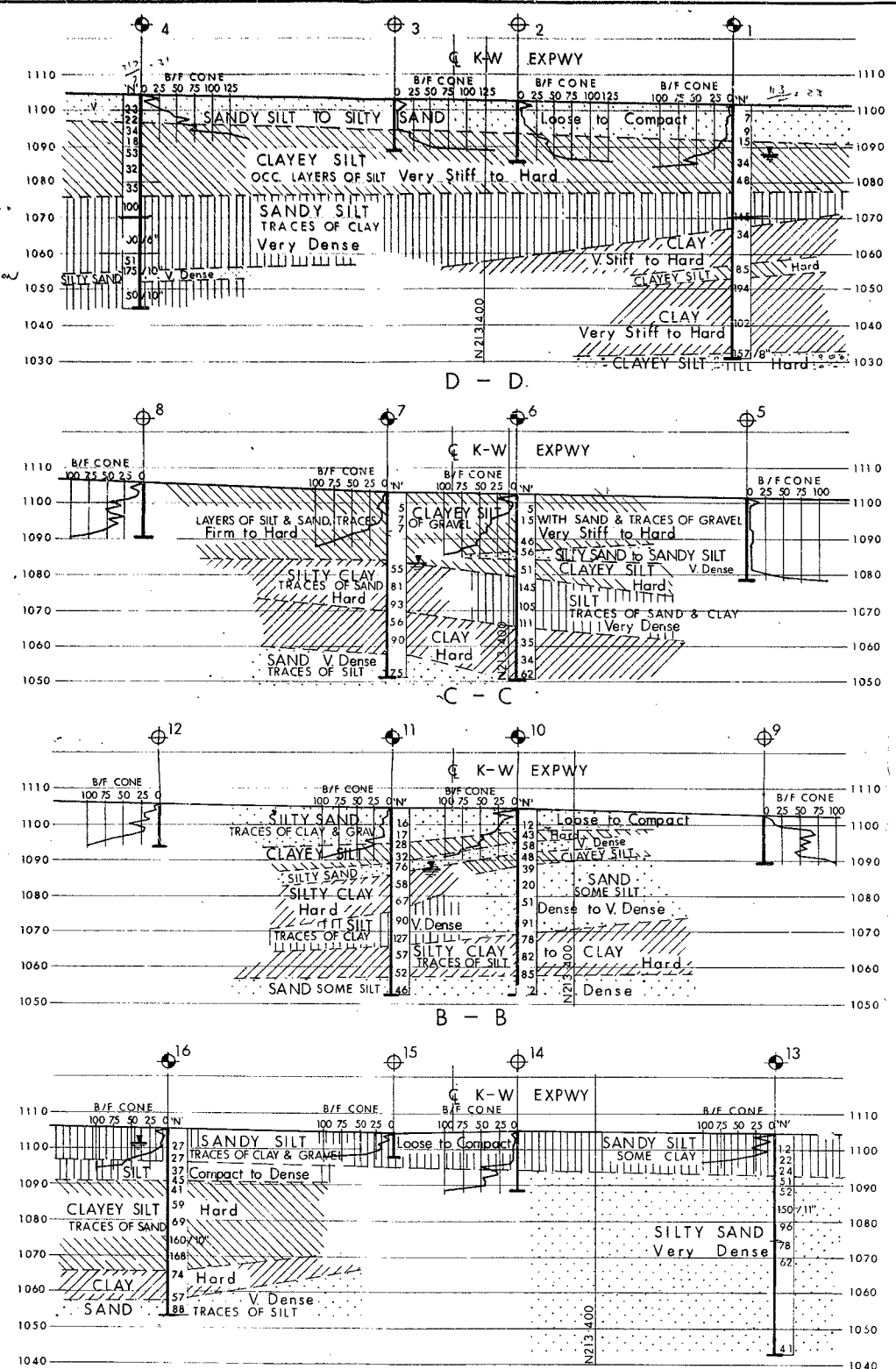


#68-F-3R
W.P. #24-67
KITCHENER
WATERLOO
EXPRESSWAY
KING STREET N.
OVERPASS

*68-F-3R
W.P. #24-67
KITCHENER
WATERLOO
EXPRESSWAY
KING STREET N.
OVERPASS

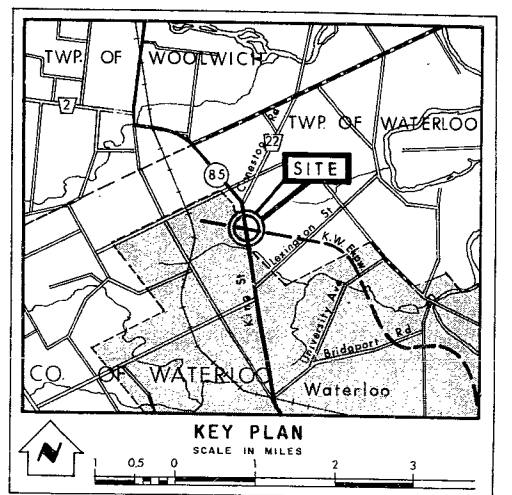
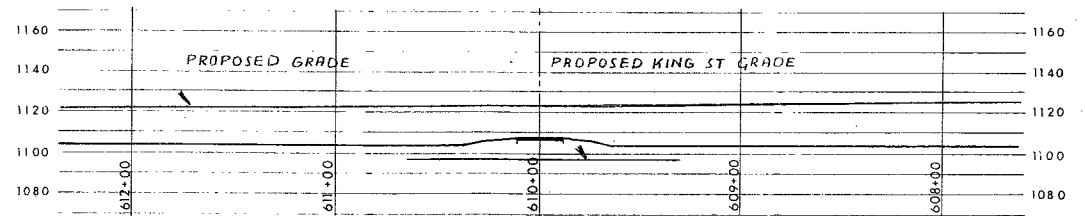
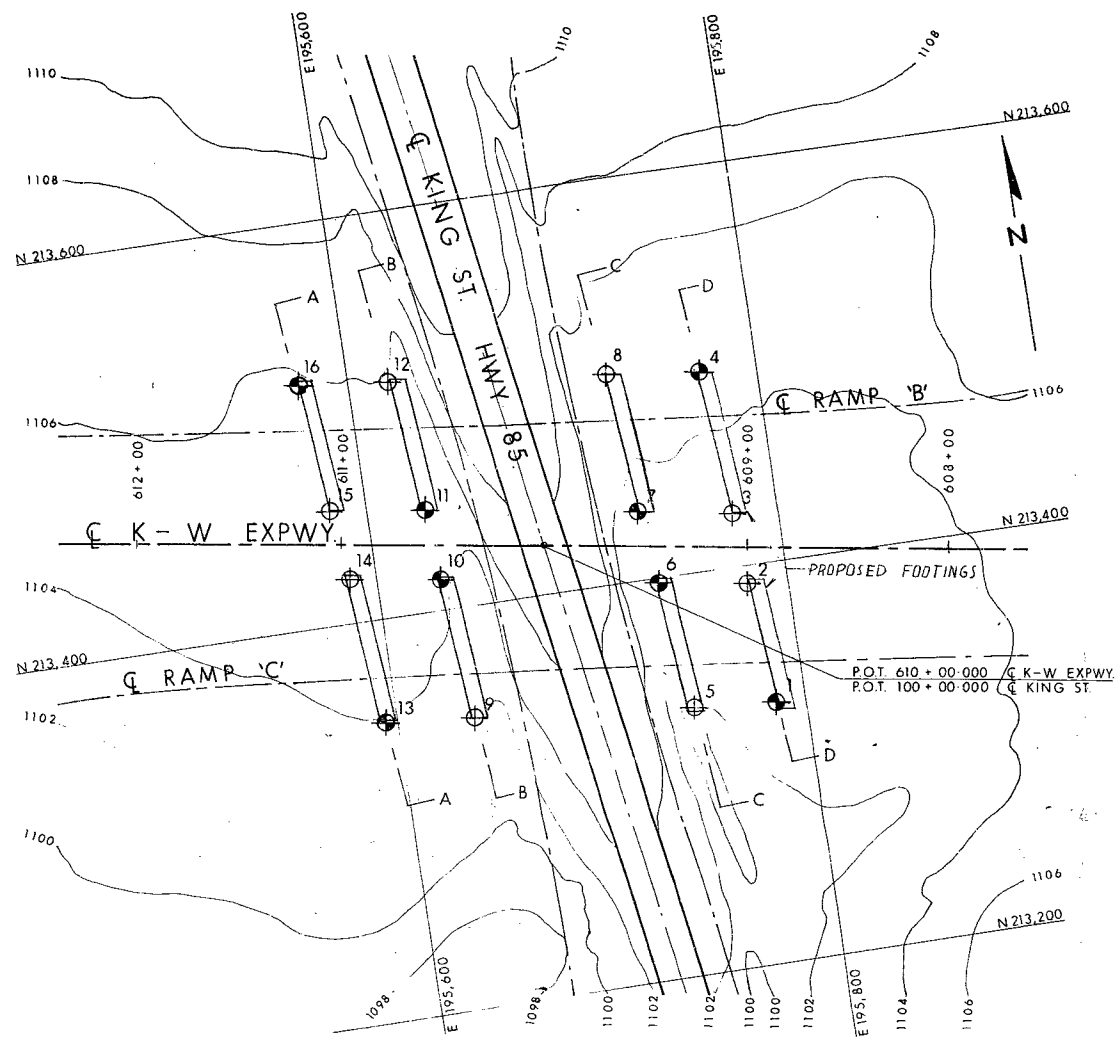
East side of
 length = 112
 - 1070
 VE
 $R = 4.2 \times 10^4$
 $N.A. = \frac{1070}{100} = 10.7$
 $4.2 \times 10^4 \times 10.7 = 448400$
 $R = \frac{448400}{5} = 89680$
 $Q = \frac{448400}{5} = 89680$
 $Q = 140 \text{ TON}$



PRINT RECORD

NO.	FOR	DATE

$Q_2 = 1 \times N.A. = \frac{1070}{100} = 10.7$
 $4.2 \times 10^4 \times 10.7 = 448400$
 $R = \frac{448400}{5} = 89680$
 $Q = \frac{448400}{5} = 89680$
 $Q = 140 \text{ TON}$



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, JAN. 68

NO.	ELEVATION	COORDINATES	
		NORTH	EAST
1	1101.6	213,329.0	195,788.5
2	1102.4	213,391.5	195,781.0
3	1102.7	213,425.8	195,778.0
4	1104.3	213,497.2	195,772.2
5	1101.6	213,334.5	195,744.9
6	1102.5	213,398.2	195,737.0
7	1103.5	213,433.5	195,731.0
8	1105.1	213,502.0	195,726.6
9	1102.6	213,346.2	195,637.0
10	1104.5	213,414.8	195,631.2
11	1104.5	213,449.5	195,628.0
12	1106.0	213,514.2	195,619.2
13	1104.2	213,350.0	195,593.5
14	1105.1	213,422.0	195,586.8
15	1104.8	213,456.8	195,582.8
16	1105.4	213,520.0	195,575.2

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION - FOUNDATION SECTION

KING STREET

KING'S HIGHWAY NO. K - W EXPWY DIST. NO. 4

CO. WATERLOO

TWP. WATERLOO LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. S. N.	CHECKED	W.P. NO. 24-67	M.B.T. DRAWING NO.
DRAWN A.B.	CHECKED	JOB NO. 68-F-3 (R)	68-F-3A
DATE FEB. 6, 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CONT. NO.		

REF. NO. 2143-SK-51

MEMORANDUM

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

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: February 11, 1969

OUR FILE REF.

IN REPLY TO

SUBJECT: Kitchener-Waterloo Expressway
King Street North Overpass
W.P. 24-67, Site 33-267
District No. 4

68 F-3


Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.

CSG:rd

Attach.

c.c. Foundation Section


C.S. Grebski,
Bridge Design Engineer

4-7-69

4-7-69

4-7-69

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: February 23, 1968

OUR FILE REF.

IN REPLY TO

MAR 6 1968

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Kitchener-Waterloo Expressway
King Street Overpass
At Hwy. #85 North Waterloo, Ontario
District No. 4 (Hamilton)
W.J. 68-F-3R -- W.P. 24-67

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/MdeF
Attach.

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)
B. A. Tregaskes
D. W. Farren
W. Zonnenberg
H. Greenland
W. S. Melnyshyn
J. Roy
W. D. Bradley, City Engr., Kitchener
A. D. Margison & Assoc. Ltd.
University of Waterloo
Foundations Files ✓
Gen. Files

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 - 5.5) Clayey Silt with Sand & Gravel -
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 - 7.1) General.
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-

FOUNDATION INVESTIGATION REPORT
For
Kitchener-Waterloo Expressway
King Street Overpass
At Hwy. #85 North Waterloo, Ontario
District No. 4 (Hamilton)
W.J. 68-F-3R -- W.P. 24-67

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed overpass at the crossing of Kitchener-Waterloo Expressway and Hwy. #85 in North Waterloo, was received from the Bridge Location Section (memo from Mr. W. S. Melnychyn, Regional Bridge Location Engineer, dated December 14, 1967.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the location of the proposed structure. Presented in this report are the results of this investigation, together with recommendations pertaining to the design of the proposed foundations and approach embankments.

2. DESCRIPTION OF THE SITE:

The site is located on King St. (Hwy. #85), about 0.75 mile north of Lexington Rd., Waterloo, Ontario. The surrounding area is farmland and the topography slopes gently downwards from north to south.

Physiographically, the site is located in the region referred to as the Waterloo Hills.

3. FIELD INVESTIGATION PROCEDURE:

A total of 8 boreholes and 16 dynamic cone penetration tests, was carried out during the course of the field work. Boring was achieved by means of conventional diamond drilling

cont'd. /2 ...

3. FIELD INVESTIGATION PROCEDURE: (cont'd.) ...

equipment adapted for soil sampling purposes. Samples were recovered using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test.

Samples were visually examined in the field and subsequently in the laboratory.

The location and elevations of all boreholes are shown on Drawing 68-F-3A, which accompanies this report.

4. LABORATORY TESTS:

Laboratory tests were carried out on split-spoon samples to determine Atterberg limits, grain-size distribution, and natural moisture contents. Four Shelby tube samples were utilized for lab - vane tests, unconfined shear strength, and undrained triaxial shear strength tests.

The results of tests carried out in the field and laboratory are plotted on the borehole logs which form part of this report.

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Subsoil at the site consists of various stratified glacio-fluvial deposits mostly of fine-grained composition. Detailed descriptions of the various deposits are shown on the Record of Borelog sheets which accompany this report. The estimated stratigraphical profiles shown on Drawing 68-F-3A are based upon this information. It should be noted, however, that the boundaries between deposits, as shown on the borelog sheets and in the stratigraphical profiles, are in most cases not so clearly defined in the field and occur as a transition rather than as a sudden change. A description of each of the various main soil types encountered, follows: (For boundaries, refer to Drawing 68-F-3A.)

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

5.2) Sand:

This deposit includes silty sand, sand with traces of silt, sand with some silt, and silty sand with gravel.

'N' values ranged from 16 to over 175 blows/ft., indicating compact to very dense relative densities. The natural water content ranges between 13% and 24%. From the grain-size distribution curves, the material contains:

Gravel	0	-	40%
Sand	42	-	92%
Silt & Clay ..	7	-	43%

5.3) Silt:

This deposit includes both cohesive and non-cohesive strata. The cohesive strata are: Clayey silt, clayey silt with layers of silt, and clayey silt with sand and traces of gravel. The non-cohesive strata are: Sandy silt, sandy silt to clayey silt, sandy silt to silty sand, sandy silt with traces of clay and gravel, and silt with traces of sand and clay.

For the cohesive layers the physical properties are summarized thus:

Liquid Limit	W_L	:	25	-	38%
Plastic Limit	W_P	:	15	-	21%
Moisture Content	W	:	16	-	19%
'N' Values			15	-	168 blows/ft.

Based on the foregoing, the undrained shear strength of these cohesive layers is estimated to be in the order of 2000 to more than 10,000 p.s.f. In general, the soil has a hard consistency.

In the non-cohesive layers the 'N' values ranged from 5 - 145 blows/ft., indicating a loose to a very dense relative density. The general condition, however, is very dense. The

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

5.3) Silt: (cont'd.) ...

moisture content ranges from 11% to 29%. Laboratory tests indicate the following grain-size distribution:

Gravel	:	0	-	5%	Silt	:	55	-	83%
Sand	:	3	-	39%	Clay	:	2	-	14%

5.4) Clay:

This deposit indicates clay with medium to high plasticity, clay with traces of silt, and silty clay. 'N' values ranged from 34 to 194 blows/ft., indicating a hard consistency. Physical properties determined from laboratory tests are:

Liquid Limit	W _L	:	36	-	62%
Plastic Limit	W _P	:	15	-	27%
Moisture Content	W	:	9	-	33%

From the above, it is estimated that the clay deposits are generally heavily overconsolidated with undrained shear strengths ranging from 4000 to more than 10,000 p.s.f.

5.5) Clayey Silt with Sand and Gravel (Glacial Till):

This deposit was encountered in B.H. 1 only, at a depth of 70 ft. The material consists of a heterogeneous mixture of clayey silt, sand and gravel, and is considered to be of glacial origin. A single standard penetration test gave 157 blows for 9 inches, indicating a very hard consistency. From the grain-size distribution test, the material contains:

Gravel	Sand	Silt	Clay
8%	35%	43%	14%

cont'd. /5 ...

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

5.5) Clayey Silt with Sand and Gravel (Glacial Till) - (cont'd.)..

The Atterberg limits for the fine-grained material of this deposit are:

Liquid Limit	W_L	:	19%
Plastic Limit	W_p	:	13%
Moisture Content	W	:	11%

The undrained shear strength is estimated to be in excess of 10,000 p.s.f.

6. GROUNDWATER CONDITIONS:

No attempt was made to establish an accurate groundwater level by means of piezometers. Groundwater level observed, at the time of investigation, for 5 boreholes, namely B.H.'s 1, 4, 7, 11 and 16, were 1,088.6, 1100.0, 1083.5, 1087.7 and 1101.4, respectively. The northern (and higher) boreholes were observed to have a higher groundwater level than the southern.

7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

A new overpass structure on King St. (Hwy. #85), about 0.75 mile north of Lexington Rd., Waterloo, Ontario, is proposed to be constructed. The new structure will be a 198-ft. long, 3-span twin bridge. The future grade of Dryden Blvd. will be about el. 1127.5, and of Hwy. #85, el. 1107.0 (same as existing).

The various aspects of the proposed project are discussed below, under appropriate headings.

7.2) Structure Foundations:

From the preceding paragraphs, it can be seen that the subsoil at the site consists of variable cohesive and non-cohesive

cont'd. /6 ...

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

7.2) Structure Foundations: (cont'd.) ...

layers. In general, the east side of Hwy. #85 contains more cohesive deposits than the west side.

For the structure foundations, the following is recommended:

7.2.1) Spread Footings:

The whole structure may be supported on spread footings, at or below the elevations shown in the following Table:

Position	Elevation		Safe Bearing Capacity
	N.	= North Footing	
	S.	= South Footing	
East Abutments	N. 1091.00		3.5 t.s.f.
	S. 1089.00		
East Piers	N. 1091.00		"
	S. 1089.00		
West Piers	N. 1095.00		"
	S. 1093.00		
West Abutments	N. 1097.00		"
	S. 1095.00		

No major dewatering problems are anticipated for excavations carried out to the above recommended depths. However, since the subsoil contains different deposits of non-cohesive soil as well as cohesive soil, it would be advisable to protect the bases of the excavations by means of working slabs as soon as possible after exposure.

cont'd. /7 ...

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

7.2) Structure Foundations: (cont'd.) ...

7.2.2) Piles:

The whole structure, or part of the structure only, may be supported on piles. The most suitable type of pile would be large displacement piles, such as 12.75 inch O.D. x 0.25 inch wall steel tubes which should achieve a safe capacity of 60 T/pile at or below the elevations shown in Table:

Position	Elevation
East Abutments	1070 ±
East Piers	1075 ±
West Piers	1070 ±
West Abutments	1075 - 1080 ±

The caps of these piles should be at least 4 ft. depth from finished ground level which is the frost zone.

Provided the above recommendations are followed, differential settlements are anticipated to be of negligible order.

7.3) Structure Approaches:

No stability problems are anticipated for the proposed embankments provided standard 2:1 slopes are constructed.

8. SUMMARY:

A foundation investigation at the site of the proposed new structure, the Kitchener-Waterloo Expressway - King St. overpass, at Hwy. #85 north Waterloo, Ontario, is reported.

8. SUMMARY: (cont'd.) ...

Subsoil at the site consists of various stratified glacio-fluvial deposits mostly of fine-grained composition.

Recommendations pertaining to the structure foundations and approach embankments, are as follows:

8.1) The proposed structure may be supported on spread footings.

No major dewatering problems are anticipated.

8.2) The proposed structure may be supported wholly or partly on steel tube piles. Differential settlements should be negligible.

8.3) No stability problems with regard to the approaches are anticipated, provided that standard 2:1 slopes are used.

9. MISCELLANEOUS:

The field investigation was carried out during the period January 4 - 17, 1968.

Equipment used was owned and operated by Dominion Soil Investigation, Ltd.

The supervision of the field work and the preparation of this report, were undertaken by Mr. S. Nassif, Project Foundation Engineer. General supervision of the project was carried out by Mr. K. G. Selby, Supervising Foundation Engineer.

February 1968.

SECRET

[illegible]

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-3

LOCATION

N. 213,425.8; E. 195,778.0

FOUNDATION SECTION

ORIGINATED BY SN

W P 24-67

BORING DATE

Jan. 10, 1968

COMPILED BY 2N

DATUM Geodetic

BOREHOLE TYPE

Cone Test

CHECKED BY 41

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W WATER CONTENT % W _P ——— W _L	BULK DENSITY PCF X	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
1102.7	Ground Level									
0.0						1100				
1088.7						1090				
14.0	End of Cone Test					1080				

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO.5

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-3

LOCATION

N.213,334.5; E.195,744.9

ORIGINATED BY SN

W P 24-67

BORING DATE

Jan. 11, 1968

COMPILED BY SN

DATUM Geodetic

BOREHOLE TYPE

Cone Test

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-3

LOCATION N.213,398.2; E.195,707.0

ORIGINATED BY SN

W P 24-67

BORING DATE Jan. 12, 15, 1968

COMPILED BY _____ SN

DATUM Geodetic

BOREHOLE TYPE Penn Drill

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20 40 60 80 100	20 30 40			
1102.5	Ground Level										Gr. Sa. Sl. Cl
0.0	Clayey silt to silt with sand (layered)		1	SS	5	1100					1 33 58 8
1096.5	Firm to stiff		2	SS	15						
6.0	Clayey silt with sand and traces of gravel.		3A	TW	PH						
	Very stiff to hard.		3	SS	46	1090					
1086.5			4	SS	56						
16.0	Silty sand to sandy silt. Very dense.										
1084.5											
16.0	Clayey silt with sand and traces of gravel.		5	SS	51						
	Hard.										
1079.5						1080					
23.0	Silt with traces of sand & clay.		6	SS	145						0 5 83 12
	Very dense.		7	SS	105	1070					
			8	SS	111						
1064.5											
38.0	Clay		9	SS	35	1060					
	Hard		10	SS	34						
1051.0			11	SS	62						0 0 30 70
51.5	End of Borehole					1050					

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-3 LOCATION N.213,433.5; E.195,731.0

ORIGINATED BY SN

W P 24-67

BORING DATE Jan. 11, 1968

COMPILED BY _____ SN

DATUM Geodetic

BOREHOLE TYPE Penn Drill

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT	WATER CONTENT % 20 30 40			
1103.5	Ground Level										Gr. Sa. S1. Cl
0.0	Clayey silt with layers of silt with sand, traces of gravel.		1	SS	5	1100					
			2	SS	7						
			3	SS	7						
			4	TW	PH	1090					
			5	TW	PH						
1084.5											
19.0	Silty clay, traces of sand. Hard		6	SS	55						
			7	SS	81	1080					
			8	SS	93						
1070.5						1070					
33.0	Clay Hard.		9	SS	56						
			10	SS	90	1060					
1058.5											
45.0	Sand with traces of silt. Very dense.										
1052.0			11	SS	75						
51.5	End of Borehole					1050					

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.8

FOUNDATION SECTION

JOB 63-F-3 LOCATION N. 213,502.0; E.195,726.6 ORIGINATED BY SN
 W P 24-67 BORING DATE Jan. 11, 1968 COMPILED BY SN
 DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY

SOIL PROFILE			SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — WL	BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	PLASTIC LIMIT — WP		
						20 40 60 80 100	WATER CONTENT % — P — L — P — L		
1105.1	Ground Level								
0.0									
					1100				
1090.1					1090				
14.7	End of Cone Test								
					1080				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 68-F-3 LOCATION N.213,346.2; E.95,637.0 ORIGINATED BY SN
 W P 24-67 BORING DATE Jan. 12, 1968 COMPILED BY SN
 DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY SN

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WP — W — WL WATER CONTENT %	BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT					
1102.6										
0.0						1100				
1089.8						1090				
12.8	End of Cone Test									
						1080				

RECORD OF BOREHOLE NO. 10

JOB 68-F-3 LOCATION N. 213, 111.8; E. 195, 631.2 ORIGINATED BY SN
W.P. 24-67 BORING DATE Jan. 12, 1968 COMPILED BY SN
DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY SN

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— % Plastic Limit ——— % Water Content ——— %	BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100	Wp ——— Wl ———		
1104.5	Ground Level									
0.0	Silty sand with traces of clay & gravel.									
1098.5	Loose to compact.		1	SS	12	1100				
6.0	Clayey Silt.		2	SS	43					
1096.5	Hard									
8.0	Sand, traces of silt.		3	SS	58					
1092.5	Very dense.									
12.0	Clayey silt, traces of sand.		4	SS	48					
1089.5	Hard.					1090				
15.0	Sand with some silt.		5	SS	39					
	Dense to very dense		6	SS	20					
			7	SS	51	1080				
			8	SS	91					
1069.5						1070				
35.0	Clay with traces of silt.		9	SS	78					
	Hard.		10	SS	82					
1057.5			11	SS	85	1060				
47.0	Silty sand.									
	Very dense.									
1053.0			12	SS	72					
51.5	End of Borehole					1050				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 68-F-3

LOCATION N.213,449.5; E.195,628.0

ORIGINATED BY SN

W P 24-67

BORING DATE Jan. 17, 1968

COMPILED BY SN

DATUM Geodetic

BOREHOLE TYPE Penn Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	WL	W		
1104.5	Ground Level															
0.0	Silty sand with traces of clay and gravel.		1	SS	16	1100										
	Loose to compact.		2	SS	17											
1095.0	9.5 Clayey silt, traces of sand.		3	SS	28											
1089.5	Very stiff to hard.		4	SS	32	1090										
15.0	Silty sand with gravel.		5	SS	76											
1086.5	Very dense.															
18.0	Silty clay.		6	SS	58											
	Hard.		7	SS	67	1080										
1075.5	29.5 Silt with traces of clay.		8	SS	90											
	Very dense.		9	SS	127	1070										
1066.5	38.0 Silty clay.		10	SS	52											
	Hard.		11	SS	52	1060										
1057.5	47.0 Sand with some silt.		12	SS	46											
	Dense.															
1053.0	51.5 End of Borehole					1050										

WATER CONTENT %
20 30 40

Br. Ss. Si. Cl

WL
EL 1087.7

62.6

0 88 (12)

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-3

LOCATION

RECORD OF BOREHOLE NO. 12

N.213,514.2; E.195,619.2

FOUNDATION SECTION

SN

W P 24-67

BORING DATE

Jan. 12, 1968

ORIGINATED BY

DATUM Geodetic

BOREHOLE TYPE

Cone Test

COMPILED BY

SN

CHECKED BY

—

[illegible]

FOUNDATION SECTION

JOB 68-F-3 LOCATION N.213,350.0; E.195,593.5 ORIGINATED BY SN
W.P. 24-67 BORING DATE Jan. 17, 1968 COMPILED BY SN
DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY 61

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 14		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB 68-F-3	LOCATION N. 213,422.0; E. 195,586.8	ORIGINATED BY SN			
W P 24-67	BORING DATE Jan. 18, 1968	COMPILED BY SN			
DATUM Geodetic	BOREHOLE TYPE Cone Test	CHECKED BY			

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _P WATER CONTENT _____ W _P _____ W _P ———— W _L WATER CONTENT %	BULK DENSITY γ _p C F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P S F. 20 40 60 80 100			
1105.1	Ground Level									
0.0										
						1100				
1088.2						1090				
16.9	End of Cone Test									
						1080				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 15

FOUNDATION SECTION

JOB 68-F-3

LOCATION

N. 213,456.8; E. 195,582.8

ORIGINATED BY SN

W P 24-67

BORING DATE

Jan. 12, 1968

COMPILED BY _____ SN

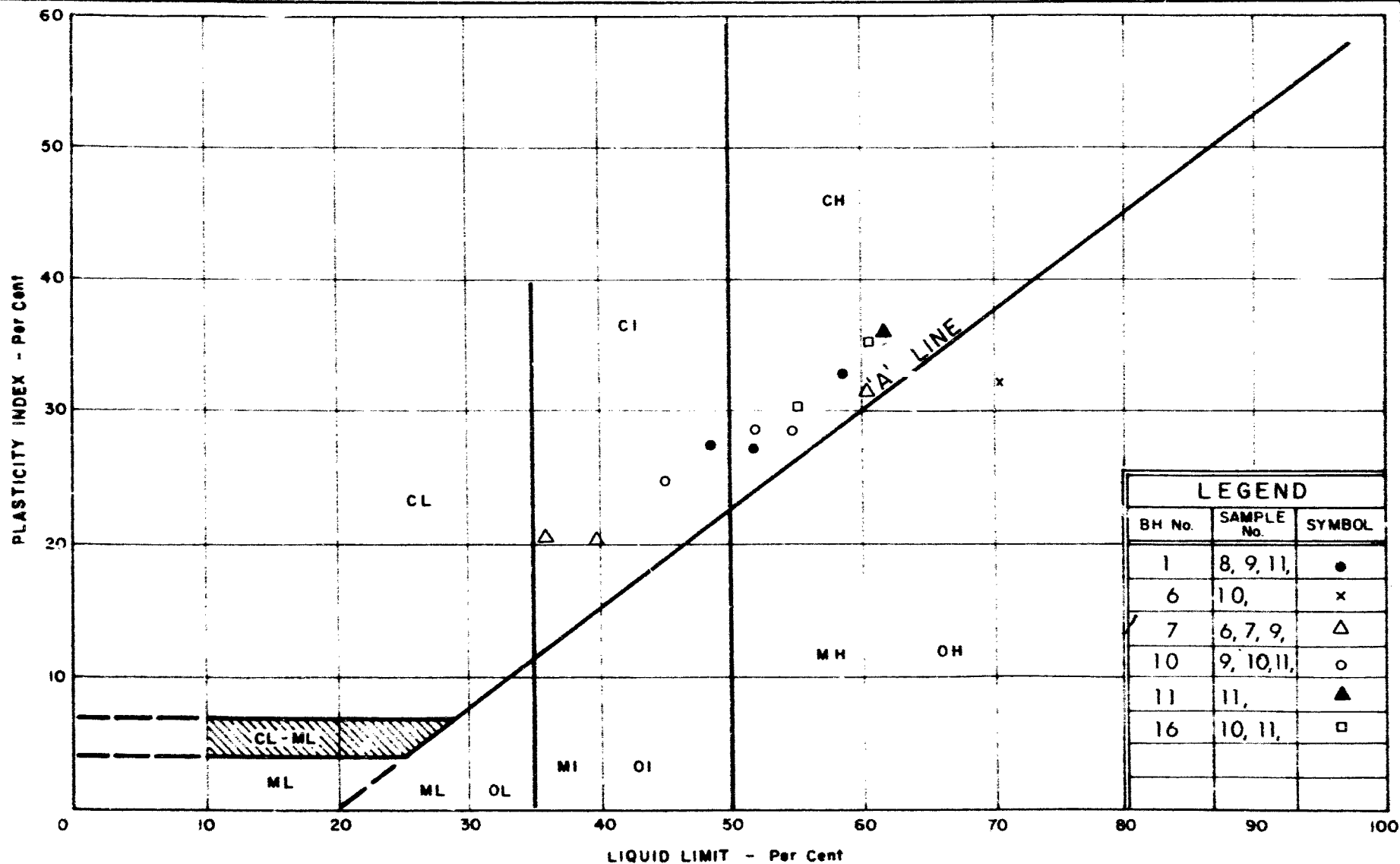
DATUM Geodetic

BOREHOLE TYPE

Cone Test

CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L		BULK DENSITY γ _B P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P. S. F.	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W		
1104.8	Ground Level											
0.0												
1097.9						1100						
6.9	End of Cone Test											
						1090						

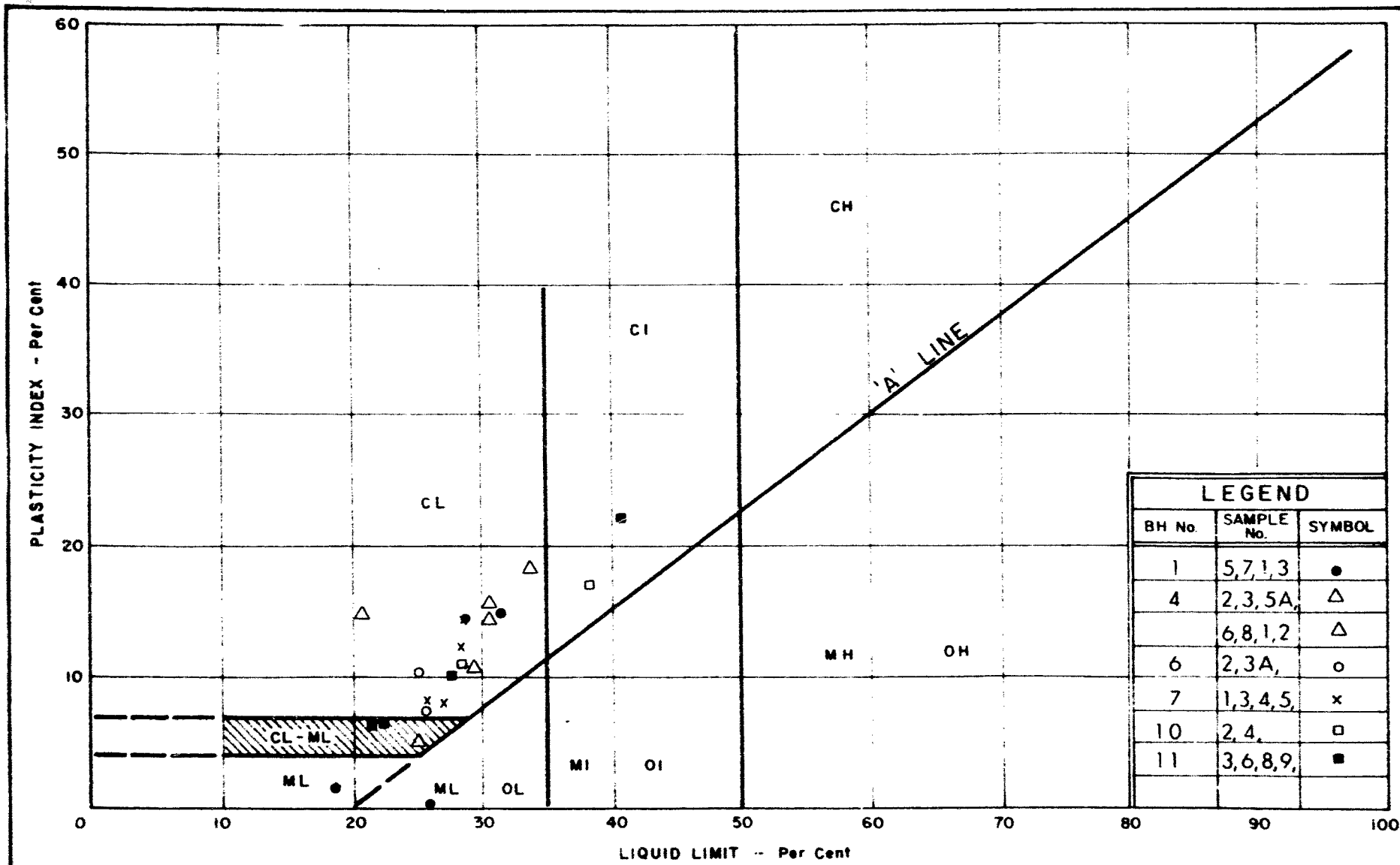


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART CLAYS

WP No. 24 - 67

JOB No. 68 - F - 3 (R)



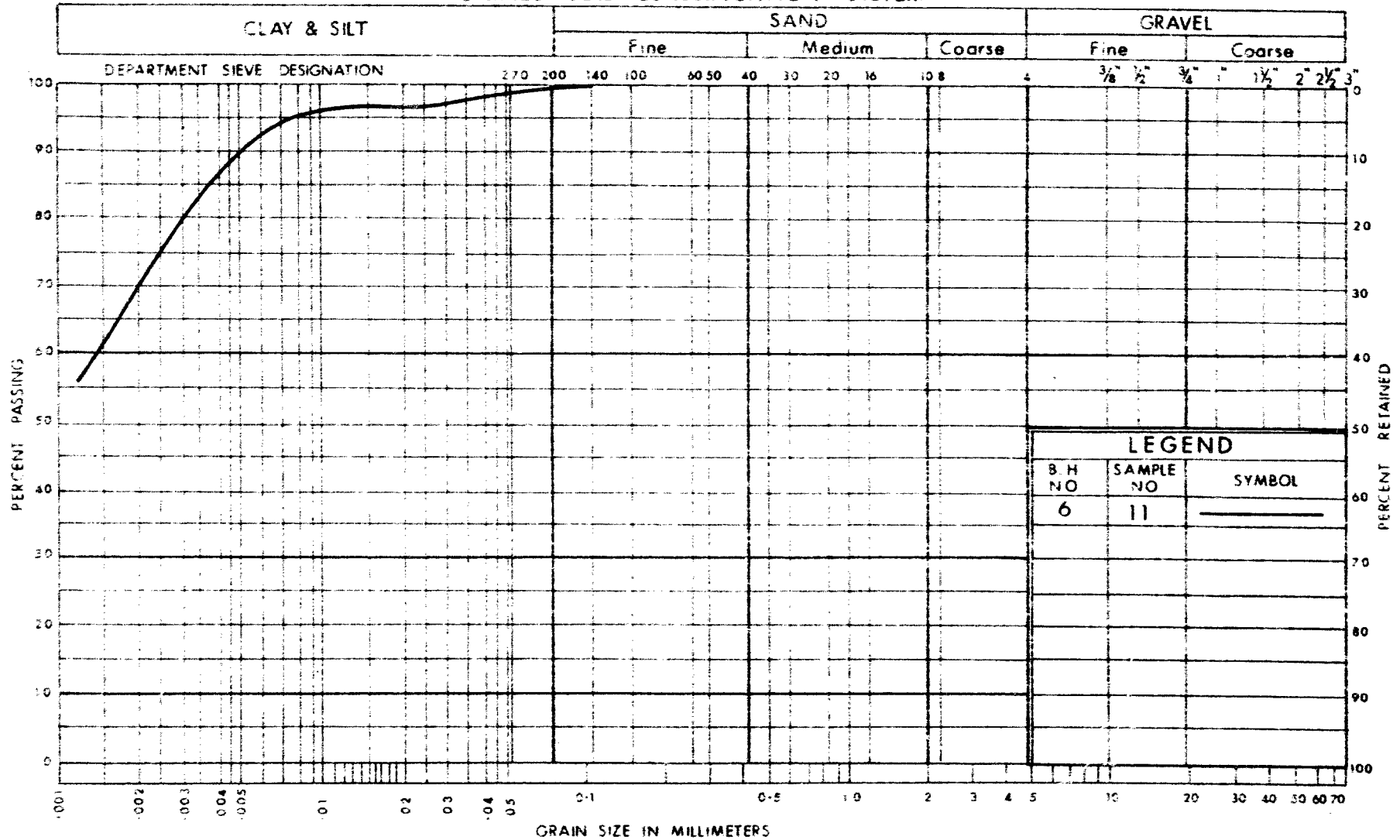
DEPARTMENT OF HIGHWAYS
**MATERIALS and
TESTING
DIVISION**

PLASTICITY CHART CLAYEY SILTS

WP No. 24 - 67

JOB No. 68 - F - 3 (R)

UNIFIED SOIL CLASSIFICATION SYSTEM



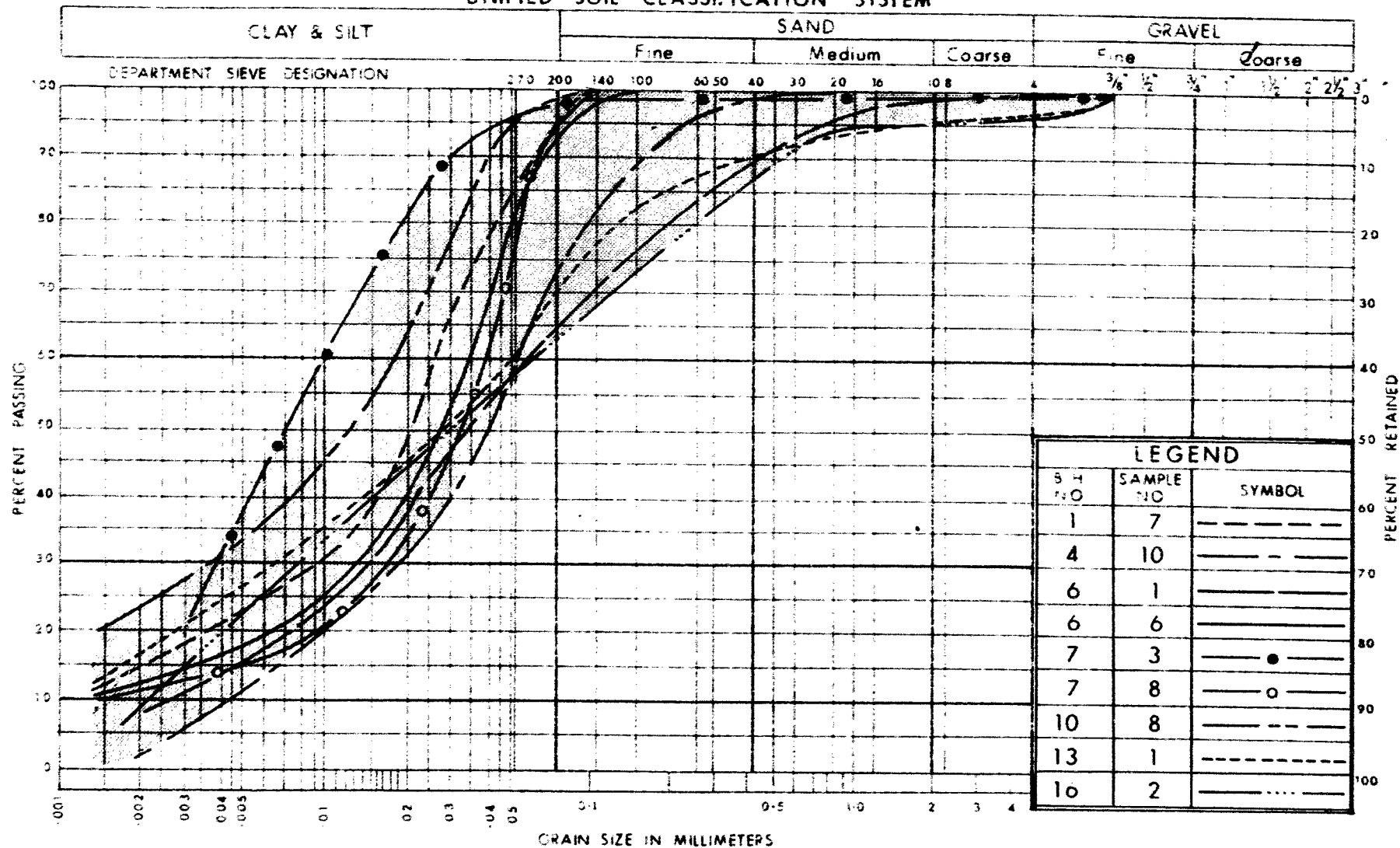
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAY

W.P. No. 24 - 67

JOB No. 68 - F - 3 (R)

UNIFIED SOIL CLASSIFICATION SYSTEM



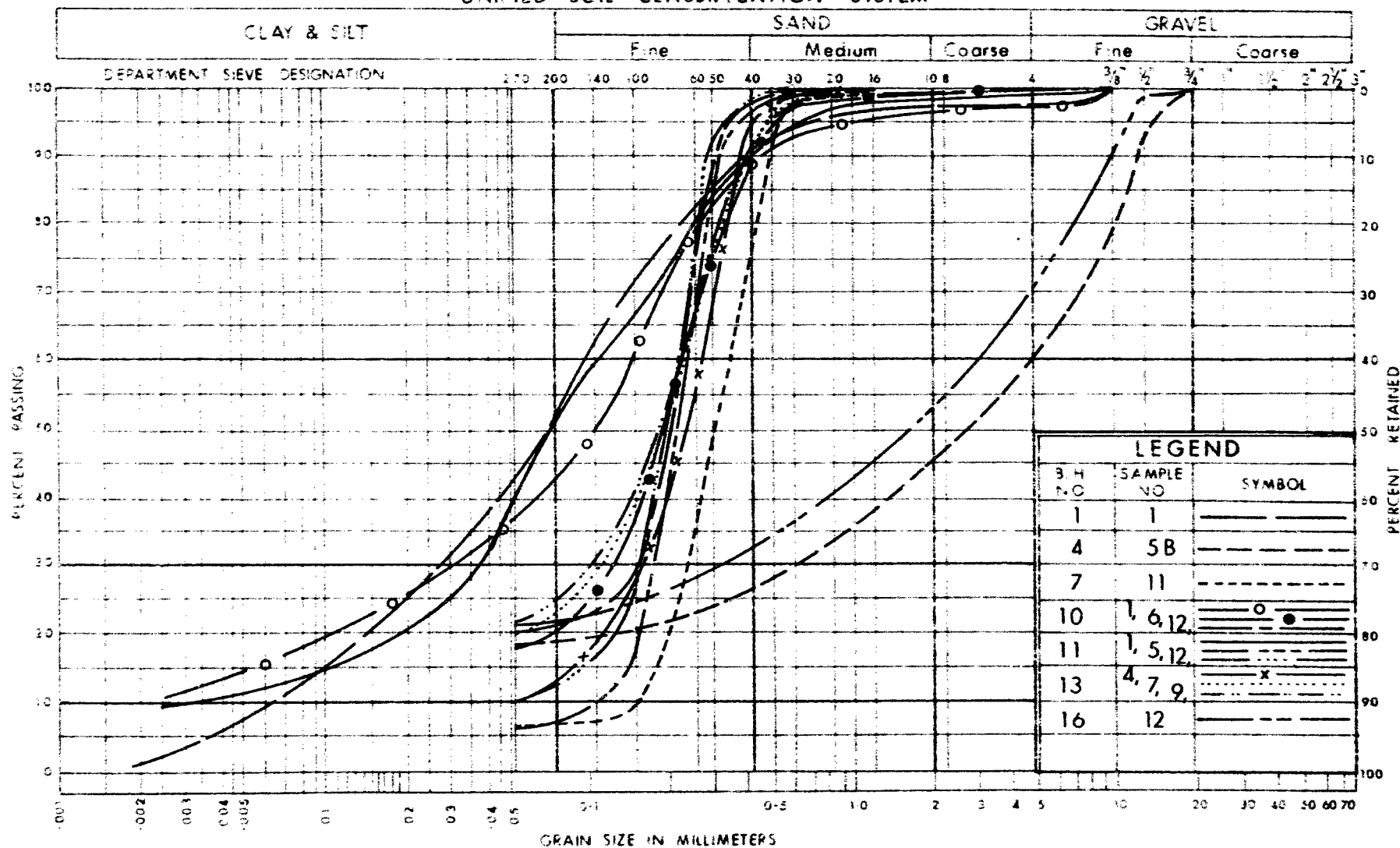
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION SILTS

W.P. No. 24 - 67

JOB No. 68-F-3(R)

UNIFIED SOIL CLASSIFICATION SYSTEM



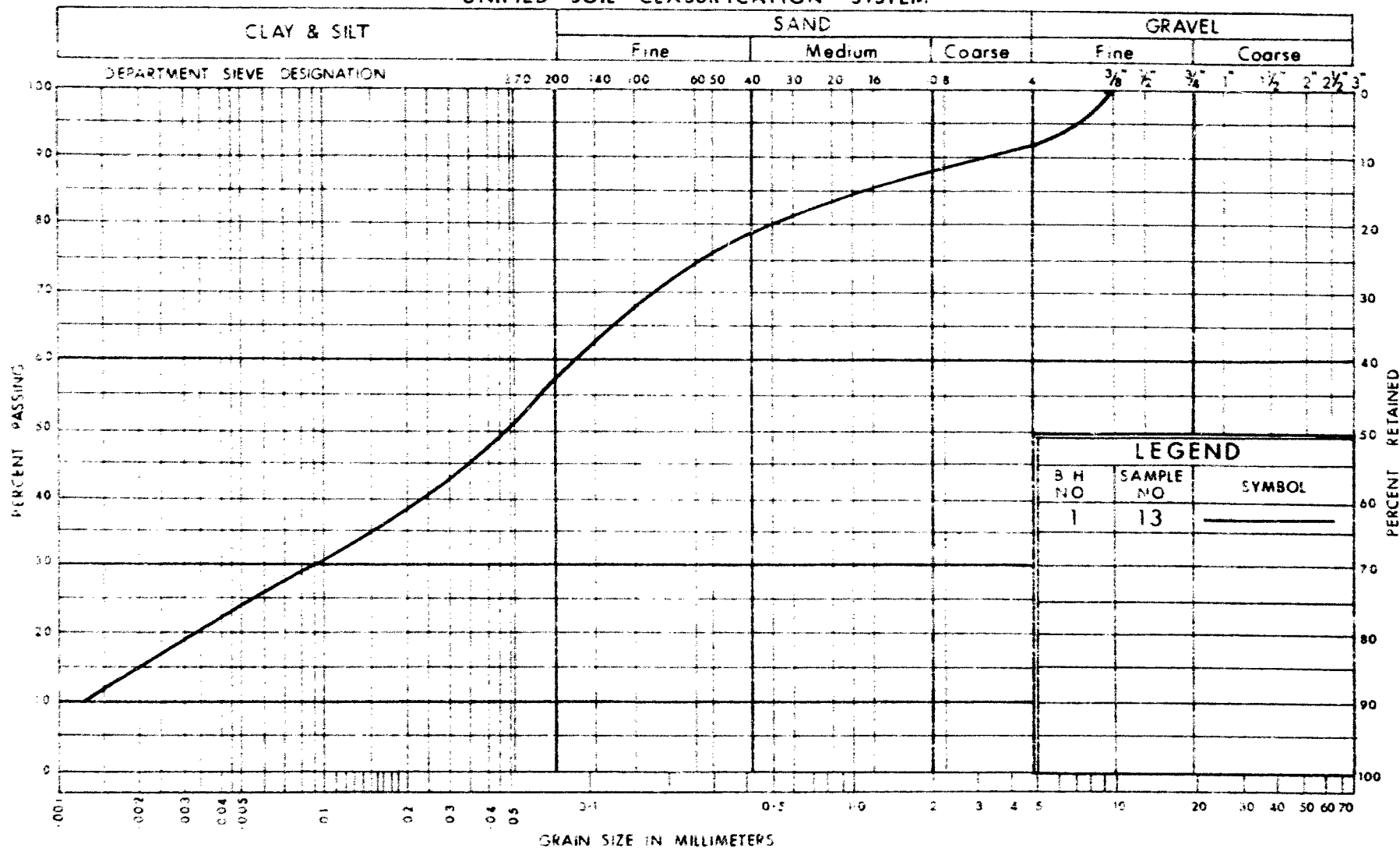
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION SANDS

W.P. No. 24 - 67

JOB No. 68 - F - 3 (R)

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT
SAND & CLAY OCC. GRAVEL
GLACIAL (TILL)

W.P. No. 24 - 67

JOB No. 68 - F - 3 (R)

VOID RATIO
VS
PRESSURE

JOB 68-F-3
BORE HOLE 1
SAMPLE 9
DEPTH 41' 3"

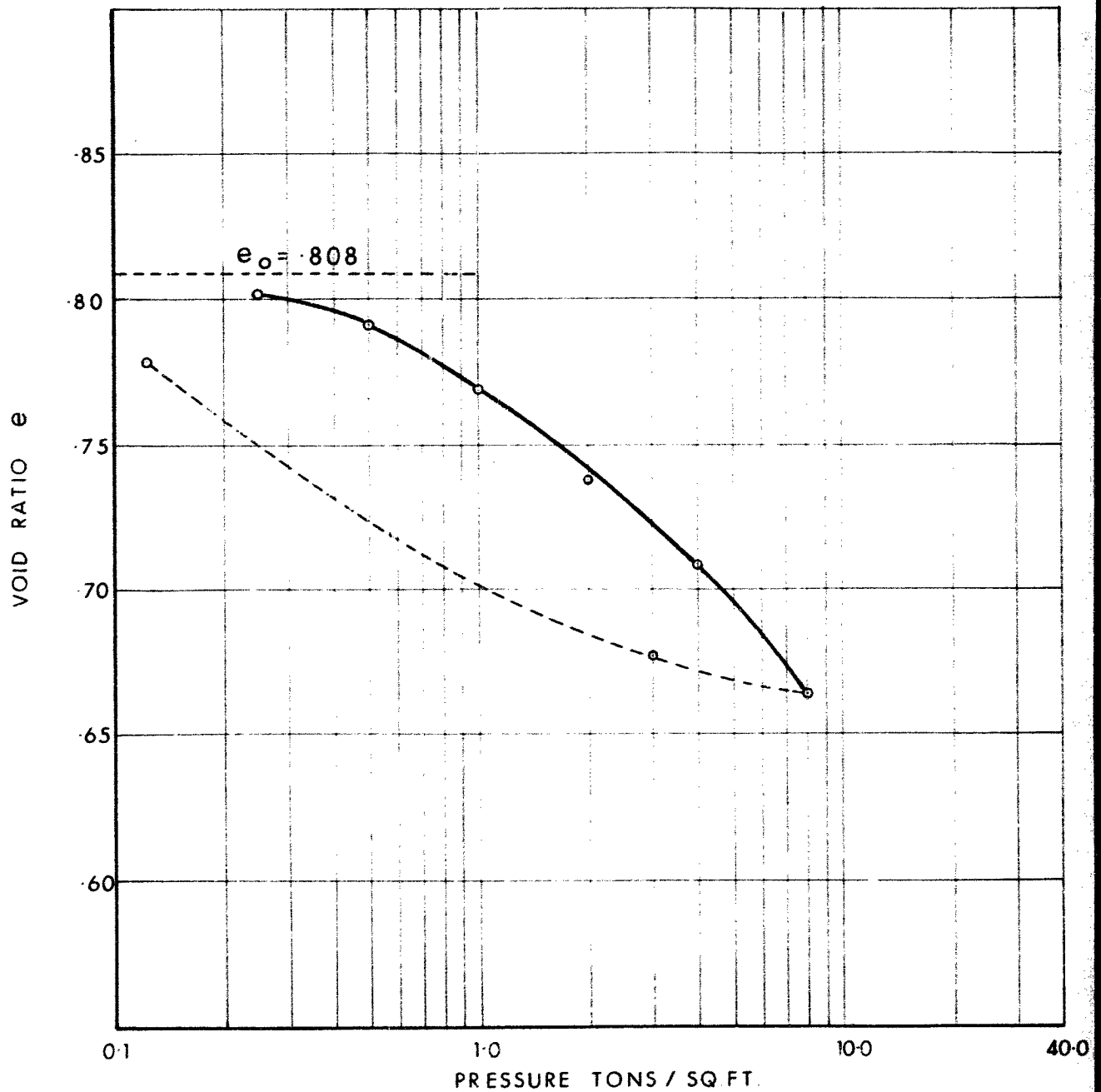


FIG.

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TYPE OF SAMPLE

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

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_r	SENSITIVITY

GENERAL

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

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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