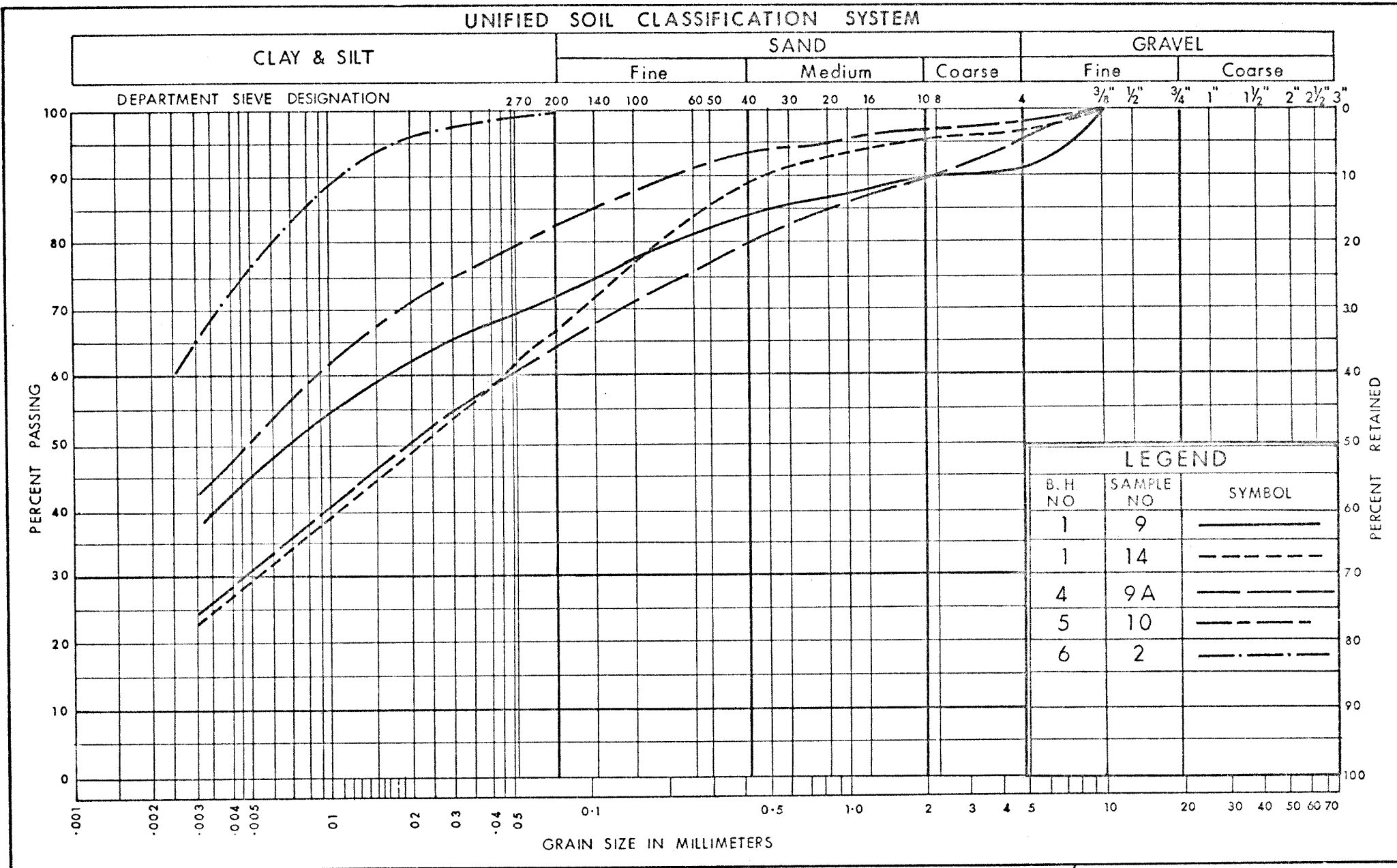
DEPARTMENT OF HIGHWAYS  
 MATERIALS and  
 TESTING  
 DIVISION

# PLASTICITY CHART CLAYEY SILT

W.P. No. 88 - 69 - 06

JOB No. 71 - 11065

FIG. 1



## ABBREVIATIONS 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
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
$S_t$	SENSITIVITY

### GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

### STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	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

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N': - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

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

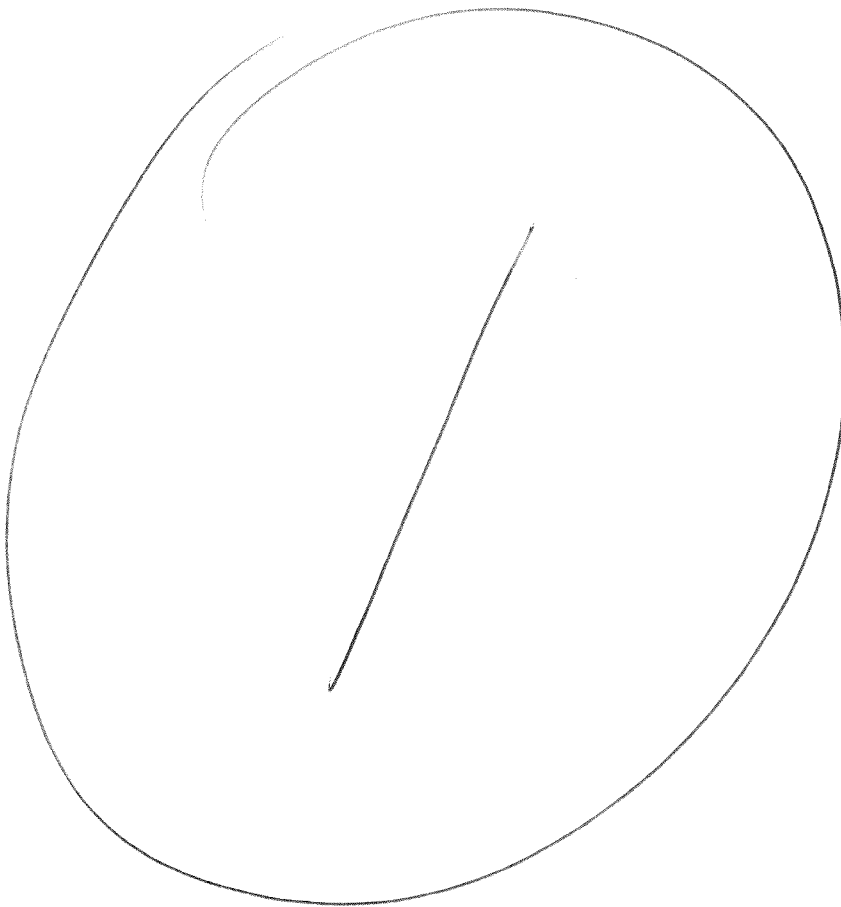
### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

# 35MM DRAWING



# SUMMARY OF PILE DRIVING RECORDS

W.O. 71-11065 W.P. 88-69-06 CONT. 73-138 DIST. 2

SITE BALACLAVA ST. - S.T.E

DATE DRIVEN MAR. 7 — APR. 2/75 WEIGHT OF ANVIL 1100 lb

HAMMER TYPE B 225 WEIGHT 1.425 T ENERGY 25000 FT/LB

[illegible]