

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: March 11, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Eastbound Lane and Westbound Lane  
Structures at the Crossing of  
Bear Brook and Proposed Hwy. #417,  
Twp. of Gloucester - Co. of Carleton  
District No. 9 (Ottawa)  
W.J. 67-F-111 -- W.P. 34-66-05

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 feel free to contact our Office.

AGS/MdeF  
Attach.

cc: Messrs. E. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
S. J. Markiewicz  
C. R. Robertson  
C. Scott  
J. E. Gruspier  
B. A. Singh  
Foundations Files  
Gen. Files ✓

*A. G. Sternac*  
A. G. Sternac  
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT  
For  
Eastbound Lane and Westbound Lane  
Structures at the Crossing of  
Bear Brook and Proposed Hwy. #417  
Twp. of Gloucester - Co. of Carleton  
District No. 9 (Ottawa)  
W.J. 67-F-111 -- W.P. 34-66-05

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation at the site of the proposed Hwy. #417 crossing over Bear Brook, some 14 miles south-east of Ottawa, in the Twp. of Gloucester, County of Carleton. The request was contained in a memo from the Bridge Division (Mr. G. Scott, Regional Bridge Location Engineer), dated August 25, 1967. An investigation was subsequently carried out by this Section to determine the subsoil conditions at the site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the proposed structures and the stability of the approach embankments.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site is located in an area bounded by 8th Line Road to the south and Halls Road to the east, on Lot 6, Concession VII, Twp. of Gloucester, County of Carleton. At this location, Bear Brook meanders along a valley floor which is about 200 feet wide. This brook has, in the geologic past, eroded the valley through the clayey overburden to depths of 25 to 30 feet below the surrounding ground surface, which is at about elevation 250. The valley banks so formed, are standing at slopes of about 2.5 to 3 horizontal to 1 vertical. At the present time, the banks appear to be stable. Occasionally, the banks are dissected by tributary gullies which lead into Bear Brook. Beyond the banks

2. DESCRIPTION OF SITE AND GEOLOGY: (cont'd.) ...

the topography consists of gently rolling terrain which, to the west, is covered with moderately dense tree growth, while to the east the land is being cultivated. The valley floor and banks in the vicinity, are covered with light brush growth.

Bear Brook, near the proposed crossings, is some 25 feet wide and about 7 feet deep. During normal flow conditions, the depth of water in the brook is about 4 to 5 feet.

Geologically, the area is located in the physiographic region known as "The Russell and Prescott Sand Plains". In this area, deep clay deposits are capped by a mantle of silts and fine sands some 10 to 20 feet thick. The deep stratum of marine clay, known locally as "Leda Clay", was deposited by the Champlain Sea, which inundated the area during the post-glacial period following the Wisconsin Glacial Age. The clay stratum is underlain by a glacial till, which in turn, is underlain by grey to black shale bedrock of the Lorraine formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Nine sampled boreholes were put down during the course of the investigation, using a conventional diamond drill rig, adapted for soil sampling purposes. Seven of these boreholes were accompanied by a dynamic cone penetration test. In addition, two cone penetration tests were also carried out to practical refusal. In two boreholes, samples were obtained only in the glacial till deposit after washing down through the overlying clay stratum.

Samples were recovered at required depths in 2" and 3" I.D. Shelby tubes, which were manually pushed into the soil. In addition, samples of the surficial deposits and glacial till were obtained using a 2" O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance

cont'd. /3 ...



3. FIELD AND LABORATORY WORK: (cont'd.) ...

the dynamic cone penetration tests. Field vane tests were carried out in the cohesive portion of the overburden, where possible, to determine the undrained shear strength of the stratum. Bedrock was proven, at five of the boring locations, by diamond core drilling in either AXT or BXL size. The groundwater level conditions across the site were determined by installing piezometers at three of the boring locations. This was supplemented by recording the groundwater level in the open boreholes at the remaining borings.

Gas pockets and artesian groundwater conditions were encountered at depth in a number of boreholes put down through the valley bottom. The emission of gas and water was stopped by placing wooden plugs and quick setting cement in the open holes at the pertinent locations.

The location and elevation of all borings were surveyed by personnel from the Kingston Region Engineering Surveys Section, and are shown on Drawings 67-F-111A (E.B.L.) and 67-F-111B (W.B.L.), together with the estimated stratigraphical profile at the respective crossings. All elevations given in the report are referenced to a Geodetic datum.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following engineering properties of the overburden:

- Natural Moisture Contents
- Bulk Densities
- Atterberg Limits
- Grain-Size Distributions
- Organic Matter Contents
- Undrained Shear Strengths
- Consolidation Characteristics

cont'd. /4 ...

3. FIELD AND LABORATORY WORK: (cont'd.) ...

The results of this testing are plotted on the Record of Borelog sheets and are summarized on the Figures in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The surficial cover along the valley floor and valley banks is composed of a firm to stiff clayey silt with some sand and gravel. This deposit is some 6 to 13 feet thick. The surficial cover is underlain by a firm to stiff, highly plastic, sensitive marine clay stratum varying in thickness from 52 feet (on valley floor) to 88 feet (on top of valley bank). Directly underlying the clay stratum is a deposit of glacial till up to 35 feet thick, composed primarily of very stiff to hard clayey silt with sand and gravel. The glacial till is in turn, underlain by shale bedrock.

The boundaries between the various soil strata, as determined in the boreholes, are shown on the accompanying borehole log sheets. The stratigraphical profile, shown on Drawing 67-F-111A and 67-F-111B, is inferred from this data.

From ground surface downward, the various soil types encountered, are as follows:

4.2) Clayey Silt with Some Sand - Surficial Deposit:

A heterogeneous surficial deposit composed primarily of grey-brown clayey silt with some sand and a trace of gravel and organic matter, was encountered at the site. The thickness of this deposit varies from 6 to 13 feet. Occasional localized zones of more plastic silty clay are present within the clayey silt. Further, numerous seams of silt, sand and gravel up to 1/2 inch thick are randomly spaced throughout the deposit. At B.H. #10 the surficial deposit consists of a 7-foot thick layer of loose sand with some silt. Grain-size distribution curves for samples of the clayey silt deposit are shown on Figure 6 in the Appendix of this report.

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Clayey Silt with Some Sand - Surficial Deposit: (cont'd.)

The Atterberg limit tests, carried out on representative samples of the deposit, are summarized both on Figure 1 and the Plasticity Chart shown on Figure 9. These results indicate that the cohesive deposit is basically inorganic and of low plasticity with localized zones having a medium to high plasticity. The natural water content is generally at or 2 to 3 percent below the liquid limit.

The laboratory and field undrained shear strength testing carried out, gave values ranging from 400 to 1,600 p.s.f., with an average value of about 800 p.s.f. Based on these results it is estimated that the consistency of the deposit ranges randomly from soft to stiff, being typically firm. The standard penetration resistance tests, carried out within the surficial deposits, gave 'N' values ranging between 1 and 11 blows/ft., which, generally, corroborates the consistency pattern given above.

4.3) Sensitive Clay:

The surficial deposits are underlain by the predominant overburden stratum across the site, a sensitive marine clay with occasional inclusions of organic matter. The thickness of this stratum ranges from 52 feet on the valley floor (B.H. #5) to 88 feet on the top of the valley bank (B.H. #8). Alternate brown and red-brown layers, with the individual layers some 5 inches thick, were encountered in the upper 6 feet of the clay at borehole 8. Further, occasional silt and sand seams, some 1/2" thick, are present below about elevation 170. Grain-size distribution curves for samples of the clay are shown on Figure 7 in Appendix I.

The engineering properties of the stratum, as determined by field and laboratory testing, are summarized on Figure 1; a brief resumé, presented in tabular form, follows:

cont'd. /6 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Sensitive Clay: (cont'd.) ...

		<u>Range</u>	<u>Average</u>
Bulk Density (p.c.f.)	( $\gamma$ )	94 - 103	97
Liquid Limit (%)	( $W_L$ )	42 - 85	65
Plastic Limit (%)	( $W_P$ )	18 - 30	25
Natural Moisture Content (%)	( $W$ )	64 - 82	75
Liquidity Index	( $I_L$ )	0.8 - 2.1	1.2
Initial Void Ratio	( $e_o$ )	1.7 - 2.4	
Compression Index	( $C_c$ )	0.95 - 2.2	
Preconsolidation Pressure (t.s.f.)	( $P_c$ )	1.1 - 2.6	
		<u>Range</u> ( $C_u$ )	<u>Range</u> Sensitivity (S)
Undrained Shear Strength (p.s.f.)	( $C_u$ )		
i) Field Vanes		500 - 1,600	4 - 16
ii) Lab. Vanes		350 - 1,850	-
iii) Lab. Testing		300 - 1,250	-

The Atterberg limit tests, summarized above, are also plotted on the Plasticity Chart, Figure 10. These results indicate that, in general, the clay is inorganic and of high plasticity, with the natural water content greater than the liquid limit. Referring to Figure 1, it can be seen that the undrained shear strength increases in a linear fashion with depth as represented by a  $C_u/P_o$  ratio of about 0.3, where  $P_o$  is the effective overburden pressure. Based on these results, it is estimated that the consistency of the stratum varies from firm, immediately below the

cont'd. /7 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Sensitive Clay: (cont'd.) ...

surficial deposit, increasing to stiff with depth. The undrained shear strength values obtained from the laboratory testing, gave consistently lower values than that obtained from the field vane tests. It is considered that this is primarily due to unavoidable sample disturbance caused by the field and laboratory handling and subsequent testing of the sensitive clay.

The consolidation characteristics of the stratum were determined by carrying out five laboratory tests, the results of which are shown as Void Ratio vs. Pressure plots, on Figures 12 to 16, inclusive. The results of this testing indicates that the clay is preconsolidated by about 600 to 800 p.s.f. in excess of existing overburden pressure on the top of the valley banks. It is, however, preconsolidated by about 1,800 to 2,000 p.s.f. in excess of existing overburden pressure on the valley floor. The relatively high values given for the initial void ratio ( $e_0$ ) and the compression index ( $C_c$ ) are within the normal range for such values obtained from laboratory consolidation testing on sensitive "Leda Clay".

4.4) Clayey Silt with Sand and Some Gravel - Glacial Till:

This heterogeneous but basically cohesive deposit, which directly underlies the sensitive clay stratum across the site, is encountered at between elevations 150 and 159. The glacial till was not penetrated at all the boring locations; it was, however, found to have a total thickness varying from 21 feet at B.H. #8 to 34 feet at B.H. #5. The upper zone of the glacial till is transitional with respect to the overlying clay - i.e., in general, it is in a reworked and softened condition. Occasional seams and layers of sand, silt and gravel, up to 6 inches thick, are randomly spaced throughout the deposit. In addition, the glacial till becomes very bouldery below about elevation 140, as indicated by the necessity of advancing the borings by diamond drilling techniques. The boulders encountered in this zone vary

cont'd. /8 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.4) Clayey Silt with Sand and Some Gravel - Glacial Till:  
(cont'd.) ...

from 4 to 6 inches in size. Typical grain-size distribution curves, obtained from samples of the deposit, are shown on Figure 8.

The Atterberg limit tests carried out on representative samples of the glacial till, are plotted on the Plasticity Chart, Figure 11. These results gave values for the liquid limit and plastic limit that range from 16 to 37 and 12 to 21, respectively. The corresponding natural water content within the upper reworked zone of the deposit is typically at or slightly above the liquid limit. Below this upper zone the natural water content is generally between the liquid and plastic limit, represented by a liquidity index ( $I_L$ ) between 0.3 and 0.6.

The standard penetration resistance or 'N' values vary from 8 to 16 blows/ft. in the upper reworked zone; below this zone the values range from 30 blows/ft., increasing with depth to as high as 169 blows/8 inches. Based on these results, it is estimated that the consistency of the glacial till varies from stiff to very stiff in the upper reworked zone, while below this zone the deposit varies from very stiff to hard.

4.5) Shale Bedrock:

Bedrock was established in five of the borings, namely: B.H.'s #1, 3, 4, 5 and 8, by obtaining from 2 to 6 feet of either AXT or BXL rock core. The depth at which bedrock was encountered ranged from about elevations 123 to 134 - i.e., from 90 to 116 feet below existing ground surface.

The bedrock is composed of a grey fossiliferous shale, the upper 3 to 4 feet of which is in a fractured and jointed condition. Below this upper fractured zone the bedrock is reasonably sound.

cont'd. /9 ...

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out during the period of the investigation, in 1) sealed piezometers installed in boreholes #8, 9 and 10, and 11) the open boreholes at the remaining locations. These observations, which are recorded on the borehole logs and summarized on Drawings No. 67-F-111A and 67-F-111B, indicate that the groundwater level in the surficial deposits and sensitive clay stratum ranges from elevation 243, on the top of the valley bank, to elevation 216 on the valley floor - i.e., some 6 to 8 feet below ground surface. The ice level on Bear Brook, during the period of the investigation, was at about elevation 217; this agrees closely with the water levels recorded on the valley floor.

An artesian water pressure head was encountered in the borings put down through the valley floor. This artesian head exists in the lower portion of the basal till deposit; the surface of this zone was encountered between elevations 129 and 136. Once the surface of this zone was penetrated, the groundwater level instantaneously rose in the casing to an elevation between 228 and 232. This represents an artesian head of the order of 8 to 11 feet above the valley floor. This artesian condition generally prevailed until the casing extended some 3 to 4 feet into bedrock, which is inferred to be down into the sound bedrock. Based on this, it is inferred that the artesian pressure exists in the upper fractured zone of the bedrock as well as the lower portion of the glacial till. Occasional pockets of natural gas, under intense pressure, were also encountered within this zone. It was necessary to plug off this artesian and gas flow as discussed previously in Section 3.

cont'd. /10 ...

## 6. DISCUSSION AND RECOMMENDATIONS:

### 6.1) General:

It is proposed to construct twin parallel overpass structures to carry the East and Westbound lanes of proposed Highway #417 over Bear Brook. The Westbound lane structure (W.B.L.) will be located some 400 feet north of the Eastbound lane structure (E.B.L.). Present proposals call for three-span structures (70'-70'-70' and 60'-60'-60' for the W.B.L. and E.B.L. structures, respectively). The proposed profile grade of Hwy. #417 in the vicinity of the crossings is elevation 262. At this grade the associated approach embankments will vary in height from about 10 feet to as much as 38 feet above the crest of the valley bank and the valley floor, respectively. The embankments will have an initial crest width of 46 feet with provision to widen this in the future to 54 feet.

The configuration of Bear Brook is to be changed, particularly in the vicinity of the W.B.L. crossing which is to be relocated some distance to the east. The proposed channel so formed, will be some 8 to 10 feet deep, 30 feet wide at mid-height, and have side slopes of the order of 2:1.

The predominant deposit across the site is a stratum of firm to stiff sensitive marine clay varying from 52 feet to 88 feet in thickness. The clay is underlain by up to 35 feet of stiff to hard cohesive glacial till which, in turn, is followed by shale bedrock.

The presence of an extensive deposit of soft and highly compressible clay at a relatively shallow depth requires that steps must be taken to ensure overall stability of the approach embankments, and that the structures must be supported on piled foundations. As the stability of the approach fills is the major problem at this site, it will be discussed first.

cont'd. /11 ...



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

6.2) Approach Embankments:

Prior to placing any fill for the west approach embankment of the W.B.L., Bear Brook should be realigned as proposed. Any organic matter associated with the existing channel should be subexcavated. The existing channel and any localized subexcavated zones should then be backfilled with granular material.

The critical condition for stability of an embankment on normally or slightly overconsolidated clays, as is the case with this clay stratum, generally occurs during or immediately after construction. This being the case, a total stress analysis ( $\phi = 0$ ) provides a suitable means of assessing the stability of the embankment sections. In this method of analysis, stability is governed by the applied loads and by the stress-strain and undrained shear strength properties of the foundation and embankment soils.

Analyses have been carried out, therefore, in terms of total stresses, both manually and by the use of the electronic computer, to determine the stability of the fill sections. The following assumptions were made:

cont'd. /12 ...

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

6.2) Approach Embankments: (cont'd.) ...

1) Soil Properties:

Fill Material

Bulk Density  $\gamma = 125$  p.c.f.

Angle of Shearing Resistance  $\phi = 30^\circ$

Foundation Subsoil

<u>Elev.</u>	<u>Subsoil</u>	<u>Parameters</u>
251 to 243 (Top of Valley Bank)	} Surficial Deposit - } Sand or Clayey Silt } with Some Sand.	$\gamma = 110$ p.c.f.
224 to 216 (Below Valley Floor)		$\phi = 30^\circ$
243 - 216	Sensitive Clay - $\gamma = 95$ p.c.f.	{ $C_u = 500$ p.s.f.
216 - 204	" " $\gamma = 33$ p.c.f.	
204 - 192	" "	
192 - 180	" "	
180 - _____	" "	
		{ $C_u = 800$ p.s.f.
		{ $C_u = 900$ p.s.f.
		{ $C_u = 1,100$ p.s.f.
		{ $C_u = 1,300$ p.s.f.

2) All the berms required have been assumed to be at the mid-height of the section. The surface of the berms should slope away from the fill at a gradient of 20:1 for drainage purposes.

3) The realigned channel was, for computational purposes, assumed to be at least 10 feet from the toe of the embankment.

cont'd. /13 ...

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

6.2) Approach Embankments: (cont'd.) ...

The stability computations, which are summarized on Figures 2 to 4 in the Appendix, are given in the following paragraph. The requirements listed provide a minimum factor of safety of 1.3 with respect to stability.

Stability of Approach Embankments

		Length of Berm Required At Mid-Height	
1)	<u>W.B.L. Structure</u>		
Longitudinal Direction			
- West Approach		50 ft.	(See Figure #2)
- East Approach		25 ft.	( " " #2)
Transverse Direction			
- West Approach		0 to 50 ft.	(See Figure #3)
- East Approach		No Berms	" " #3)
11)	<u>E.B.L. Structure</u>		
Longitudinal Direction			
- Both East and West Approaches		60 ft.	(See Figure #2)
Transverse Direction			
- Both East and West Approaches		0 to 40 ft.	(See Figure #4)

From the stability analyses, the following conclusions have been drawn:

1) At the proposed profile grade (elev. 262), berms will be required in both the longitudinal and transverse direction at all the approach fill locations.

cont'd. /14 ...

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

6.2) Approach Embankments: (cont'd.) ...

2) The berm requirements in the longitudinal direction will entail a lengthening of the structures from that proposed. The length of the W.B.L. structure will have to be increased from the proposed 210 feet to 285 feet, while the E.B.L. structure will have to be increased from 180 feet to 300 feet.

3) Smooth transitions between different berm requirements should be affected as the height of fill varies.

The underlying highly compressible clay stratum will undergo excessive settlements due to consolidation, over a long-term period, under the weight of the approach embankments. Settlement computations were, therefore, carried out, the results of which are summarized on Figure 5 in the Appendix. The maximum consolidation settlement will occur under the west approach embankment of the W.B.L. structure, where the height of fill will be of the order of 38 feet. The computations indicate that this settlement could be as much as 7 feet under the centre-line of the embankment. The maximum settlement expected to occur beneath the E.B.L. approach embankment is about 5 feet.

The total amount of this settlement should occur within a period of 65 years, while about 40% will occur in the first 7 years (refer to plot on Figure 5). It would be advantageous, therefore, to construct the embankments first and leave them in place for as long as possible prior to construction of the structures. In any event, the final paving should be delayed for as long a period as possible. In conclusion, it is considered that the immediate approaches to the structures will present a permanent maintenance problem and will require re-paving from time to time.

cont'd. /15 ...

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

6.2) Approach Embankments: (cont'd.) ...

As an alternative, a multispan structure can be adopted to span the problem area, in so doing, the berm requirements would be minimized as well as the adverse effects associated with excessive settlements. In such a case, the W.B.L. structure should be spanned from about Sta. 428+50 to 433+20, having a total length of 470 feet, while the E.B.L. structure should be spanned from about Sta. 432+80 to 436+80, having a total length of 400 feet. Whether this alternative is feasible or not, will be dependent on economic considerations.

6.3) Foundations:

The structure piers and abutments should be supported on end-bearing piles founded within the lower competent zone of the glacial till or on bedrock. For estimating purposes, it can be assumed that the pile tips would be located between elevations 130 and 135. The allowable pile load would be dependent on the section chosen - for example, a 12 BP 74 steel H-pile, driven to practical refusal, could be designed to carry 90 tons/pile.

Since settlement of the proposed roadway embankments will be excessive, some negative skin friction forces can be imposed on the end-bearing piles supporting the abutments. These forces, combined with movement of subsoil due to strain imposed by the embankment loading, will generally tend to displace the piles laterally and can cause rotation of the abutments. In view of this, we recommend that consideration be given to supporting the extreme ends of the wing walls on end-bearing piles founded as aforementioned. It is considered that this will improve the stability of the abutment in the longitudinal direction. In addition, no bouldery or rock fill should be placed in areas where piles are to be driven.

cont'd. /16 ...

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

6.3) Foundations: (cont'd.) ...

Pile caps should be founded at sufficient depth below finished grade so as to ensure adequate frost protection.

No major dewatering problems are anticipated. However, if excavations are required below groundwater level, seepage may occur; this can be dealt with by pumping from sumps.

7. SUMMARY:

A foundation investigation at the site of the proposed E.B.L. and W.B.L. crossings of proposed Hwy. #417 and Bear Brook, in the Township of Gloucester, County of Carleton, is reported.

The predominant deposit across the site is a stratum of firm to stiff sensitive marine clay some 52 to 88 feet thick, overlying up to 35 feet of stiff to hard cohesive glacial till. The glacial till is underlain by shale bedrock, the surface of which was encountered between elevations 122 and 134. The groundwater level in the clay stratum was about 6 to 8 feet below ground surface. An artesian water pressure head was encountered in the lower portion of the glacial till and the upper fractured portion of the bedrock along the valley floor.

It is recommended that the piers and abutments be supported on end-bearing piles located within the glacial till or on bedrock. Construction procedures have been outlined in this report.

Detailed recommendations have been made regarding the procedures necessary to ensure stability of the approach fills. Berms will be required in both the longitudinal and transverse direction for all the approaches. The berm requirements in the longitudinal direction will entail an increase in the length of both structures over that proposed, as discussed in the report.

cont'd. /17 ...

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

In view of the excessive settlements which have been estimated, it would be advantageous to allow as much time as possible between the construction of the approach embankments and completion of the final grade. There will be a continuing maintenance problem.

As an alternative, a multispan structure can be adopted to span the area where berms are required and excessive settlements are expected. The approximate increased span length of the structures required, is given in the report.

8. MISCELLANEOUS:

The field work for this project was carried out during the period of January 2 to February 5, 1968, under the supervision of Mr. C. Mirza, Project Foundation Engineer. The equipment used was owned and operated by F. E. Johnston Drilling Co. Ltd.

This report was written by Mr. Mirza and Mr. B. T. Darch, Senior Foundation Engineer, and was reviewed by Mr. M. Devata, Supervising Foundation Engineer.

March, 1968.

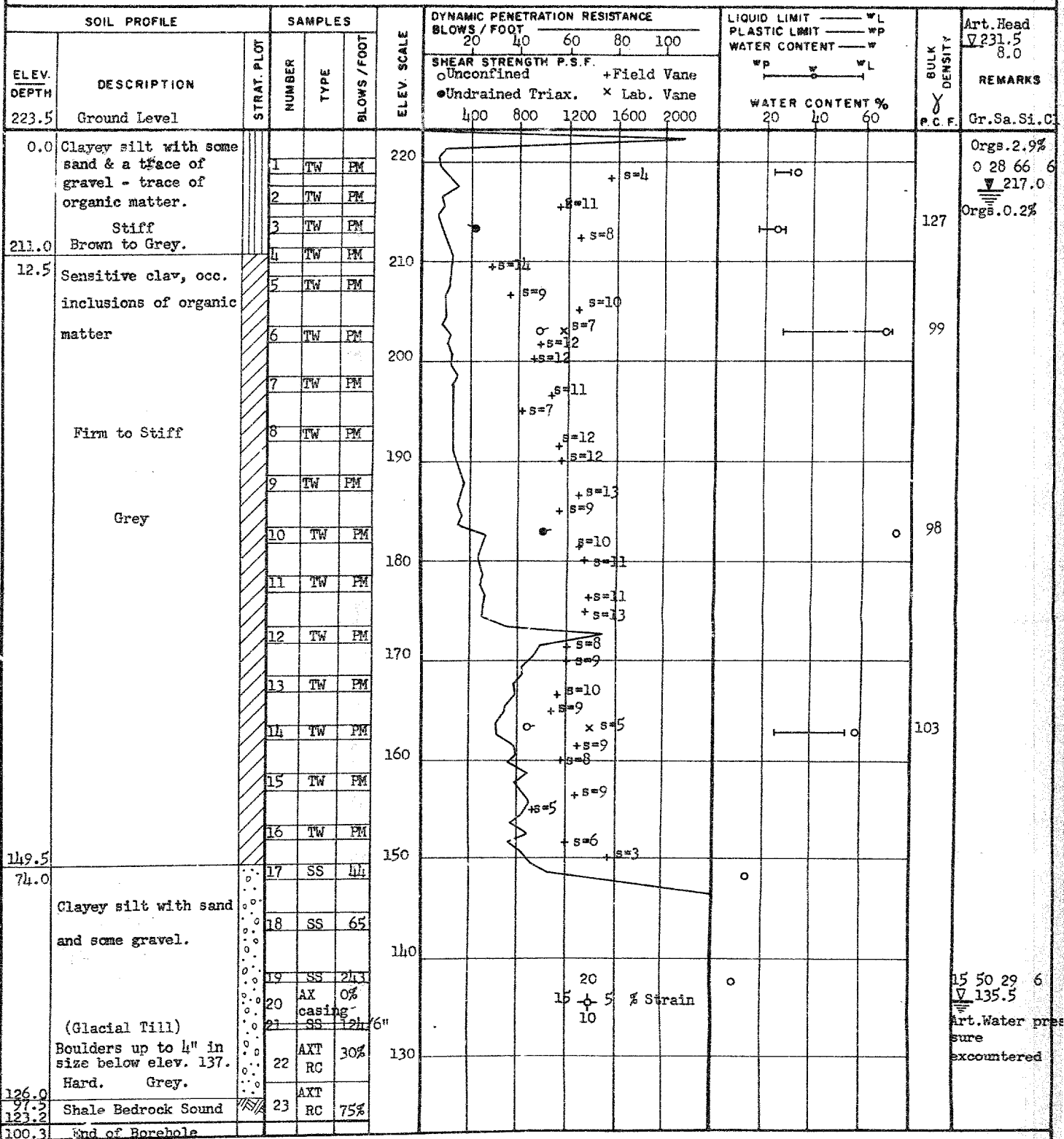
DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 67-F-111 LOCATION Sta. 434 + 06 @ Hwy. 417 EBL o/s 31' Lt. ORIGINATED BY CM  
W.P. 34-66-05 BORING DATE Jan. 16-23, 1968 COMPILED BY WH  
DATUM Geodetic BOREHOLE TYPE Diamond Drill, NX, BX Casing - AXT Core CHECKED BY WH





DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 434 + 66 @ Hwy. 417 EBL. o/s 23' Rt. ORIGINATED BY CM  
W.P. 34-66-05 BORING DATE January 24, 1968 COMPILED BY CM  
DATUM Geodetic BOREHOLE TYPE Diamond Drill CHECKED BY SLK

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT %			
223.1	Ground Level										
0.0	Probably Clayey Silt				220						
210.0					210						
	Probably Clay				200						
					190						
					180						
					170						
					160						
153.1					150						
70.0	Probably Glacial Till				140						
137.8											
85.3	End of Penetration Test				130						

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 435 + 26 @ Hwy. 417 EBL o/s 31' Lt. ORIGINATED BY CM  
W.P. 34-66-05 BORING DATE Jan. 18 - 22, 1968 COMPILED BY WH  
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX BX CHECKED BY HL

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20 40 60 80 100	WATER CONTENT %			
223.9	Ground Level							400 800 1200 1600 2000			▽ 232. Artes. Head
0.0	Probably clayey silt.										
214.											▽ 217.
	Probably Clay										
149.9											
74.0	Clayey silt with sand & some gravel. (Glacial Till) (occ. shale fragments below elev. 140) Stiff to hard. (gray)		1	SS	16						
			2	SS	88						
			3	SS	72						
133.6			4	SS	134 2"						
131.9	Shale Bedrock		5	MT RC	90%						▽ 133.9 90 Artesian water pressure encountered
92.0	End of Borehole										

FOUNDATION SECTION

ORIGINATED BY CM

COMPILED BY \_\_\_\_\_ WH

CHECKED BY

SUPER IMPOSED DOCUMENT MAY  
APPEAR AS MULTI-FEED ON FILM.

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO.5

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 430 + 75 @ Hwy. 417 W.B.L. o/b 38' Lt. ORIGINATED BY CM  
W.P. 34-66-05 BORING DATE Jan. 4 - 17, 1968 COMPILED BY WH  
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX BX CHECKED BY WH

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE						LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT					WATER CONTENT %				
217.2	Water Level						20	40	60	80	100					Artes. Head
215.5	Water						SHEAR STRENGTH P.S.F.					WATER CONTENT %				Gr. Sa. Si. Cl.
1.7	Clayey silt or silty clay with some sand & a trace of gravel - trace of organic matter. Firm.		1	TW	PM		○ Unconfined + Field Vane					— P — W — L				
208.2			2	TW	PM	210	● Undrained Triax Lab Vane									
9.0	Sensitive clay, with occasional inclusions of organic matter (seams of sandy silt up to 1/2" thick below elev. 168)		3	TW	PM		400	800	1200	1600	2000	20 40 60				
			4	TW	PM											
			5	TW	PM	200										
			6	TW	PM											
			7	TW	PM	190										
			8	TW	PM											
			9	TW	PM	180										
			10	TW	PM											
			11	TW	PM	170										
			12	TW	PM											
			13	TW	PM	160										
156.7			14	TW	PM											
60.5	Clayey silt with sand and some gravel (glacial till) (occasional seams & layers of sandy silt up to 6" thick throughout. Boulders up to 4" in size below elev. 130)		15	TW	PM	150										
			16	SS	30											
			17	SS	34	140										
			18	SS	20											
	Stiff to hard.															
									</							

15.05 % Strain  
10COPY WHEN DOCUMENTARY  
WORK IS COMPLETED ON FILE

DEPARTMENT OF HIGHWAYS - ONTARIO

# RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 431 + 75 @ Hwy. 417 WBL o/B 31' Rt. ORIGINATED BY CM  
W.P. 34-66-05 BORING DATE Jan. 18 - 24, 1968 COMPILED BY WH  
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX BX Casing CHECKED BY JK

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	20	40	60	80	100	20			40
222.7	Ground Level							400	800	1200	1600	2000				
0.0	Probably					220										
215.	Clayey silt					210										
	Probably					200										
	Clay					190										
						180										
						170										
						160										
152.7						150										
70.0	Clayey silt with sand & some gravel (glacial till) occasional seams & layers of sand & gravel up to 6" thick. Boulders up to 6" in size below elev. 130)		1	SS	40	140										
			2	SS	18											
			3	SS	22											
	Stiff to hard		4	SS	109	130										
121.7	Grey		5	SS	130											
101.0	End of Borehole		6	SS	162											

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 67-F-111

LOCATION Sta. 432 + 02 @ Hwy. 417 WBL o/s 23' Lt.

ORIGINATED BY CM

W.P. 34-66-05

BORING DATE Jan. 18, 1968

COMPILED BY WH

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W <sub>L</sub>		BULY DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT		
224.9	Ground Level										
0.0	Probably										
217.	Clayey silt										
	Probably										
	Clay										
150.4	Probably										
74.5	Glacial Till										
144.6											
80.3	End of Cone Test										

OFFICE OF THE ENGINEER  
MAY 1968

DEPARTMENT OF HIGHWAYS - ONTARIO				RECORD OF BOREHOLE NO. 8				FOUNDATION SECTION				
MATERIALS & TESTING DIVISION												
JOB 67-P-111				LOCATION Sta. 433 + 32 @ Hwy. 417 W. 9/s 3' Rt.				ORIGINATED BY CM				
W.P. 34-66-05				BORING DATE Jan. 3 - 4, 1968				COMPILED BY WH				
DATUM Geodetic				BOREHOLE TYPE Diamond Drill HX - BX casing - AXT Core				CHECKED BY <i>LL</i>				
SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — W <sub>L</sub>		BULK DENSITY		REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	WATER CONTENT — W <sub>P</sub>	WATER CONTENT %	ρ <sub>c</sub> F		
250.5	Ground Level											
0.0	Clayey silt with some sand & a trace of gra. occ. seams of silt. Brown to grey. Firm		1	SS	9							0 34 54 12
212.5			2	SS	6							242.9
8.0	Layered clay (alternate brown & red-brown layers up to 5" thick).		3	2" TW	PM							
216.5			4	2" TW	PM							0 0 30 70
14.0	Sensitive clay, occasional inclusions of organic matter.		5	2" TW	PM							
			6	2" TW	PM							
			7	2" TW	PM							0 1 35 64
	Firm to stiff		8	2" TW	PM							Plan #1 R Tip at Elev. 217.2
			9	2" TW	PM							
	Grey		10	2" TW	PM							
			11	2" TW	PM							
			12	2" TW	PM							
			13	2" TW	PM							
			14	2" TW	PM							
			15	2" TW	PM							
			16	2" TW	PM							
			17	2" TW	PM							
			18	2" TW	PM							
			19	2" TW	PM							
155.0			20	2" TW	PM							
95.5	Clayey silt with sand and some gravel (glacial till) (occasional seams of sandy silt up to 4" thick. Boulders up to 5" in size below elev. 114h)		21	SS	48							6 43 40 11
	Stiff to hard.		22	SS	169/20							
134.0	Grey		23	AXT	0%							
116.5	Shale Bedrock		24	AXT	85%							
128.5	Sound below elev. 130			RC	Rec.							
122.0	End of Borehole											





DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 67-P-111

LOCATION Sta. 436 + 86 @ Hwy. 417 EBL

ORIGINATED BY CM

W.P. 34-66-05

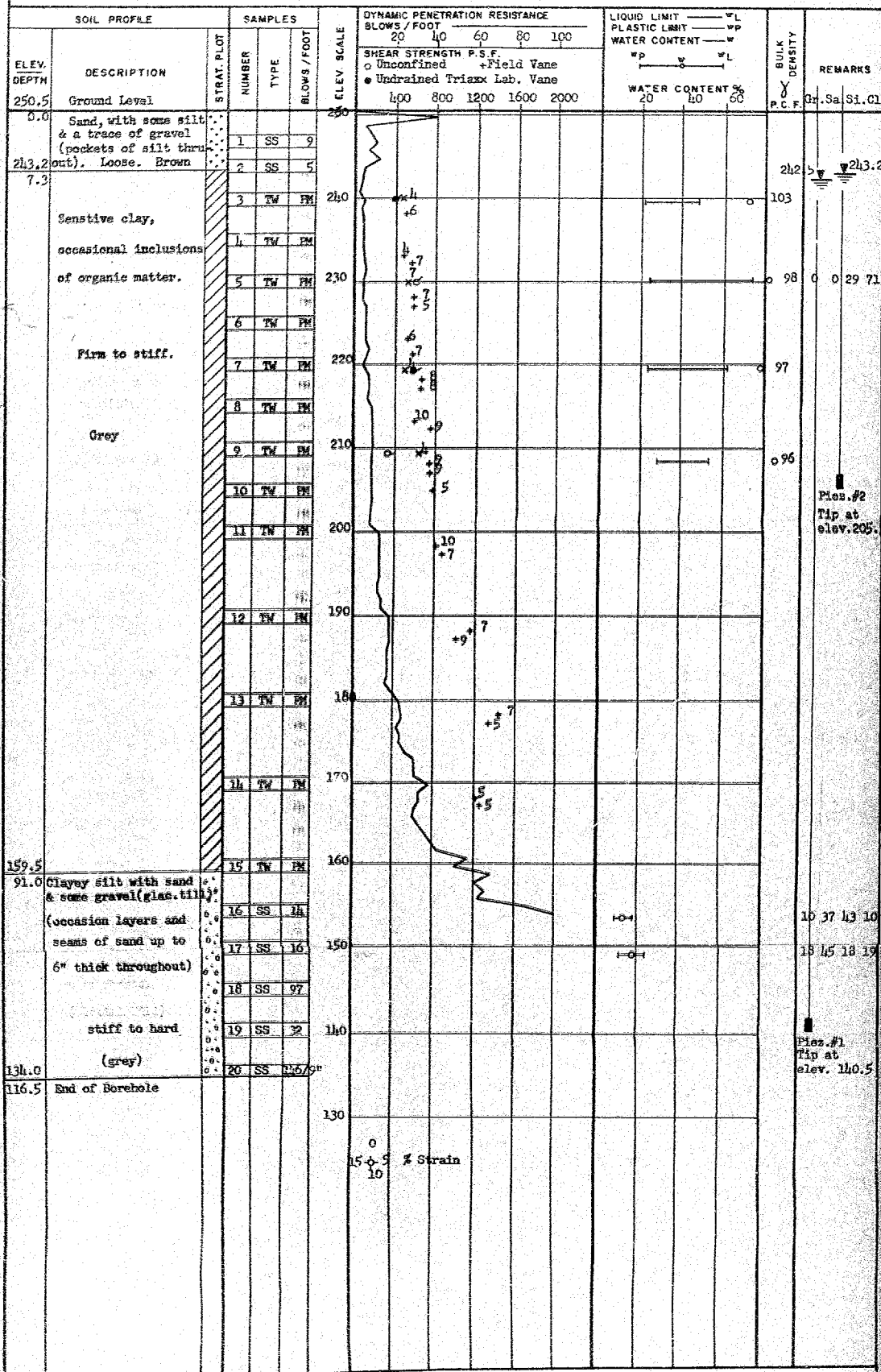
BORING DATE Jan. 23, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 67-F-111

LOCATION Sta. 429 + 60 @ Hwy. 417 WBL

ORIGINATED BY GEH

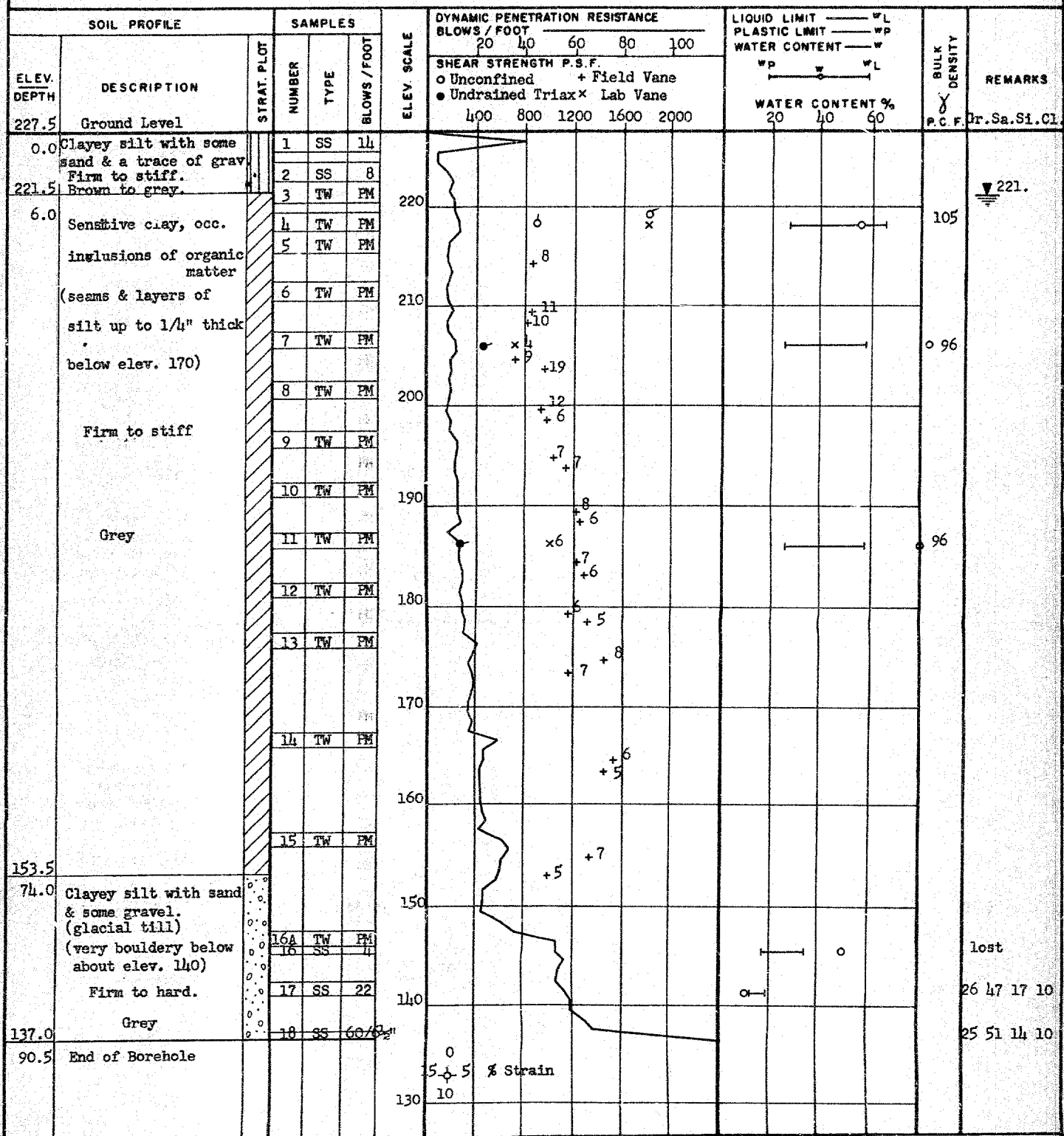
W.P. 34-66-05

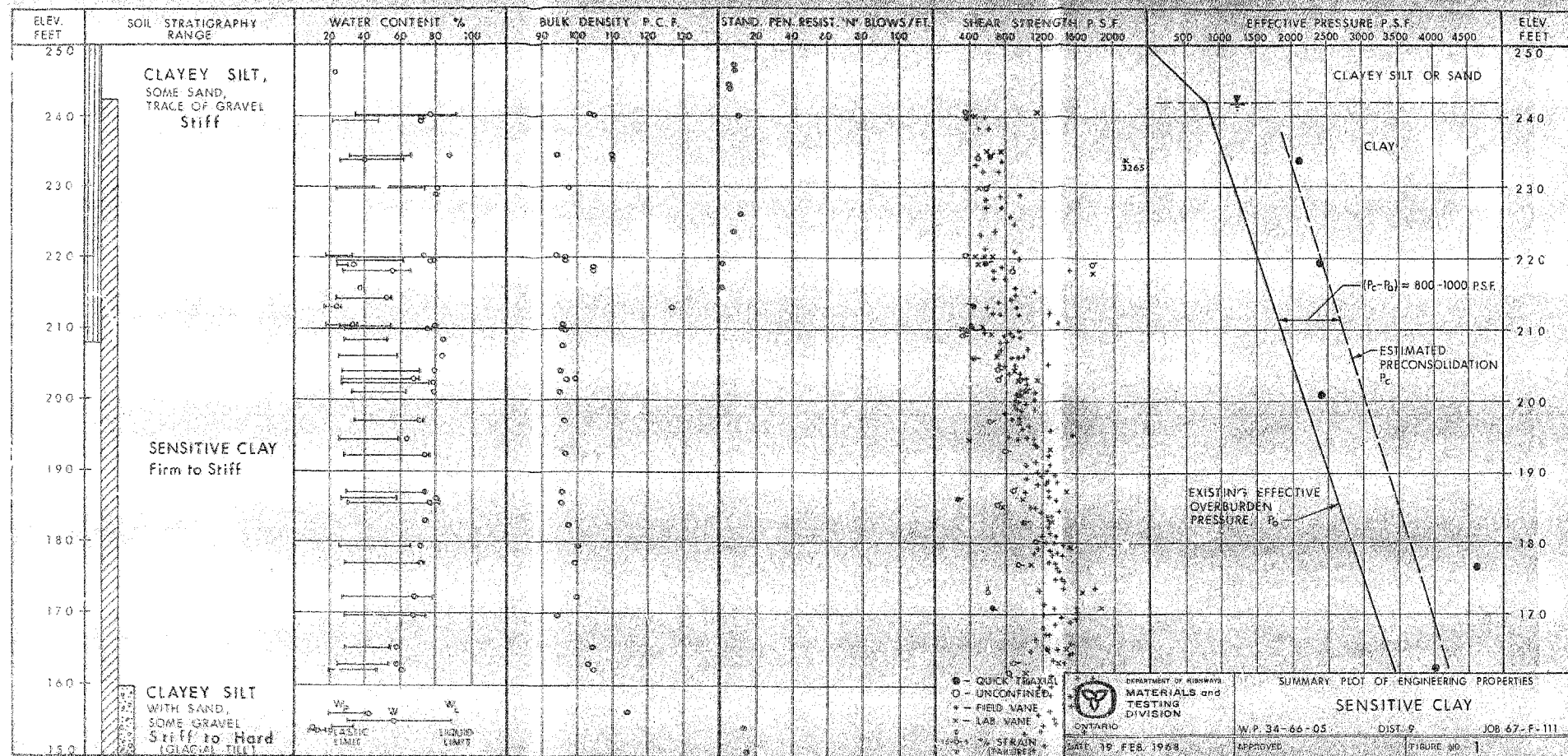
BORING DATE Jan. 25 - 29, 1968

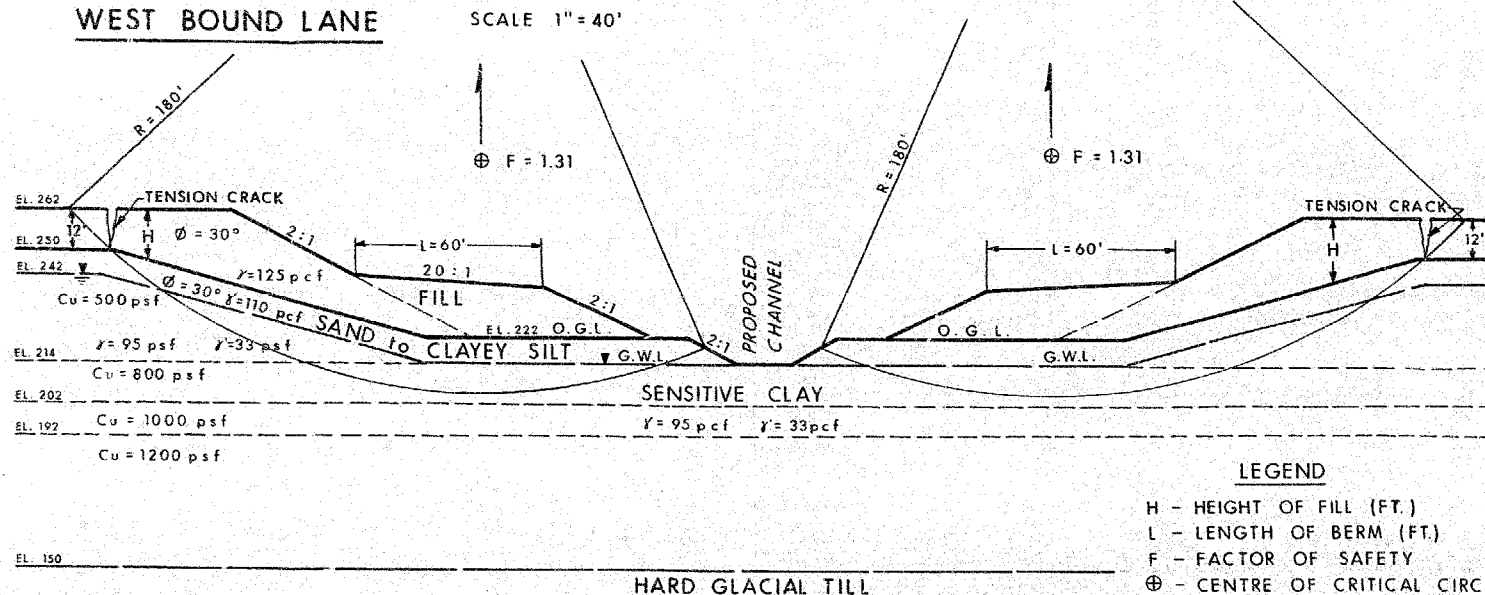
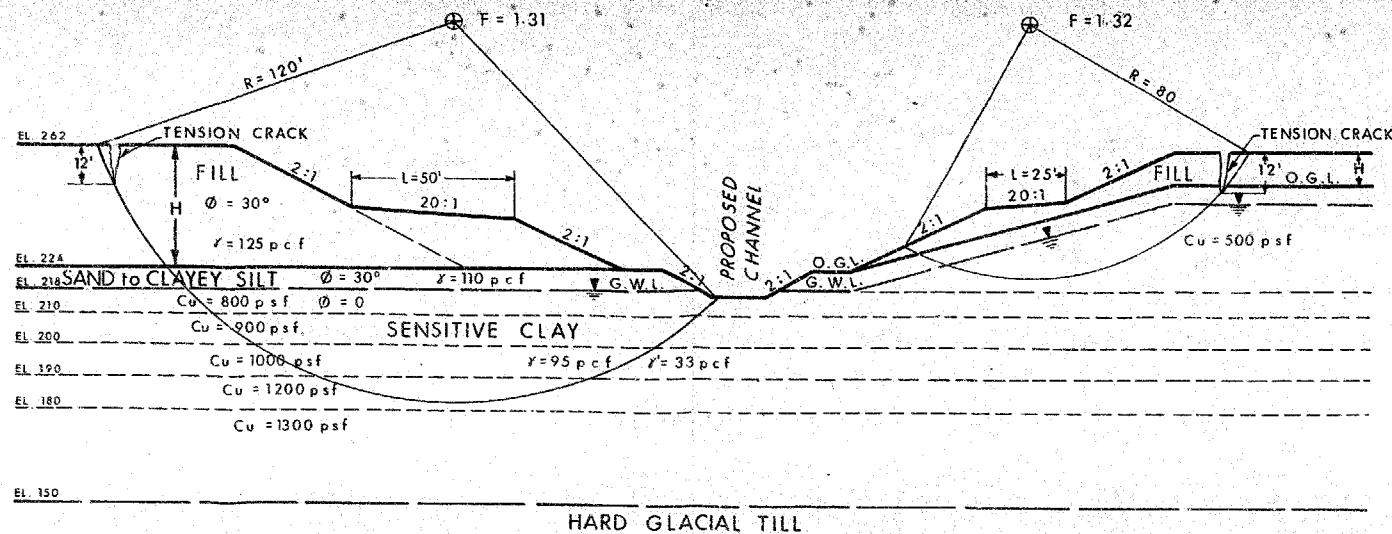
COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Diamond Drill NX BX

CHECKED BY *HL*





#### LEGEND

- H - HEIGHT OF FILL (FT.)
- L - LENGTH OF BERM (FT.)
- F - FACTOR OF SAFETY
- ⊕ - CENTRE OF CRITICAL CIRCLE
- R - RADIUS OF CIRCLE (FT.)



DATE MAR. 6, 1968

SUMMARIZED RESULTS OF STABILITY ANALYSES  
E.B.L. & W.B.L. APPROACH EMBANKMENTS  
(LONGITUDINAL DIRECTION)

W.P. NO. 34-66-05

DIST. 9

JOB NO. 67-F-1111

APPROVED

FIGURE NO. 2

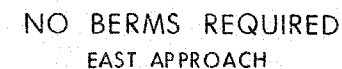


Diagram illustrating the cross-section of a trapezoidal embankment. The top width is  $L = 46'$ . The side slopes are  $2:1$ . The embankment is composed of FILL over a layer of SAND to CLAYEY SILT. The ground level is marked as O.G.L. Below the embankment, the undrained shear strength ( $C_u$ ) is listed for different soil types:

- $C_u = 500 \text{ psf}$
- $C_u = 800 \text{ psf}$
- $C_u = 900 \text{ psf}$
- $C_u = 1000 \text{ psf}$
- SENSITIVE CLAY
- $C_u = 1200 \text{ psf}$
- $C_u = 1300 \text{ psf}$

SECTION B-B



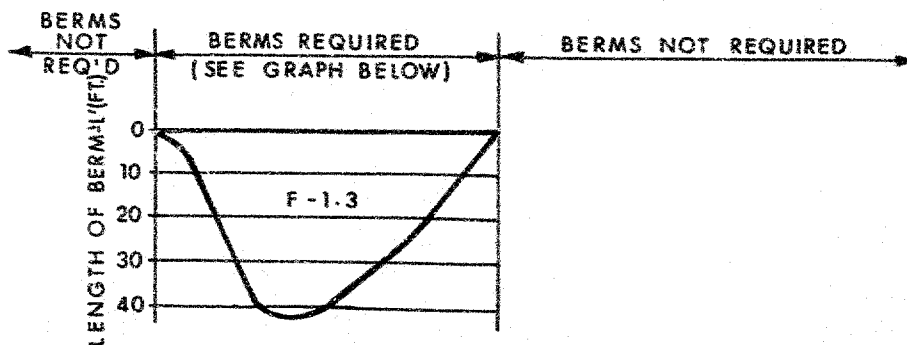
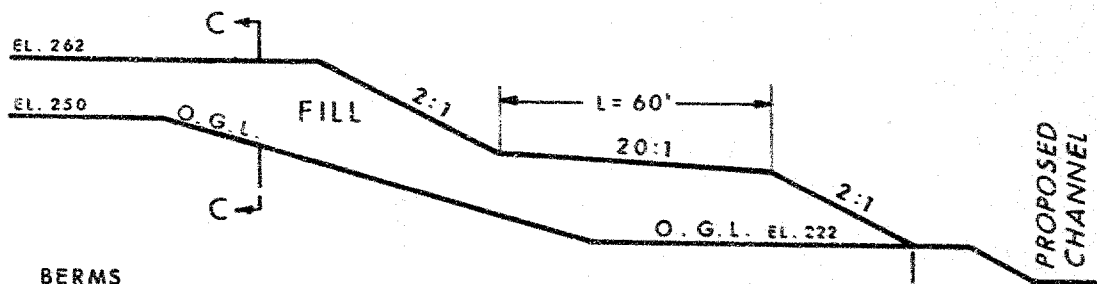
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

SUMMARIZED RESULTS OF STABILITY ANALYSES  
W.B.L. APPROACH EMBANKMENTS  
(TRANSVERSE DIRECTION)

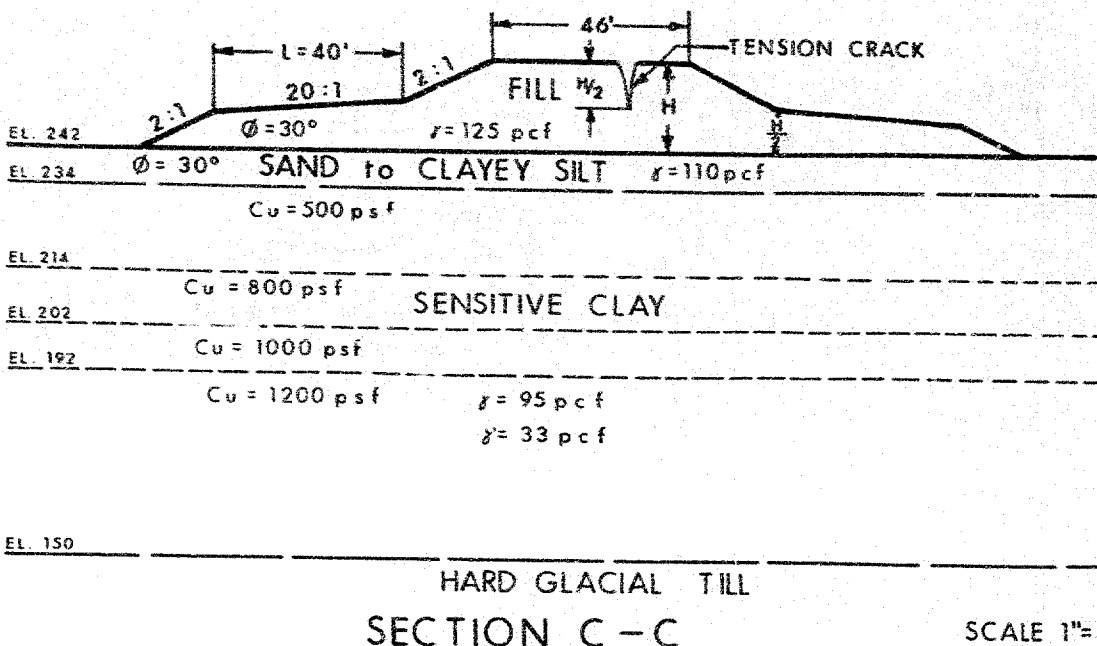
JOB 67-F-111

FIGURE NO. 3

# PROFILE E.B.L.



## BERM REQUIREMENTS—TRANSVERSE DIRECTION (EAST & WEST APPROACHES)



## SECTION C-C

SCALE 1"=40'



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MATERIALS and  
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## SUMMARIZED RESULTS OF STABILITY ANALYSES E.B.L. APPROACH EMBANKMENTS (TRANSVERSE DIRECTION)

W.P. 34-66-05

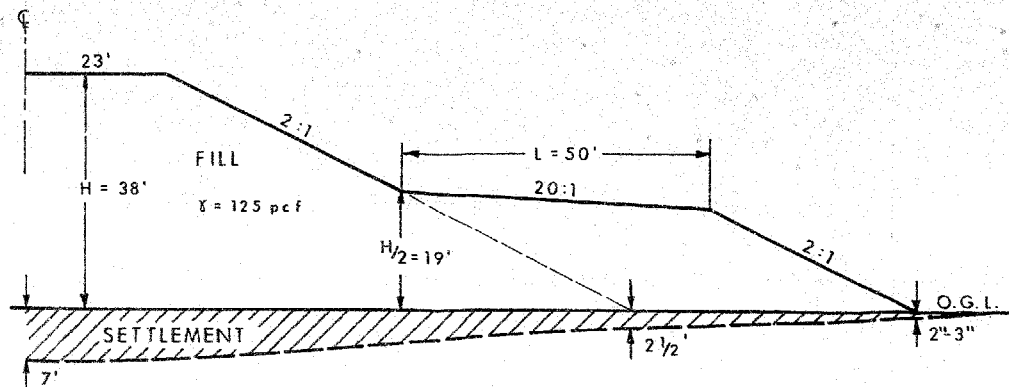
DIST. 9

JOB 67-F-111

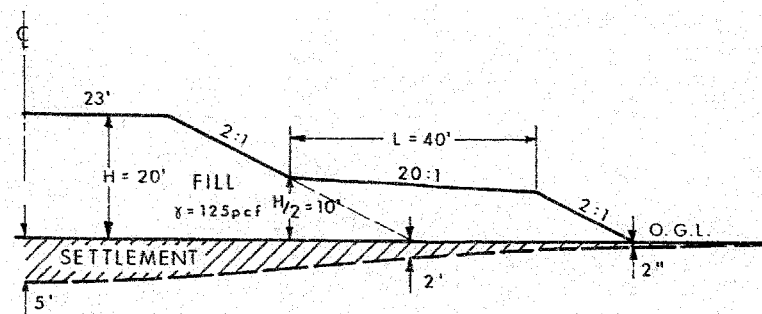
DATE MAR. 8 1968

APPROVED

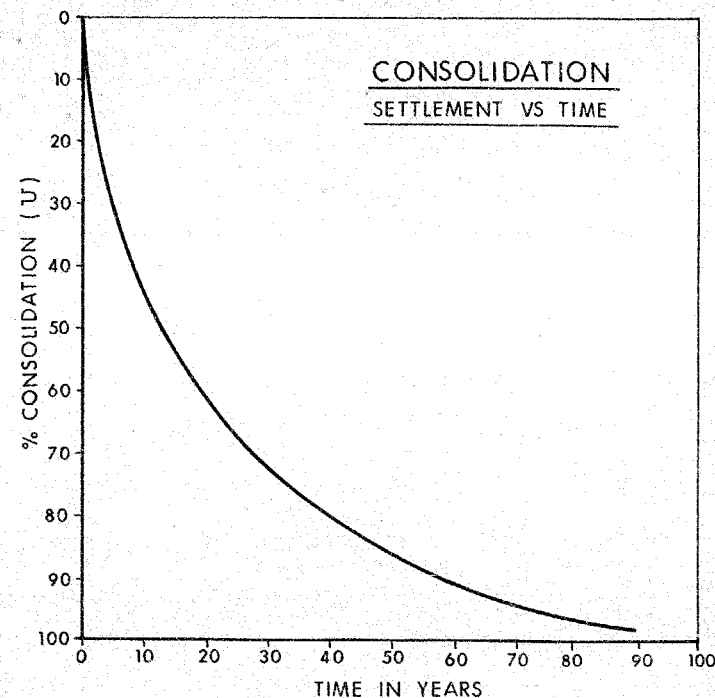
FIGURE NO. 4



W.B.L. STRUCTURE - WEST APPROACH  
(SECTION A-A, SEE FIG. 3)



E.B.L. STRUCTURE - EAST & WEST APPROACHES  
(SECTION C-C, SEE FIG. 4)



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

DATE MAR 8 1968

SUMMARIZED RESULTS OF SETTLEMENT COMPUTATIONS

E.B.L. & W.B.L. APPROACH EMBANKMENTS

W.P. 34-66-05

DIST 9

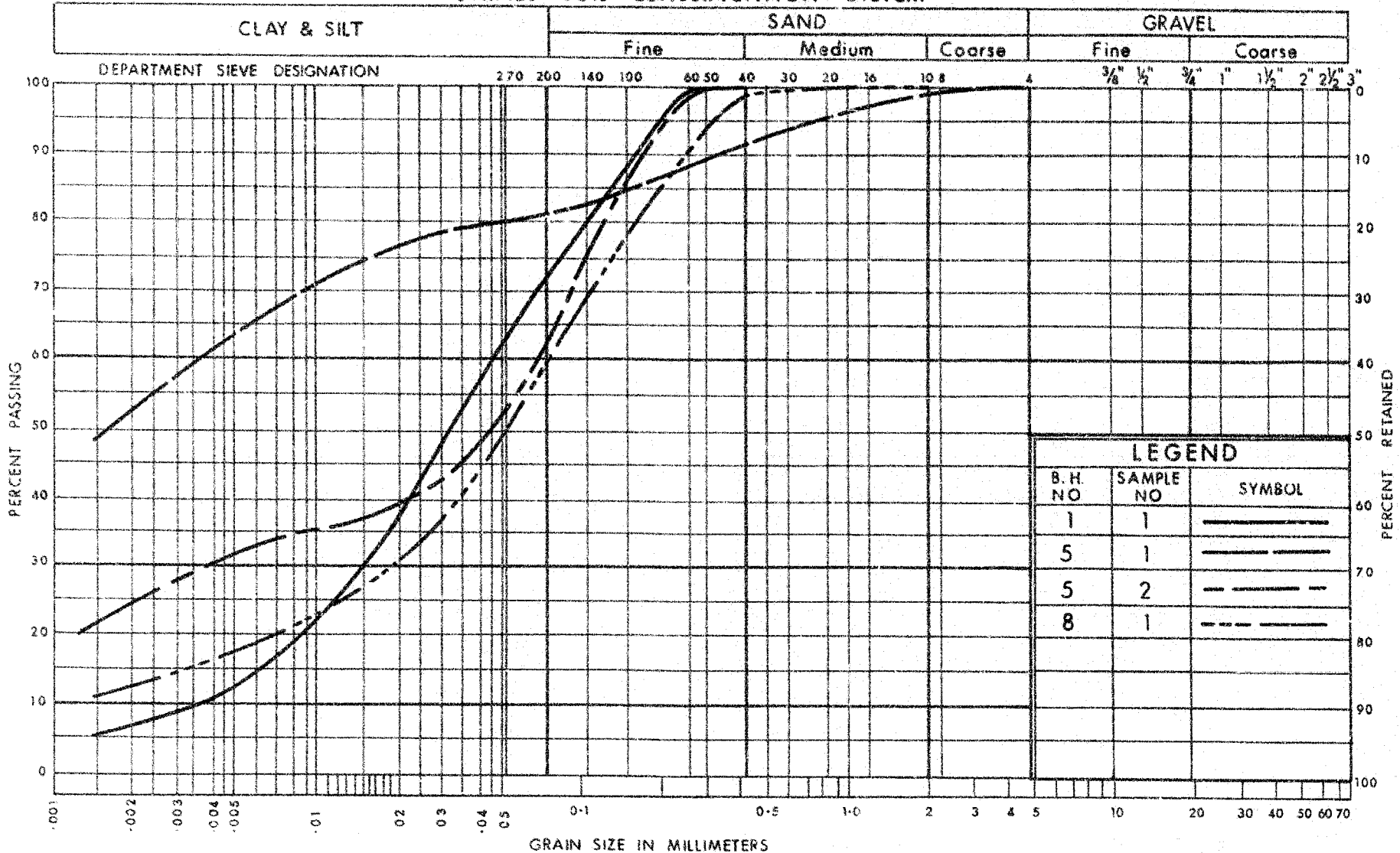
JOB 67-F-111

APPROVED

FIGURE NO. 5



# UNIFIED SOIL CLASSIFICATION SYSTEM



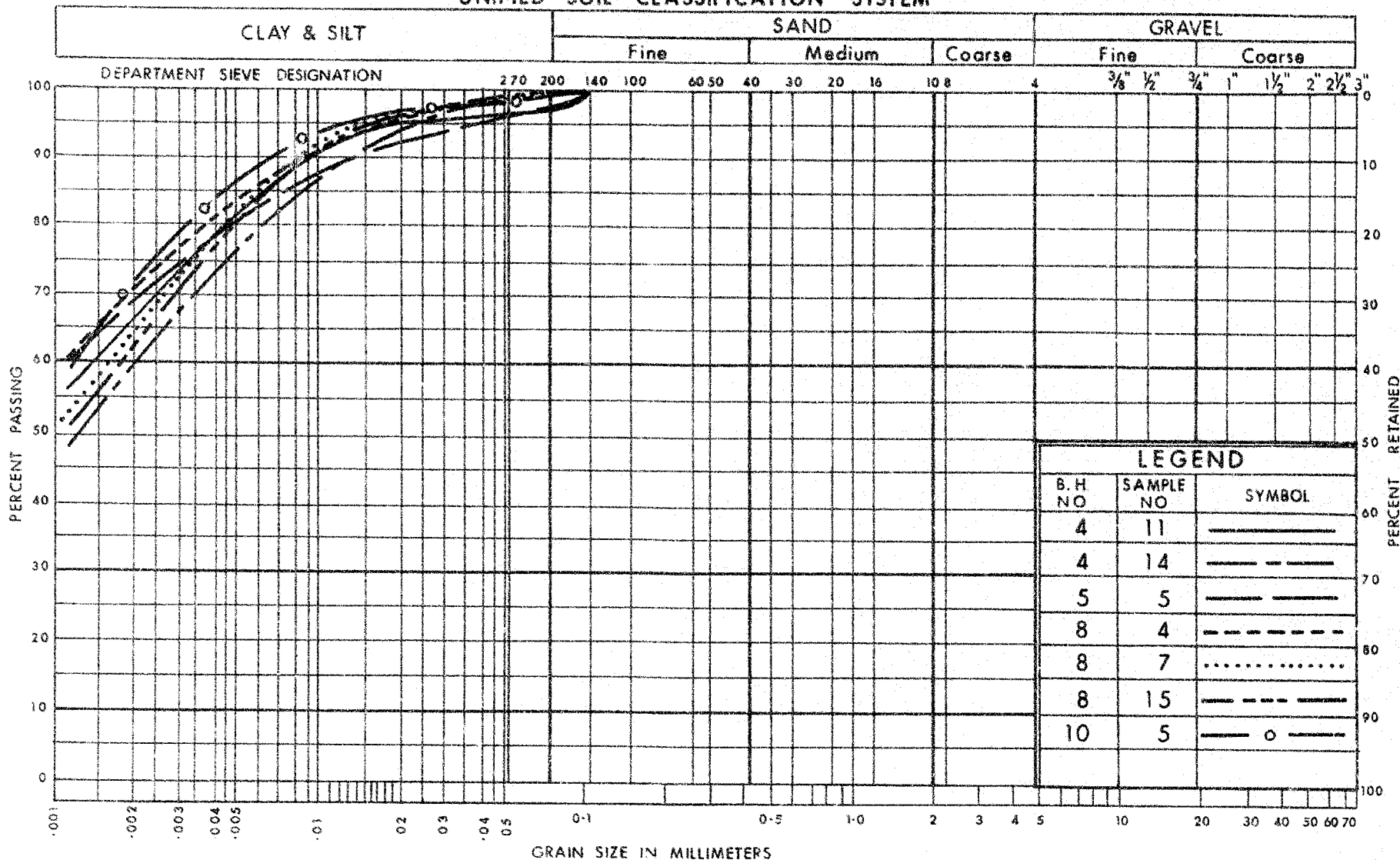
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION CLAYEY SILT WITH SAND

W.P. No. 34 - 66 - 05  
JOB No. 67 - F - 111  
FIGURE NO. 6



# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

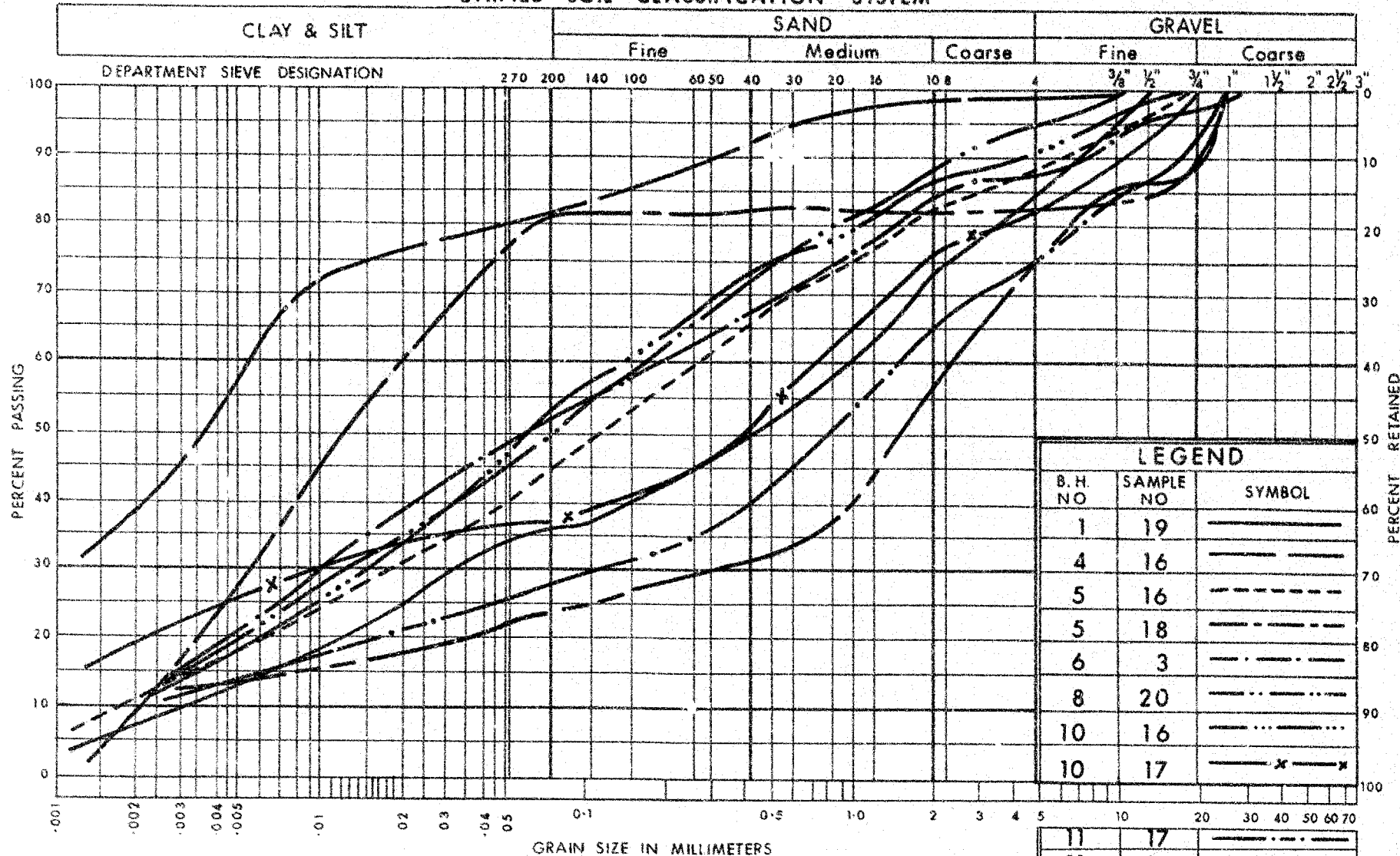
## GRAIN SIZE DISTRIBUTION SENSITIVE CLAY

W.P. No. 34 - 66 - 05

JOB No. 67 - F - 111

FIGURE NO. 7

# UNIFIED SOIL CLASSIFICATION SYSTEM



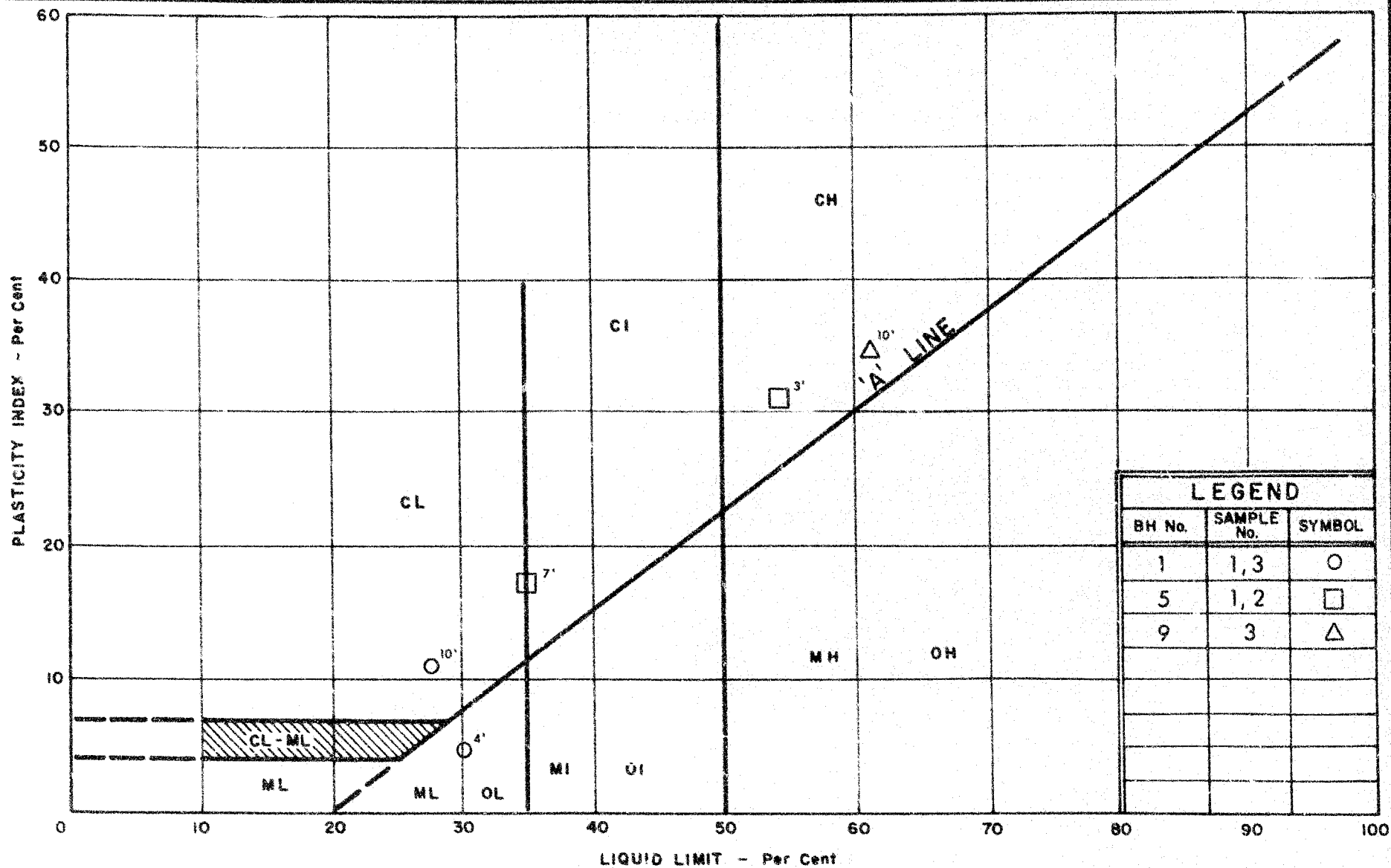
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT WITH SAND & SOME GRAVEL  
(GLACIAL TILL)

W.P. No. 34-66-05

JOB No. 67-F-111

FIGURE NO. 8



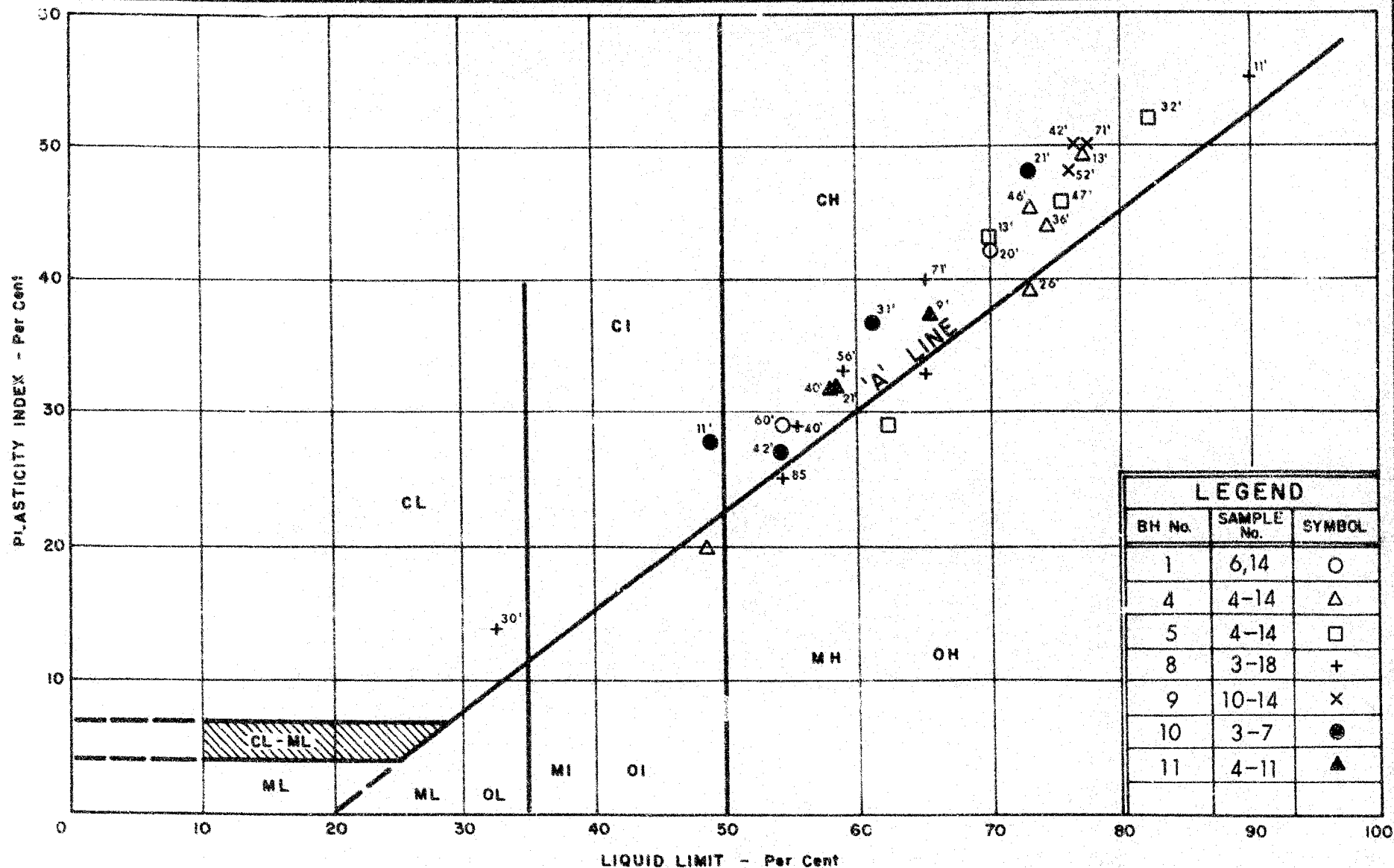
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT WITH SAND

WP. No. 34-66-05

JOB No. 67-F-111

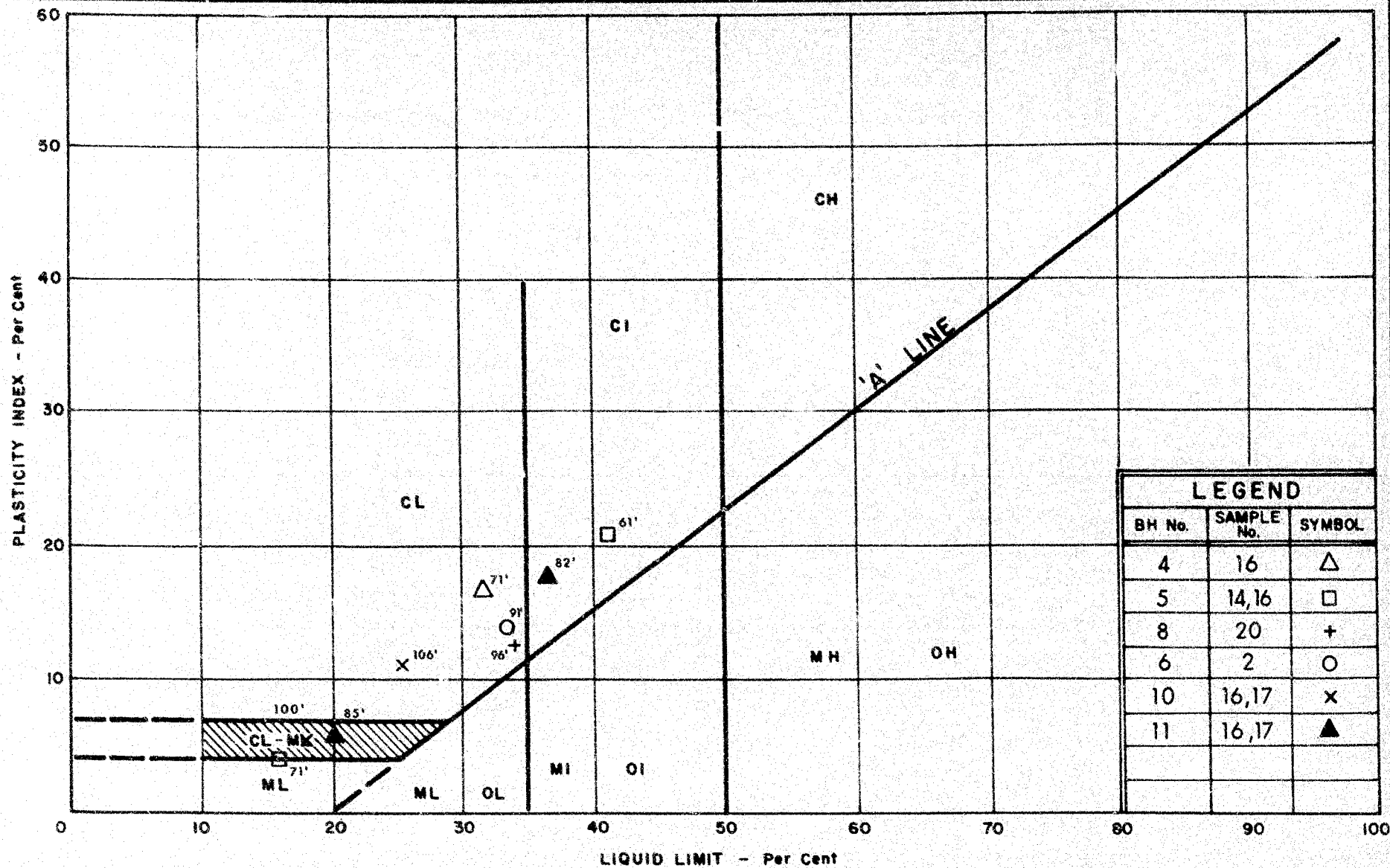
FIGURE NO. 9



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
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DIVISION

# PLASTICITY CHART GREY SENSITIVE CLAY

WP No. 34-66-05  
JOB No. 67-F-111  
FIGURE NO. 10



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT WITH SAND & SOME GRAVEL (GLACIAL TILL)

W.P. No. 34 - 66 - 05

JOB No. 67 - F - 111

FIGURE NO. 11

# VOID RATIO vs PRESSURE

$W_L = 72.7$   
 $W_p = 27.6$   
 $W = 71.3\%$   
 $C_c = 2.16$

BORE HOLE 4  
 SAMPLE 11  
 DEPTH 46'2"  
 ELEV. 117.4

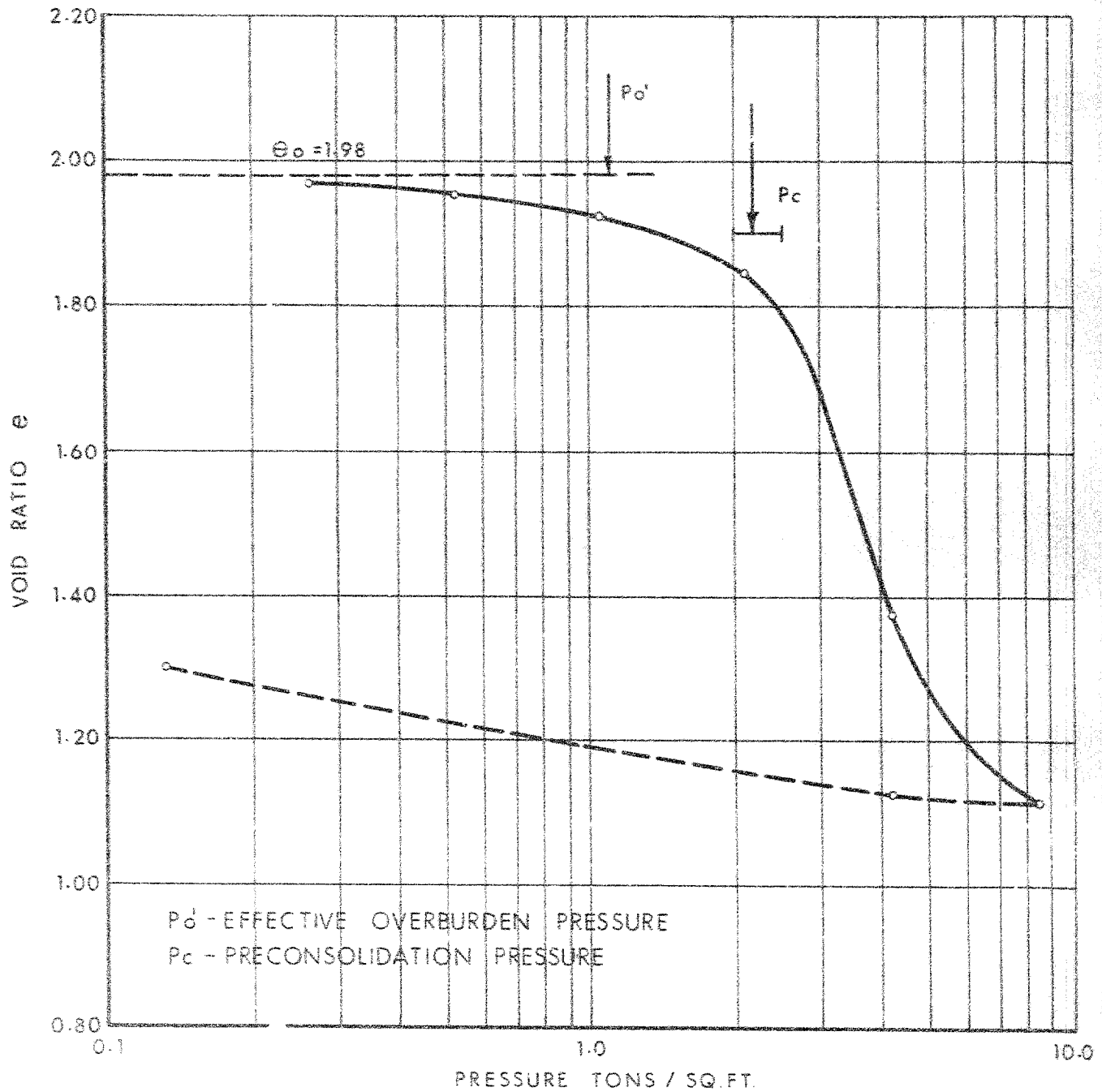


FIG. 12

# VOID RATIO vs PRESSURE

$W_L = 48.3$   
 $W_p = 19.6$   
 $W = 61.4\%$   
 $C_c = 0.93$

BORE HOLE 4  
 SAMPLE 14  
 DEPTH 61'3"  
 ELEV. 161.8

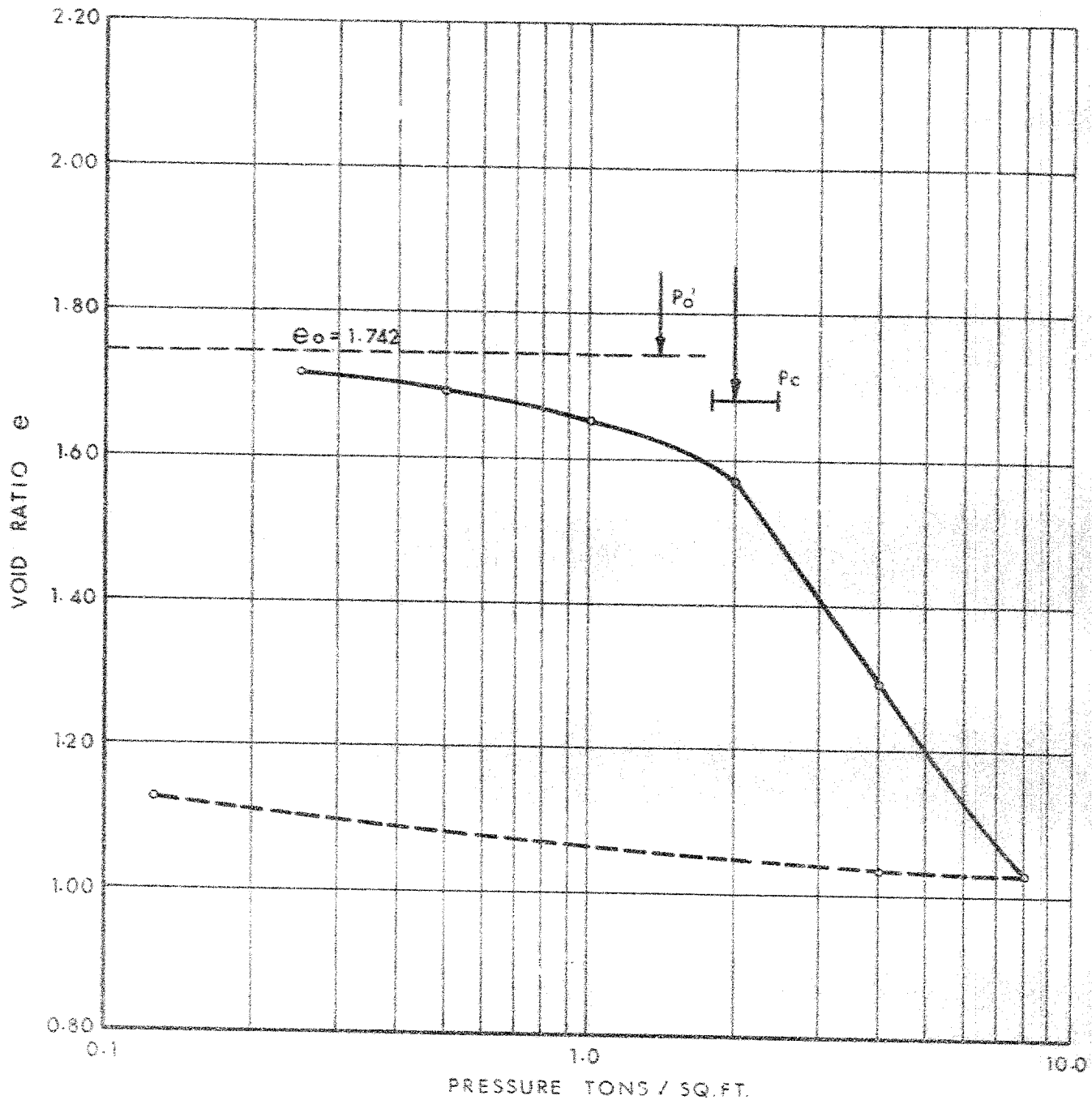


FIG. 13

# VOID RATIO vs PRESSURE

$W_L = 62.6$

$W_p = 33.3$

$W = 80.8\%$

$C_c = 1.95$

BORE HOLE 5

SAMPLE 5

DEPTH 16 2"

ELEV. 201.1

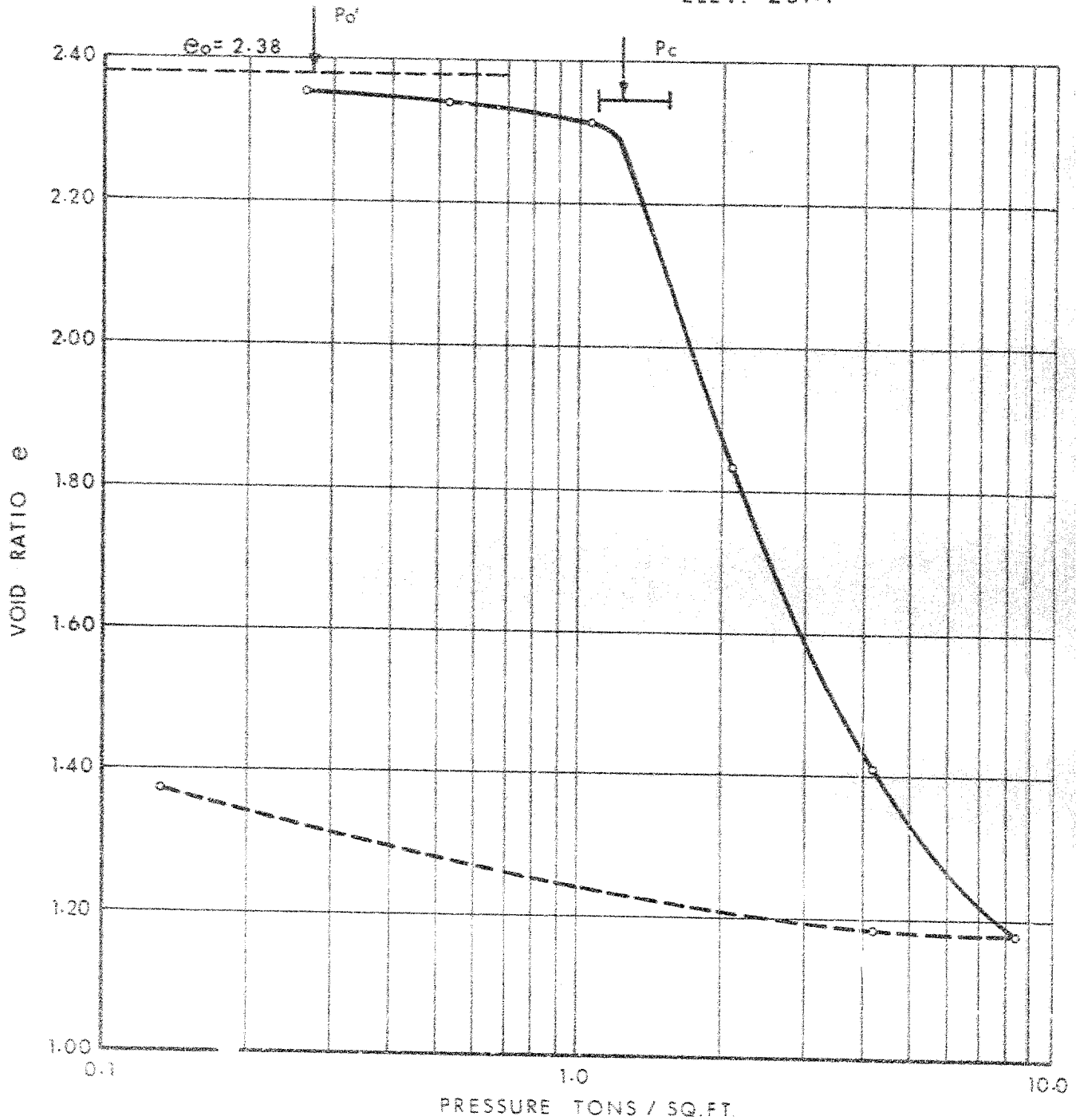


FIG. 14



# VOID RATIO vs PRESSURE

$W_L = 65.0$

$W_p = 32.3$

$W = 84.6\%$

$C_c = 2.32$

BORE HOLE 8

SAMPLE 4

DEPTH 16' 0"

ELEV. 234.5

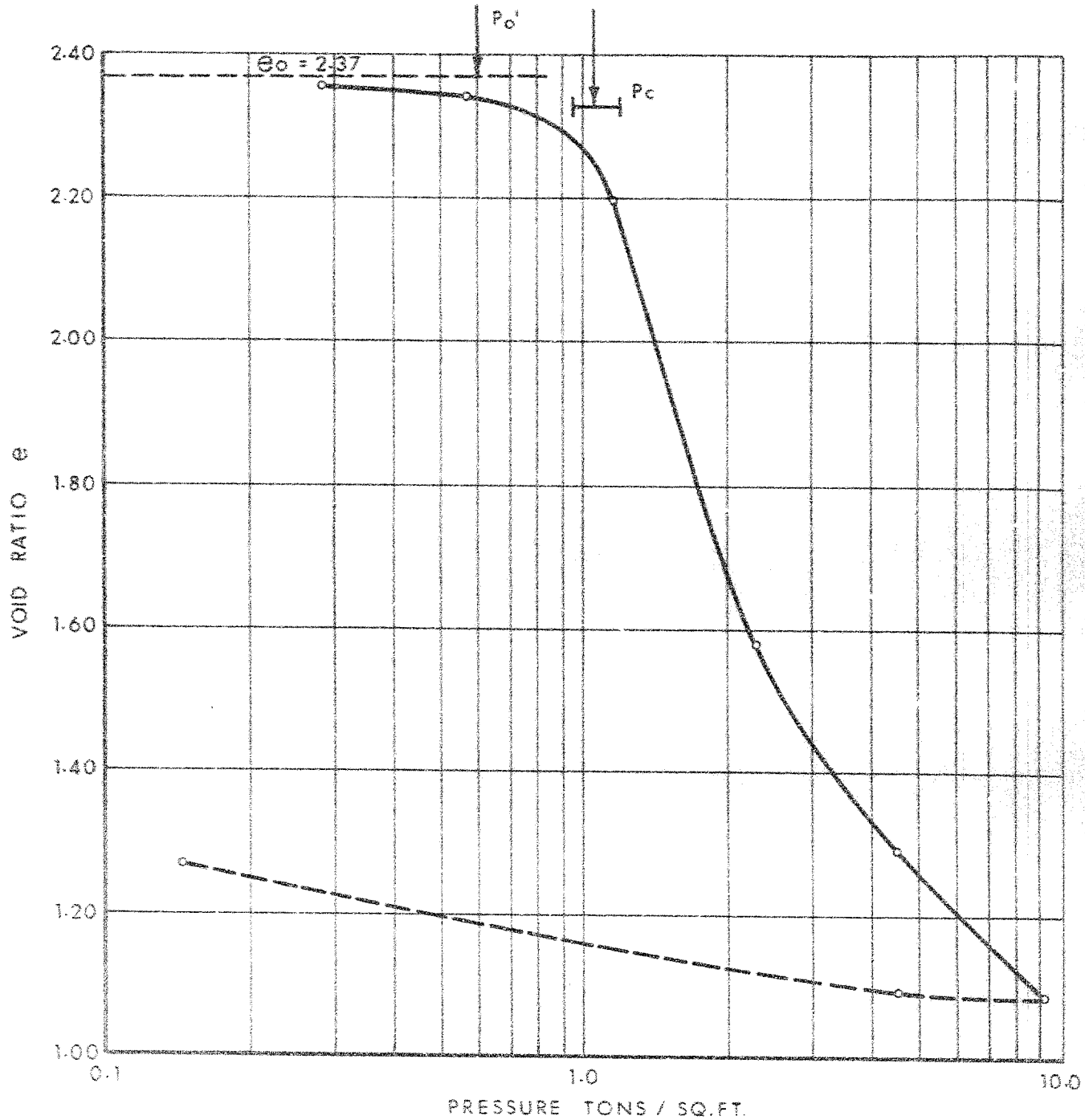


FIG. 15

# VOID RATIO vs PRESSURE

$W_L = 32.2$

$W_p = 18.1$

$W = 73.3\%$

$C_c = 2.17$

BORE HOLE 8

SAMPLE 7

DEPTH 31' 3"

ELEV. 219.2

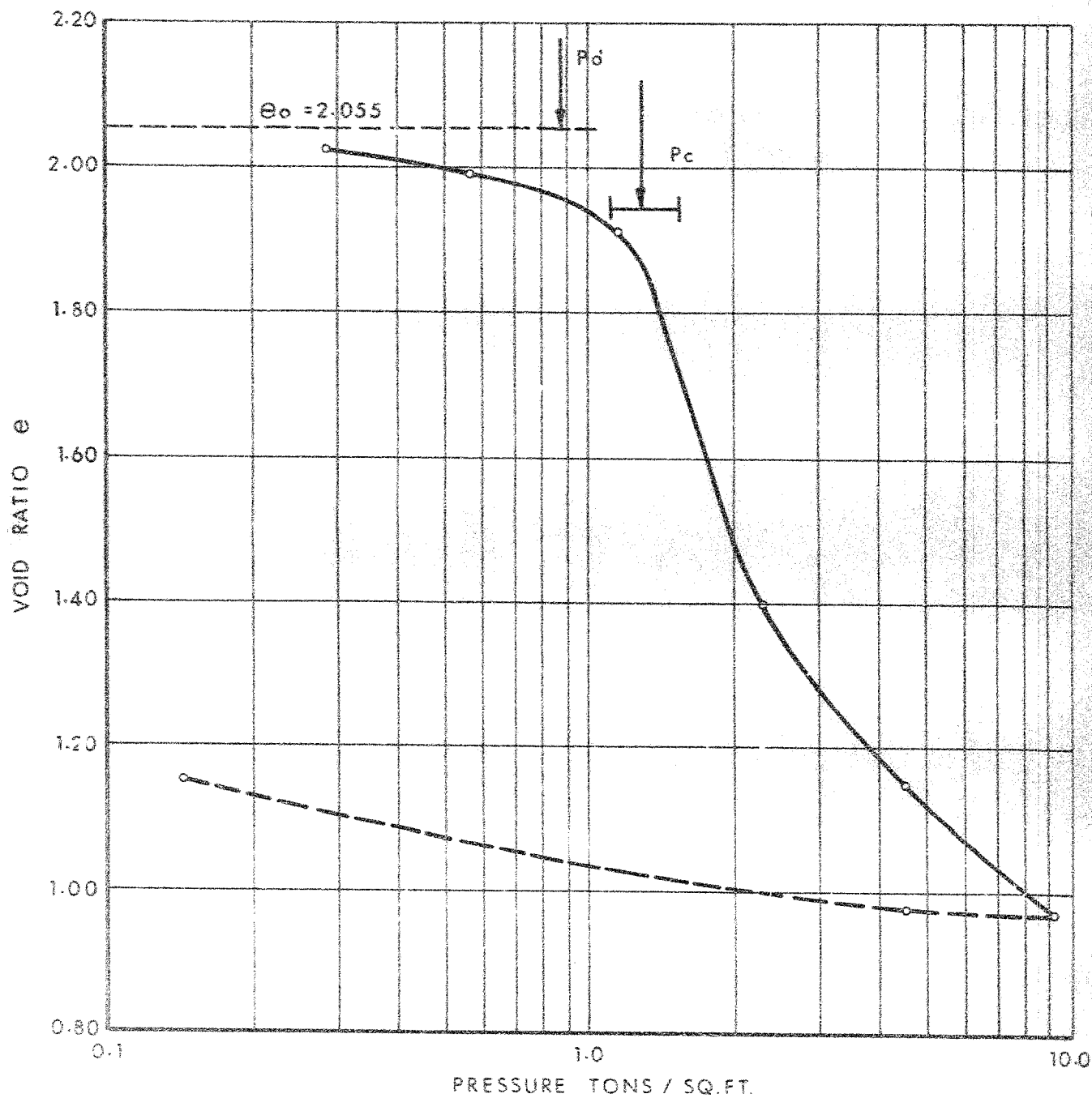


FIG. 16

## 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 <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cd</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY

# 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
$T_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_i$	SENSITIVITY

## GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.718
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

## STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

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

## FOUNDATIONS

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

## SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

Mr. J. L. Forster  
Regional Functional Planning  
Engineer,  
Functional Planning, Kingston

M. & T. Division  
Kingston

January 13, 1967

Re: Hwy. 417, W.P. 34-66  
Ottawa Easterly 13 Miles

67-F-111

Further to our memo of December 16th, 1966 please be advised that preliminary borings have been carried out with a power auger and hand auger equipment at Bear Brook (Sta. 435+) and 3 of the grade separation sites on this project.

The subsoil material at the westerly end (Hawthorne Rd. and relocated Hwy. 31) is till and therefore foundation problems are not anticipated. On the remainder of the project the subsoil consists of 0 - 15' of silty sand over 10' - 50' of firm to soft silty clay. The final structure foundation investigations for both the stream crossings and the grade separations on this portion should be carried out early in order to determine the magnitude of settlements expected under the approach fills at various sites. Placement of the approach fills at least one year in advance of building the structures may be recommended at several of the sites.

The streams are generally cut down to the clay stratum on this portion.

*H. A. Meyer*  
H. A. Meyer

HAM:mgm

for: J. E. Gruspier  
Regional Materials Engineer

cc: A. G. Stermac

## MEMORANDUM

To: Mr. B. B. Davies  
Bridge Engineer  
Bridge Division,  
Admin. Bldg.

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

Attention: Mr. S. McCombie

DATE: January 30, 1968

OUR FILE REF.

IN REPLY TO

## SUBJECT:

INTERIM  
FOUNDATION INVESTIGATION REPORT  
For  
The Proposed E.B.L. and W.B.L.  
Structure Crossings of Bear Brook  
Proposed Highway 417  
District No. 9 (Ottawa)  
W.J. 67-P-111 -- W.P. 34-66-05

1. Introduction:

A request for a foundation investigation at the above mentioned site, was contained in a memo from Mr. G. Scott, Regional Bridge Location Engineer, dated August 25, 1967. The site is located immediately north of 8th Line Road and west of Halls Road in the Township of Gloucester, County of Carleton.

The field investigation phase of this project will be completed this week. Due to the urgency of this project, we have been requested to submit our written recommendations as soon as the field and laboratory testing has been completed. The final report will, therefore, be submitted after the completion of drawings and borehole logs.

In the interim, we are submitting this memo which contains preliminary information on the subsoil and groundwater conditions, together with our recommendations for the structure foundations and approach fills.

2. Site:

The bridge structures will cross over a valley, some 170 feet wide, the floor of which is at about elevation 224. The crest of the valley banks, which are standing at about 3 horizontal to 1 vertical, is at about elevation 250 - i.e., the banks are some 24 to 26 feet high. The valley floor and banks are covered with light brush cover.

cont'd. /2 ...

2. Site: (cont'd.) ...

Bear Brook meanders along the valley floor. This brook is some 25 feet wide and about 7 feet deep. During normal flow conditions the depth of water in the brook is about 4 to 5 feet.

3. Subsoil Conditions:

A brief description of the soil conditions follows.

The surficial cover along the valley floor and valley banks is composed of a firm to stiff red-brown to gray-brown clayey silt with some sand and gravel. This deposit is some 9 to 12 feet thick. Underlying the clayey silt deposit is the predominant overburden stratum across the site, a sensitive grey clay of high plasticity. The base of the clay stratum is between about elevations 150 and 154 - i.e., it is about 60 feet and 90 feet thick along the valley floor and beneath the crest of the valley banks, respectively.

The undrained shear strength of the stratum is about 800 p.s.f. immediately below the surficial deposits, increasing linearly with depth to a maximum of about 1,300 p.s.f. Based on this shear strength profile, the consistency of the stratum varies from firm near the top, increasing to stiff with depth.

Directly underlying the clay stratum is a basal till deposit composed of very stiff to hard grey clayey silt with sand and gravel. The thickness of this deposit across the site varies from about 20 to 30 feet. The till is in turn underlain by shale bedrock, the surface of which is encountered between about elevations 123 and 132. The upper 2 to 3 feet of the bedrock is in a fractured condition; below this depth the rock is basically sound.

4. Groundwater Conditions:

At the time of the investigation, the piezometric groundwater level in the clay was encountered at a depth of about 7 to 8 feet below ground surface - i.e., at about elevation 217 on the valley floor, rising to about elevation 242 at the top of the bank. An artesian groundwater head was encountered within the lower portion of the basal till along the valley floor. The stabilized piezometric head for this artesian condition was at about elevation 234; in other words, about 10 feet above the valley floor.

cont'd. /3 ...

5. Recommendations:

It is proposed to construct twin parallel 3-span overpass structures over Bear Brook: one for the Eastbound lane (E.B.L., 60'-60'-60'), and one for the Westbound lane (W.B.L., 70'-70'-70') of proposed Highway 417. The W.B.L. structure will be about 400 feet north of the E.B.L. structure. The proposed grade of the W.B.L. and E.B.L. is at elevations 251 and 262, respectively.

a) Foundations.

The subsoil conditions across the site are not favourable for spread footing type of foundations. For this reason, it is recommended that the proposed piers and abutments be supported on end-bearing piles driven to practical refusal within the dense basal till, or to the shale bedrock. The allowable loads will depend on the pile section chosen (e.g., 12 BP 74 steel H-piles may be designed for 90 tons per pile.)

b) Approach Embankments:

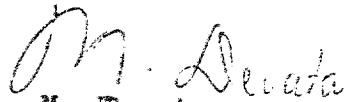
Preliminary stability computations carried out, indicate that the approach embankments to the Westbound Lane structure can be built on the subsoil without danger of base failure, provided standard side slopes of 2 horizontal to 1 vertical are employed. However, computations indicate that once the height of the approach embankments to the Eastbound Lane exceed 25 feet, berms may be required in both the longitudinal direction as well as the transverse direction. The exact details of the berm requirements will be discussed in our final foundation report.

Due to the fact that the subsoil consists of compressible cohesive material, settlements will occur due to the imposed loads of the embankment. This will be discussed in detail in our final report.

The complete foundation report for this project will be forwarded to you as soon as possible. If you have any further queries, or if any of the foregoing requires clarification, please do not hesitate to call us.

BD/MdeF

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Ferren  
S. J. Markiewicz  
C. Scott  
C. R. Robertson  
J. E. Gruspier  
B. A. Singh  
Foundations Files ✓  
Gen. Files

  
M. Davata,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. E. Stermac,  
PRINCIPAL FOUNDATION ENGR.



Mr. E. S. Davis,  
Bridge Engineer,  
Bridge Division,  
Admin. Bldg.

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

Attention: Mr. E. McCombie

February 13, 1968

Proposed W.B.L. and A.B.L. Structures at  
The Crossing of Hwy. 417 and Bear Brook  
District No. 9 (Ottawa)  
W.P. 34-66-03 -- W.J. 67-7-111

A grade revision has been proposed for the W.B.L. structure by the Regional Bridge Location Section, and this will affect the recommendations contained in our interim foundation report submitted on January 30, 1968.

The grade has been increased approximately 11 ft. above the original grade (elev. 251). An increase of this magnitude necessitates a complete re-evaluation of the stability of the approach fills of the W.B.L. structure, and our preliminary computations indicate berms will be required both in longitudinal and transverse directions. The exact details will be discussed in our final foundation report.

RD/MSF

cc: Messrs. E. S. Davis (2)  
E. A. Tregaskes  
D. W. Farren  
A. J. Markiewicz  
G. Scott  
C. E. Robertson  
J. S. Crispier  
B. A. Singh

Foundations Files  
Gen. Files

*M. Devata*  
M. Devata,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. C. Sternac,  
PRINCIPAL FOUNDATION ENGR.

CONTRACT 67-F-111

JOB NO. 67-F-111

W. P. NO. 34-1605

### PIEZOMETER DATA

PIEZOMETER NO. 8

LOCATION STA. 433+32 @ WBL. HWY 417 - 0.3' RT

ORIGINAL GROUND ELEVATION 250.5

TIP ELEVATION (33'-4") 217.2

**FUTURE FILL HEIGHT**

DATE INSTALLED JAN 10/68

## PIEZOMETER READINGS

[illegible]

JOB NAME PROP. H-417 BEAR BROOK

CONTRACT 67-F-111

JOB NO. 67-F-111

W. P. NO. \_\_\_\_\_

### PIEZOMETER DATA

PIEZOMETER NO. 9

LOCATION STA. 483+00 @ EBL. HWY. 417

ORIGINAL GROUND ELEVATION 244.0

TIP ELEVATION (40'-0") 204.0

FUTURE FILL HEIGHT

DATE INSTALLED *JAN. 31/68*

### PIEZOMETER READINGS

[illegible]

JOB NAME PROP. Hwy. 417 - BEAR BROOK

CONTRACT 67-F-111

JOB NO. 67-F-111

W. P. NO.

### PIEZOMETER DATA

PIEZOMETER NO. 10 (SHALLOW - 5TH.)

LOCATION STA. 436+86 & ERL. HWY. 417.

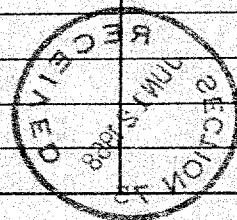
ORIGINAL GROUND ELEVATION 250.5

TIP ELEVATION (45'-0) 205.5

FUTURE FILL HEIGHT

DATE INSTALLED JAN 30/68

### PIEZOMETER READINGS

[illegible]





CONTRACT 67-F-111

JOB NO. 67-F-111

W. P. NO. \_\_\_\_\_

### PIEZOMETER DATA

PIEZOMETER NO. 9

LOCATION STA. 433+00 @ EBL. HWY. 417

ORIGINAL GROUND ELEVATION 244.0

TIP ELEVATION (40'-0") 204.0

FUTURE FILL HEIGHT

DATE INSTALLED JAN. 31/68

## PIEZOMETER READINGS

[illegible]

CONTRACT 67-1-111

W. P. NO. \_\_\_\_\_

PIEZOMETER NO. 10 SHALLOW (SOUTH)

LOCATION STA. 436+86 @ E.B.L. HWY. 417

ORIGINAL GROUND ELEVATION 750.5

TIP ELEVATION (45'-0") 205.5

**FUTURE FILL HEIGHT**

DATE INSTALLED JAN. 30/68

[illegible]

JOB NAME PROP HWY 417 - BEAR BROOK

CONTRACT 67-F-111

JOB NO. 67-F-111

W. P. NO. \_\_\_\_\_

## PIEZOMETER DATA

PIEZOMETER NO. 10 DEEP (NORTH)

LOCATION STA. 436+86 of EBL HWY. 417

ORIGINAL GROUND ELEVATION 250.5

TIP ELEVATION (110'-0") 140.5

FUTURE FILL HEIGHT.

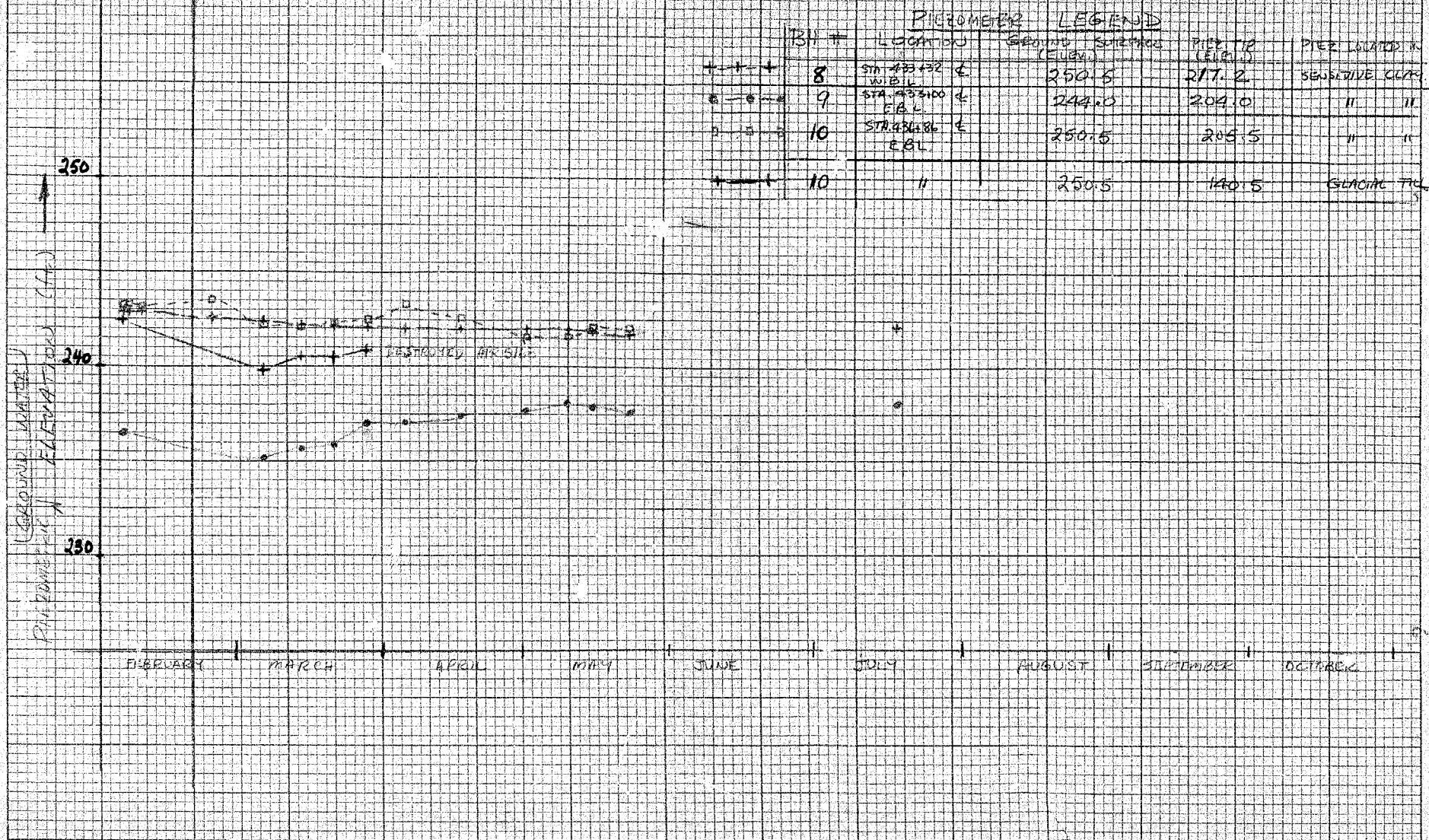
DATE INSTALLED JAN. 26/68

### PIEZOMETER READINGS

[illegible]



WJ 63-F-111 W.P. 84-11-05  
 HWY #47 CROSSING OF BEAR BROOK.  
 RECORD OF PIEZOMETRIC GROUND  
 WATER LEVELS IN TILL & ~~CLAY~~ <sup>CLAY</sup> ~~STONE~~



Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

~~Receives,~~

G. Scott, Kingston Region  
C.R. Robertson, Ottawa District  
L. Forster, Kingston Region  
S. Markiewicz, Kingston Region

Bridge Division,  
Downsview, Ontario

October 30, 1968

Bear Brook Bridge  
(E.B.L. Structure)  
W.P. 34-66-05, Site 3-266  
Highway 417, District 9

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-6467-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$278,000. This cost includes tender, materials, engineering and sundry construction.

Any comments or revisions you may have should be submitted within three weeks.

CSG:rd

C.S. Grebaki,  
Bridge Design Engineer

Attach.

c.c. S. McCombie  
A. Stermac (2)  
D. Barr  
J. Anderson

*No Comments*  
*M. Lavata*  
*Nov 6/68.*

Department of Highways Ontario

Copy for the information of  
Mr. A. Stermac

Re: ~~Re: Mr. A. Stermac~~

~~G. Scott, Kingston Region~~  
~~C.R. Robertson, Ottawa District~~  
~~L. Forster, Kingston Region~~  
~~S. Marikiewicz, Kingston Region~~

Bridge Division,  
Downsview, Ontario

October 30, 1968

Bear Brook Bridge  
M.B.L. Structure  
1 Mile South of Carleton Place  
M.P. 34-66-14, Site 3-256  
Highway 417, District No. 9

Attached herewith are prints of the Preliminary Bridge Plan  
Drawing D-6573-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$352,000.  
This cost includes tender, materials, engineering and sundry  
construction.

Any comments or revisions you may have should be submitted  
within three weeks.

CSG:rd

C.S. Grebcki,  
Bridge Design Engineer

Attach.

c.c. S. McCosbie  
A. Stermac (2)  
D. Barr  
J. Anderson

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

Messrs.

G. Scott, Kingston Region  
C.R. Robertson, Ottawa District  
L. Forster, Kingston Region  
S. Marichewicz, Kingston Region

Bridge Division,  
Downsview, Ontario

October 30, 1968

Bear Brook Bridge  
W.B.L. Structure  
1 Mile South of Carleton Place  
W.P. 34-66-14, Site 3-266  
Highway 417, District No. 9

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-6578-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$352,000. This cost includes tender, materials, engineering and sundry construction.

Any comments or revisions you may have should be submitted within three weeks.

CSG:rd

C.S. Greboki,  
Bridge Design Engineer

Attach.

c.c. S. McCombie  
A. Stermac (2)  
D. Barr  
J. Anderson

## MEMORANDUM

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

FROM: Bridge Office,  
Downsview, Ontario

ATTENTION:

DATE: December 11, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT: Bear Brook Bridge (E.B.L. Structure)  
W.P. 34-66-05, Site 3-266  
Highway 417 (E.B.L.), District 9

67-F-111

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.

JL Klein

for C.S. Grebski,  
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Section

Advised Mr Lin on Dec 17/68 that Pier #3 may require some scour protection since it is very close to the stream bank.

M Devada  
Dec 17/68

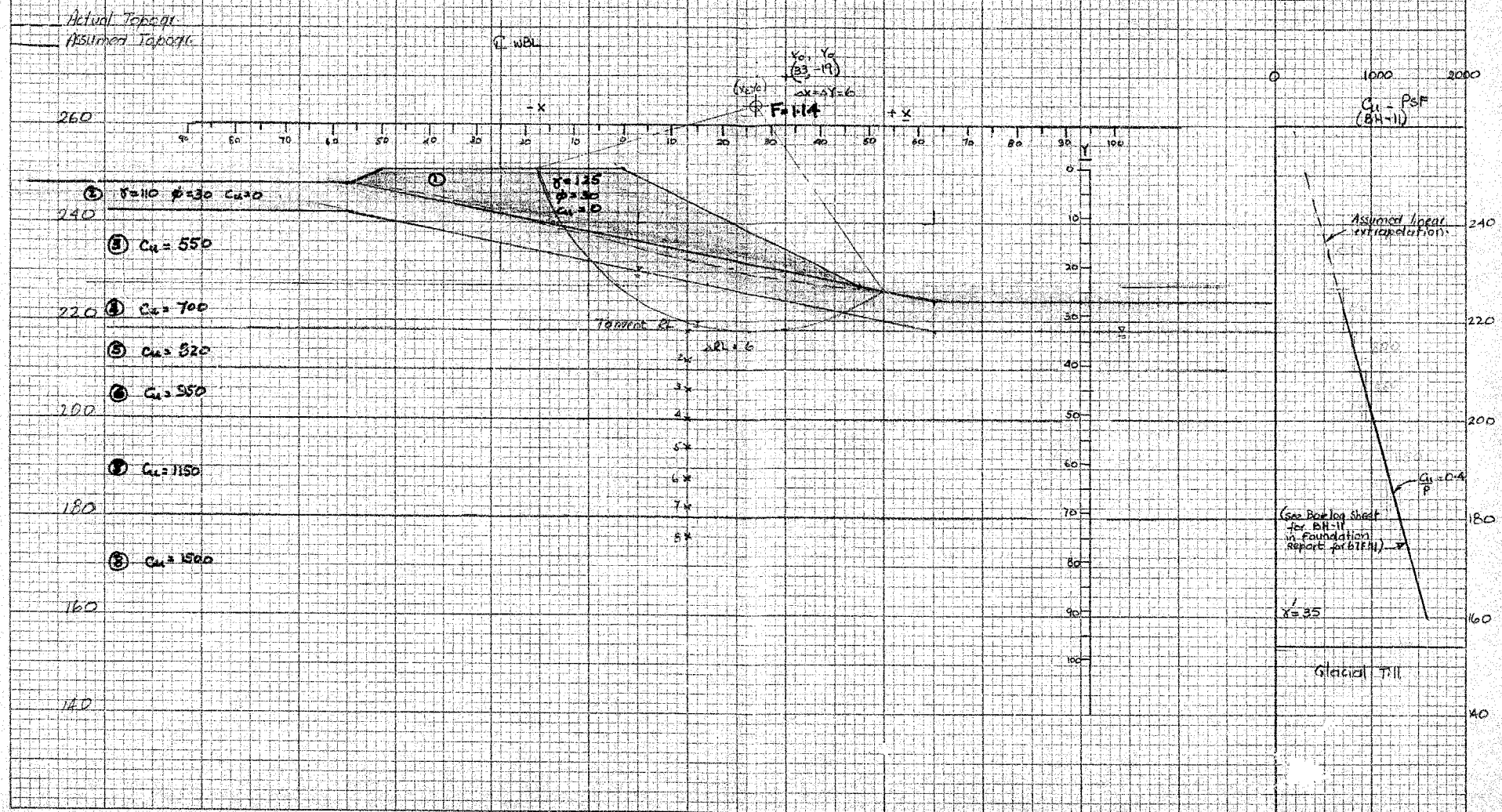


# WESTBOUND LANE - WEST APPROACH - ABUT SHIFT 30' EAST - SECTION A-A STABILITY CHECK: 67-F-111

see Drawing D-6578-1

C. Mirza  
Jan 13/69

Borehole 11 is applicable:



SLICES	X-INIT.	Y-INIT.	DELX	DELY	TANG. R.L.	INCR.	NO. R	TENSION CRACK	NO. PTS.%-X<	NO. PTS.%X<	CUT-OFF%-X<	CUT-OFF%&X<
40	33	-19	6.0	6.0	33.0	6.0	8	0.0	3	3	-200.0	200.0

X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD
-200.00	3.00	-56.00	3.00	-50.00	0.0	48.00	24.00	63.00	27.00	200.00	27.00		

## SECTIONAL DETAILS

SECTION	X COORD	SOIL TYPE	Y COORD	WATER TABLE
---------	---------	-----------	---------	-------------

1	-200.00	1	0.0	9.00
---	---------	---	-----	------

1		2	3.00	
---	--	---	------	--

1		3	9.00	
---	--	---	------	--

1		4	24.00	
---	--	---	-------	--

1		5	33.00	
---	--	---	-------	--

1		6	41.00	
---	--	---	-------	--

1		7	51.00	
---	--	---	-------	--

1		8	71.00	
---	--	---	-------	--

2	-56.00	1	0.0	9.00
---	--------	---	-----	------

2		2	3.00	
---	--	---	------	--

2		3	9.00	
---	--	---	------	--

2		4	24.00	
---	--	---	-------	--

2		5	33.00	
---	--	---	-------	--

2		6	41.00	
---	--	---	-------	--

2		7	51.00	
---	--	---	-------	--

2		8	71.00	
---	--	---	-------	--

3	17.00	1	0.0	24.00
---	-------	---	-----	-------

3		2	18.00	
---	--	---	-------	--

3		3	24.00	
---	--	---	-------	--

3		4	24.00	
---	--	---	-------	--

3		5	33.00	
---	--	---	-------	--

3		6	41.00	
---	--	---	-------	--

3		7	51.00	
---	--	---	-------	--

3		8	71.00	
---	--	---	-------	--

4	63.00	1	0.0	33.00
---	-------	---	-----	-------

4		2	27.00	
---	--	---	-------	--

4		3	33.00	
---	--	---	-------	--

4		4	33.00	
---	--	---	-------	--

4		5	33.00	
---	--	---	-------	--

4		6	41.00	
---	--	---	-------	--

4		7	51.00	
---	--	---	-------	--

4		8	71.00	
---	--	---	-------	--

5	200.00	1	0.0	33.00
---	--------	---	-----	-------

5		2	27.00	
---	--	---	-------	--

5		3	33.00	
---	--	---	-------	--

5		4	33.00	
---	--	---	-------	--

5		5	33.00	
---	--	---	-------	--

5		6	41.00	
---	--	---	-------	--

5		7	51.00	
---	--	---	-------	--

5		8	71.00	
---	--	---	-------	--

## SOIL PROPERTIES

SOIL TYPE	COHESION	PHI	BULK DENSITY	SUBMERGED DENSITY
-----------	----------	-----	--------------	-------------------

1	0.0	30.0	125.0	63.0
---	-----	------	-------	------

2	0.0	30.0	110.0	48.0
---	-----	------	-------	------

3	550.	0.0	97.0	35.0
---	------	-----	------	------

4	700.	0.0	97.0	35.0
---	------	-----	------	------

5	820.	0.0	97.0	35.0
---	------	-----	------	------

6	950.	0.0	97.0	35.0
---	------	-----	------	------

7	1150.	0.0	97.0	35.0
---	-------	-----	------	------

8	1500.	0.0	97.0	35.0
---	-------	-----	------	------

# CRITICAL CIRCLE

RADIUS	XC	YC	F. OF S.
46.00	27.00	-13.00	1.143
40.00	27.00	-7.00	1.149
52.00	27.00	-19.00	1.152
58.00	27.00	-25.00	1.160
52.00	33.00	-19.00	1.172
46.00	33.00	-13.00	1.172
58.00	33.00	-25.00	1.172
64.00	27.00	-31.00	1.181
40.00	33.00	-7.00	1.186
64.00	33.00	-31.00	1.187

THIS JOB COMPLETED. RUNNING DATE JAN 15, 1969 TIME ELAPSED # 176 SECONDS



DEPARTMENT OF HIGHWAYS  
ONTARIO

## PRODUCTION REQUEST

TO - SCHEDULING OFFICER

ELECTRONIC COMPUTING BRANCH

REFERENCE NO. 167-F-111REQUIRED FOR Foundation SectionAUTHORIZED BY M. DevataSHIPPING ADDRESS Rm 107 Lab Bldg.TITLE Sub. Fndn Engr.DATE Jan 14, 1968LOCATION CODE 06-8-06-1-02-00REQUIRED DATE Jan 15, 1968JOB TITLE Bear Brook - WBL - West Approach - Sect A-A Final DesignNO. OF COPIES OF OUTPUT 1

## DESCRIPTION

Slope stability Analysis - Total stress (033) - one unitKindly call CAM MIRZA @ 3282 when results  
become available

## SYSTEMS TO BE USED

Name SLOPE STABILITY ANALYSIS -  
TOTAL STRESS (033)No. 0051Units 1

## FOR ELECTRONIC COMPUTING BRANCH USE ONLY

E.C.B. NO. 114034TECHNICIAN NO. 025DATE REC'D JAN 17/69

PRIORITY NO. \_\_\_\_\_

DATE COMPLETED JAN 15/69

APPROVED \_\_\_\_\_

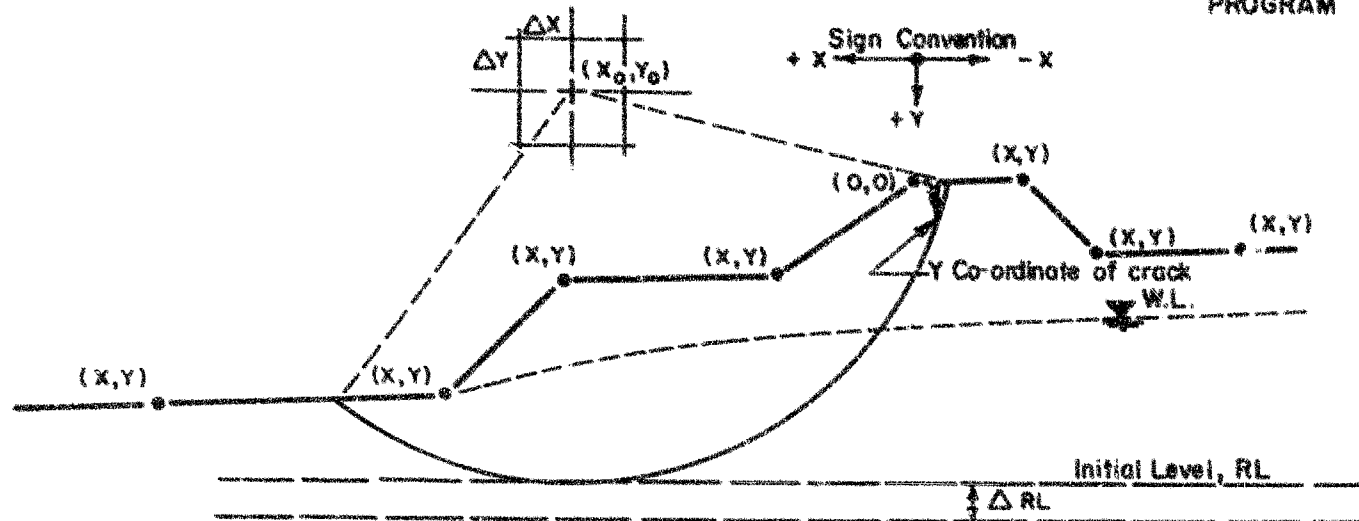
## STABILITY ANALYSIS (COMPLEX SLOPE)

MADE BY C. MIRZA

DATE JAN. 14, 1969 JOB NO. 67-F-111

PROGRAM 32 (C-a-p analysis)

PROGRAM 33 ( $\delta = 0$  analysis)



9	15	45	59	70
PROG. NO.	JOB TITLE	DATE	JOB NO.	
93	BBROOK-WBL-W-APP-SECTAA-FINAL	JAN-14-69	67-F-111	

## GEOMETRY OF SLOPE & INITIAL TRIAL CIRCLE

[illegible]

## SECTION DETAILS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	14	20 25
1	-200.0	1	0:0	9:0
1	:	2	3:0	:
1	:	3	9:0	:
1	:	4	24:0	:
1	:	5	33:0	:
1	:	6	41:0	:
1	:	7	51:0	:
1	:	8	71:0	:
2	-56:0	1	0:0	9:0
2	:	2	3:0	:
2	:	3	9:0	:
2	:	4	24:0	:
2	:	5	33:0	:
2	:	6	41:0	:
2	:	7	51:0	:
2	:	8	71:0	:
3	17:0	1	0:0	24:0
3	:	2	18:0	:
3	:	3	24:0	:
3	:	4	24:0	:

## REMARKS

Bear Brook  
 W.B.L.  
 West Approach  
 Sect. A-A.  
 Final Design

## SECTION DETAILS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	14	20 25
3	:	5	33:0	:
3	:	6	41:0	:
3	:	7	51:0	:
3	:	8	71:0	:
4	63:0	1	0:0	33:0
4	:	2	27:0	:
4	:	3	33:0	:
4	:	4	33:0	:
4	:	5	33:0	:
4	:	6	41:0	:
4	:	7	51:0	:
4	:	8	71:0	:
5	200:0	1	0:0	33:0
5	:	2	27:0	:
5	:	3	33:0	:
5	:	4	33:0	:
5	:	5	33:0	:
5	:	6	41:0	:
5	:	7	51:0	:
5	:	8	71:0	:

## REMARKS

Bear Brook  
W.B.L  
West Approach  
Sect A-A  
Final Design

## SECTION DETAILS

[illegible]

## REMARKS

REMARKS  
Bear Brook  
W. B. L.  
West Approach  
Sect. A-A.  
Final Design

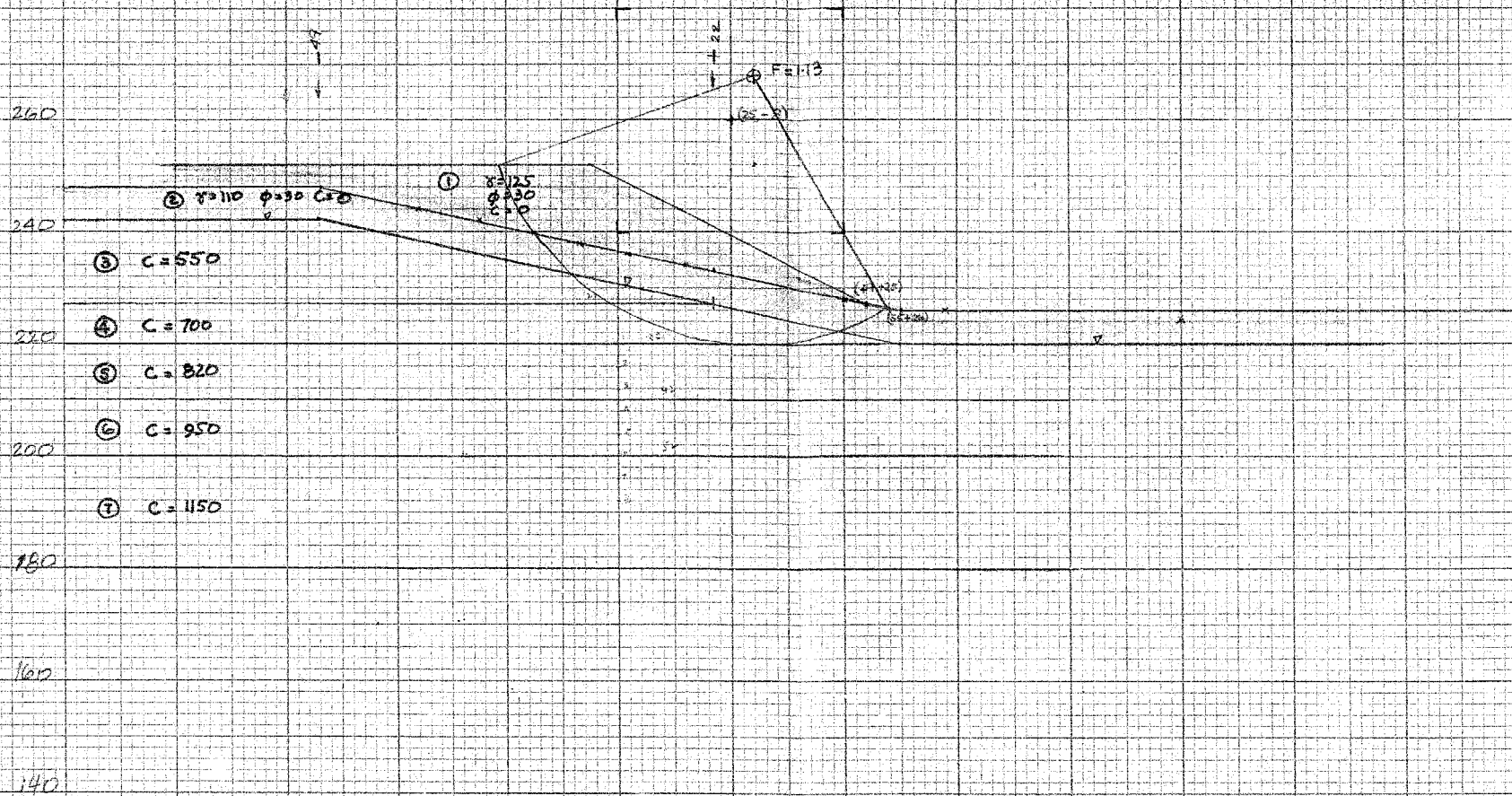




WEST BOUND LANE - WEST APPROACH - ABUT. SHIFT 15' EAST - SECT C-C - STABILITY CHECK 67-F-111

See DWG D-6578-1

C. Mirzo  
Jan 16/67



SLICES	X-INIT.	Y-INIT.	DELX	DELY	TANG. R.L.	INCR.	NO. R	TENSION CRACK	NO. PTS.%-X<	NO. PTS.%&X<	CUT-OFF%-X<	CUT-OFF%-&X<
40	25	-8	4.0	4.0	32.0	4.0	8	0.0	1	3	-200.0	200.0

X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD
-200.00	0.0	49.00	25.00	55.00	26.00	200.00	26.00						

SECTION	X COORD	SOIL TYPE	Y COORD	WATER TABLE
1	-200.00	1	0.0	10.00

1		2	4.00	
1		3	10.00	
1		4	25.00	
1		5	32.00	
1		6	42.00	
1		7	52.00	
2	-49.00	1	0.0	10.00
2		2	4.00	
2		3	10.00	
2		4	25.00	
2		5	32.00	
2		6	42.00	
2		7	52.00	
3	22.00	1	0.0	25.00
3		2	19.00	
3		3	25.00	
3		4	25.00	
3		5	32.00	
3		6	42.00	
3		7	52.00	
4	55.00	1	0.0	32.00
4		2	26.00	
4		3	32.00	
4		4	32.00	
4		5	32.00	
4		6	42.00	
4		7	52.00	
5	200.00	1	0.0	32.00
5		2	26.00	
5		3	32.00	
5		4	32.00	
5		5	32.00	
5		6	42.00	
5		7	52.00	

SOIL TYPE		SOIL PROPERTIES		
COHESION	PHI	BULK DENSITY	SUBMERGED DENSITY	
1	0.0	30.0	125.0	63.0
2	0.0	30.0	110.0	48.0
3	550.	0.0	97.0	35.0
4	700.	0.0	97.0	35.0
5	820.	0.0	97.0	35.0
6	950.	0.0	97.0	35.0
7	1150.	0.0	97.0	35.0



# CRITICAL CIRCLE

RADIUS	XC	YC	F. OF S.
48.00	29.00	-16.00	1.131
48.00	33.00	-16.00	1.133
40.00	29.00	-8.00	1.134
52.00	33.00	-20.00	1.134
52.00	29.00	-20.00	1.137
48.00	25.00	-16.00	1.137
44.00	29.00	-12.00	1.138
44.00	33.00	-12.00	1.141
44.00	25.00	-12.00	1.141
52.00	25.00	-20.00	1.145

THIS JOB COMPLETED. RUNNING DATE JAN 20, 1969 TIME ELAPSED # 167 SECONDS

DEPARTMENT OF HIGHWAYS  
ONTARIO

## PRODUCTION REQUEST

TO - SCHEDULING OFFICER

ELECTRONIC COMPUTING BRANCH

REFERENCE NO. 67-F-111REQUIRED FOR FOUNDATION SECTIONAUTHORIZED BY M. DEVATASHIPPING ADDRESS RM 107 LAB BLDGTITLE SUPV'G FNDN ENGRLOCATION CODE 06-8-06-1-02-00DATE JANUARY 17, 1969JOB TITLE BEAR BROOK - WBL - WEST APPROACH - SECT EC - Final DesignREQUIRED DATE JAN 20, 1969NO. OF COPIES OF OUTPUT 1

## DESCRIPTION

slope stability Analysis - Total Stress (033) - 1 unit  
kindly call 3282 for pickup  
of results.

## SYSTEMS TO BE USED

Name SLOPE STABILITY ANALYSIS  
TOTAL STRESS (033)No. 0051 Units 1

## FOR ELECTRONIC COMPUTING BRANCH USE ONLY

E.C.B. NO. 117017TECHNICIAN NO. 025DATE REC'D JAN 17/69

PRIORITY NO. \_\_\_\_\_

DATE COMPLETED JAN 20/69

APPROVED \_\_\_\_\_

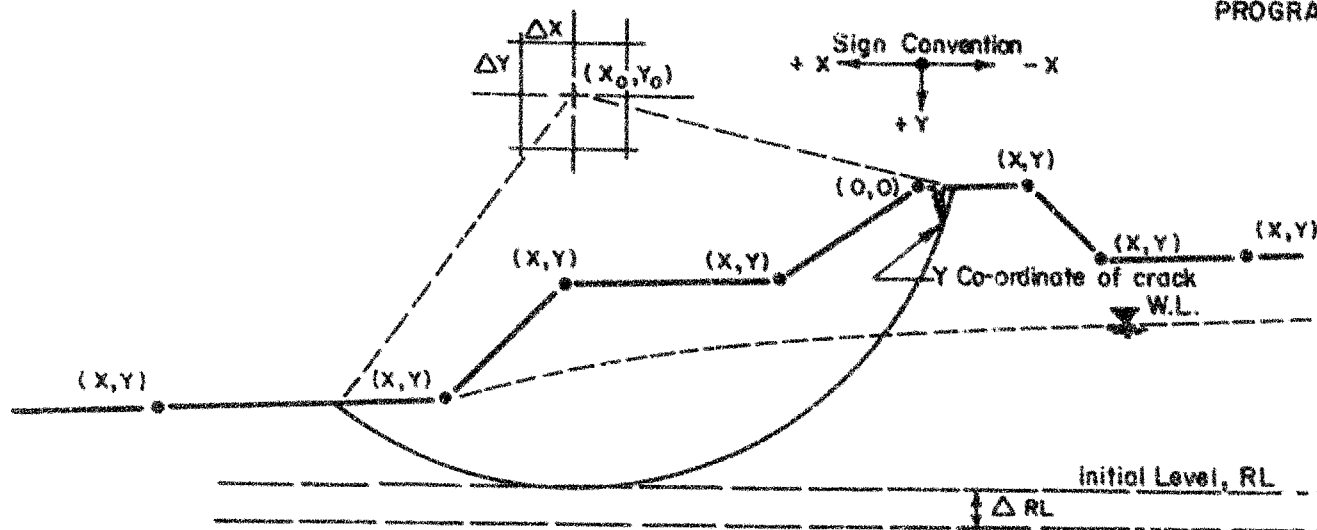
## STABILITY ANALYSIS (COMPLEX SLOPE)

MADE BY: C. MIRZA

DATE JAN 16, 1969 JOB NO. 67-F-111

~~PROGRAM 32 (C-O-P analysis)~~

PROGRAM 33 ( $\phi = 0$  analysis)



9		15		48		89	
PROG. NO.		JOB TITLE		DATE		JOB NO.	
33		B.BROOK-WBL-W-APP-SECT CC-FINAL		JAN-17-69		47-F-111	

## GEOMETRY OF SLOPE & INITIAL TRIAL CIRCLE

[illegible]

## SECTION DETAILS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	14	20 25
1	-200.0	1	0:0	1.0:0
1	:	2	4:0	:
1	:	3	10:0	:
1	:	4	25:0	:
1	:	5	32:0	:
1	:	6	42:0	:
1	:	7	52:0	:
2	-49.0	1	0:0	1.0:0
2	:	2	4:0	:
2	:	3	10:0	:
2	:	4	25:0	:
2	:	5	32:0	:
2	:	6	42:0	:
2	:	7	52:0	:
3	22.0	1	0:0	2.5:0
3	:	2	19:0	:
3	:	3	25:0	:
3	:	4	25:0	:
3	:	5	32:0	:
3	:	6	42:0	:

## REMARKS

Bear Brook  
W.B.L.  
West Appr.  
sect C-C  
Final design

## SECTION DETAILS

## REMARKS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	14	20 25
3		7	52:0	
4	55:0	1	0:0	32:0
4		2	26:0	
4		3	32:0	
4		4	32:0	
4		5	32:0	
4		6	42:0	
4		7	52:0	
5	200:0	1	0:0	32:0
5		2	26:0	
5		3	32:0	
5		4	32:0	
5		5	32:0	
5		6	42:0	
5		7	52:0	
9.9				

B Brook  
 WBL  
 west App.  
 Sect C-C.  
 Final Design



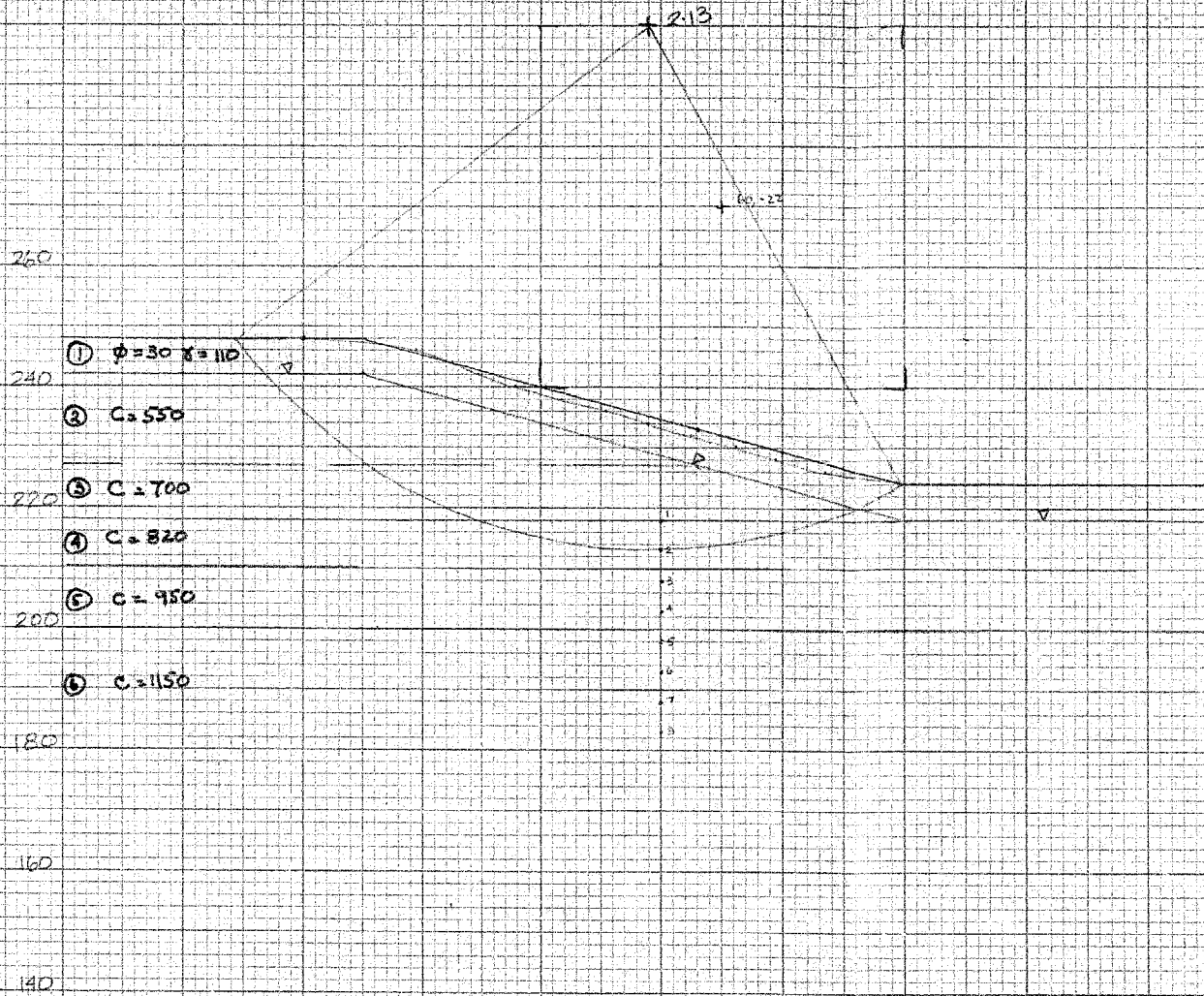
SECT. E-E

67-F-111

See DWG D-6578-1

C. MIRZA

Jan 21/69



SLICES	X-INIT.	Y-INIT.	DELX	DELY	TANG. R.L.	INCR.	NO. R	TENSION CRACK	NO. PTS. -X	NO. PTS. &X	CUT-OFF -X	CUT-OFF &X
40	60	-22	6.0	6.0	30.0	5.0	8	0.0	1	2	-200.0	200.0

X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD
-200.00	0.0	90.00	24.00	200.00	24.00						

## SECTIONAL DETAILS

SECTION	X COORD	SOIL TYPE	Y COORD	WATER TABLE
1	-200.00	1	0.0	6.00
1		2	6.00	
1		3	21.00	
1		4	30.00	
1		5	38.00	
1		6	48.00	
2	0.0	1	0.0	6.00
2		2	6.00	
2		3	21.00	
2		4	30.00	
2		5	38.00	
2		6	48.00	
3	50.00	1	15.00	21.00
3		2	21.00	
3		3	21.00	
3		4	30.00	
3		5	38.00	
3		6	48.00	
4	90.00	1	24.00	30.00
4		2	30.00	
4		3	30.00	
4		4	30.00	
4		5	38.00	
4		6	48.00	
5	200.00	1	24.00	30.00
5		2	30.00	
5		3	30.00	
5		4	30.00	
5		5	38.00	
5		6	48.00	

## SOIL PROPERTIES

SOIL TYPE	COHESION	PHI	BULK DENSITY	SUBMERGED DENSITY
1	0.0	30.0	110.0	48.0
2	550.	0.0	97.0	35.0
3	700.	0.0	97.0	35.0
4	820.	0.0	97.0	35.0
5	950.	0.0	97.0	35.0
6	1150.	0.0	97.0	35.0



CRITICAL CIRCLE

RADIUS	XC	YC	F. OF S.
87.00	48.00	-52.00	2.126
87.00	54.00	-52.00	2.135
81.00	48.00	-46.00	2.135
75.00	48.00	-40.00	2.145
81.00	54.00	-46.00	2.146
75.00	42.00	-40.00	2.154
81.00	42.00	-46.00	2.161
86.00	48.00	-46.00	2.164
82.00	46.00	-52.00	2.164
87.00	42.00	-52.00	2.165

THIS JCE COMPLETED. RUNNING DATE JAN 23, 1969 TIME ELAPSED 96 SECONDS

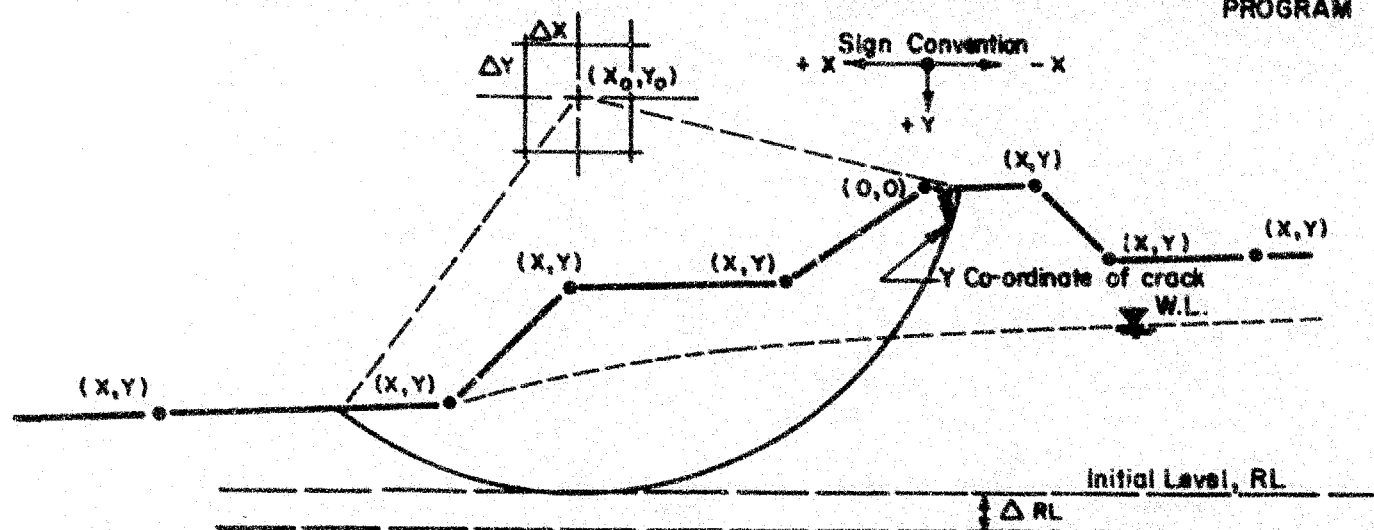
### STABILITY ANALYSIS (COMPLEX SLOPE)

MADE BY. C MIRZA

DATE JAN 21/69 JOB NO. 67-F-111

~~PROGRAM 32 (G's & B's analysis)~~

PROGRAM 33 ( $\theta = 0$  analysis)



9		13		48		55	
PROG. NO.		JOB TITLE		DATE		JOB NO.	
33		B.BROOK-WBL-W-APP SECT EE NAT. SLP		JAN-21-69		67-F-111	

## GEOMETRY OF SLOPE & INITIAL TRIAL CIRCLE

[illegible]

## SECTION DETAILS

## REMARKS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	14	20 25
1	-200.0	1	0.0	6.0
1	:	2	6.0	:
1	:	3	21.0	:
1	:	4	30.0	:
1	:	5	38.0	:
1	:	6	48.0	:
2	0.0	1	0.0	6.0
2	:	2	6.0	:
2	:	3	21.0	:
2	:	4	30.0	:
2	:	5	38.0	:
2	:	6	48.0	:
3	56.0	1	15.0	21.0
3	:	2	21.0	:
3	:	3	21.0	:
3	:	4	30.0	:
3	:	5	38.0	:
3	:	6	48.0	:
4	90.0	1	24.0	30.0
4	:	2	30.0	:

B. Brook  
WBL  
Wst App  
Nat. ground  
stab.  
Sect EE



## SOIL PROPERTIES

## REMARKS

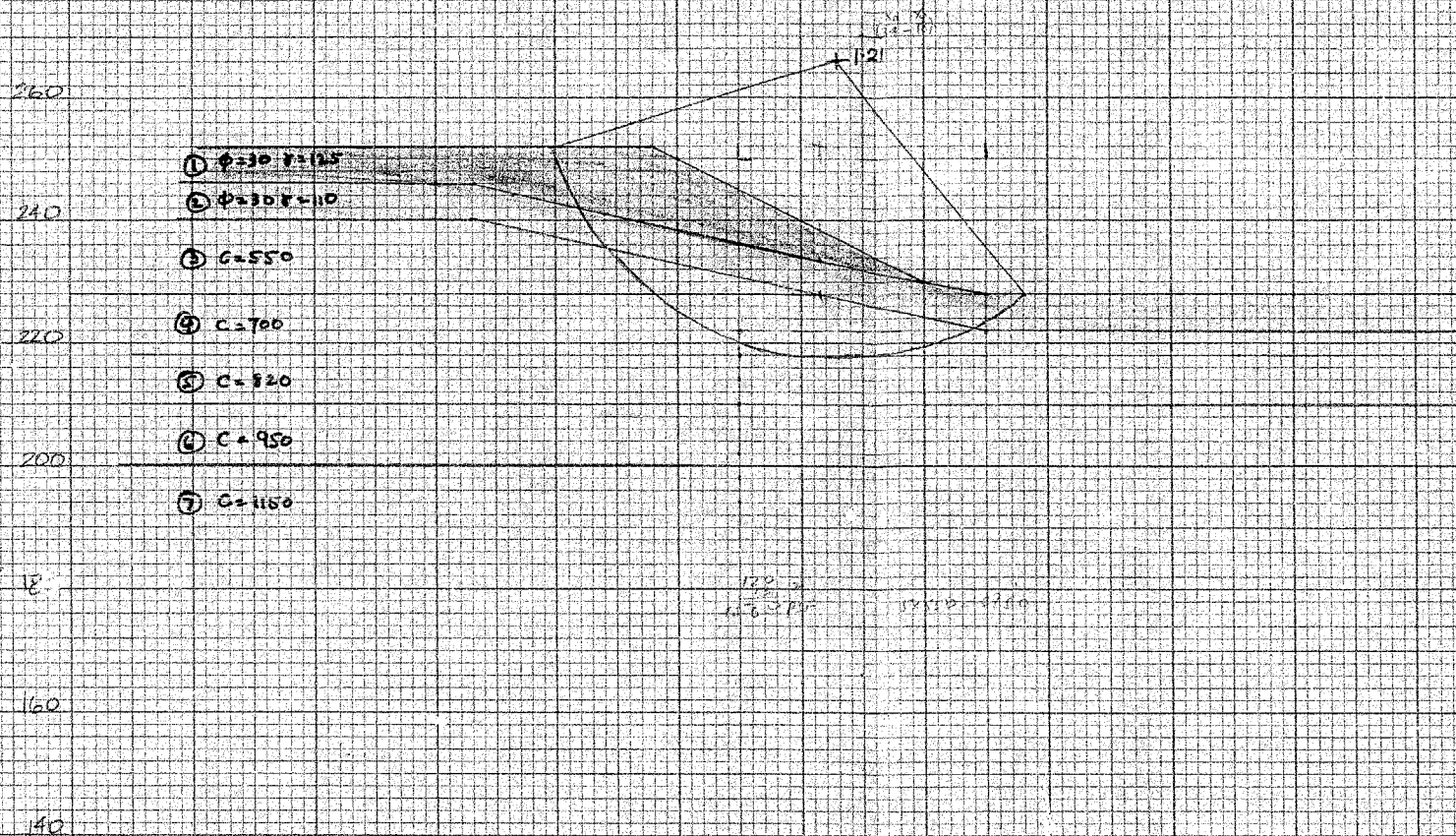
[illegible]

B. Brook  
WBL  
West App  
Nat Gr. Slab  
Sect EE



BEAR BROOK  
WBL WEST APPROACH - ABUT. @ Sta 428+64 as per DWG. D-6578-1 - CHECK STAB SECT D-D: 67-F-111

C. MUKZO  
Jan 21/69



SLICES	X-INIT.	Y-INIT.	DELX	DELY	TANG. R.L.	INCR.	NO. R	TENSION CRACK	NO. PTS. %X<	NO. PTS. %EX<	CUT-OFF %X<	CUT-OFF %EX<
40	34	-18	4.0	4.0	30.0	4.0	8	0.0	1	3	-200.0	200.0

X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD
-200.00	0.0	44.00	22.00	54.00	24.00	200.00	24.00				

## SECTIONAL DETAILS

SECTION	X COORD	SOIL TYPE	Y COORD	WATER TABLE
1	-200.00	1	0.0	12.00

1		2	6.00	
---	--	---	------	--

1		3	12.00	
---	--	---	-------	--

1		4	24.00	
---	--	---	-------	--

1		5	34.00	
---	--	---	-------	--

1		6	42.00	
---	--	---	-------	--

1		7	52.00	
---	--	---	-------	--

2	-30.00	1	0.0	12.00
---	--------	---	-----	-------

2		2	6.00	
---	--	---	------	--

2		3	12.00	
---	--	---	-------	--

2		4	24.00	
---	--	---	-------	--

2		5	34.00	
---	--	---	-------	--

2		6	42.00	
---	--	---	-------	--

2		7	52.00	
---	--	---	-------	--

3	27.00	1	0.0	24.00
---	-------	---	-----	-------

3		2	18.00	
---	--	---	-------	--

3		3	24.00	
---	--	---	-------	--

3		4	24.00	
---	--	---	-------	--

3		5	34.00	
---	--	---	-------	--

3		6	42.00	
---	--	---	-------	--

3		7	52.00	
---	--	---	-------	--

4	54.00	1	0.0	30.00
---	-------	---	-----	-------

4		2	24.00	
---	--	---	-------	--

4		3	30.00	
---	--	---	-------	--

4		4	30.00	
---	--	---	-------	--

4		5	34.00	
---	--	---	-------	--

4		6	42.00	
---	--	---	-------	--

4		7	52.00	
---	--	---	-------	--

5	200.00	1	0.0	30.00
---	--------	---	-----	-------

5		2	24.00	
---	--	---	-------	--

5		3	30.00	
---	--	---	-------	--

5		4	30.00	
---	--	---	-------	--

5		5	34.00	
---	--	---	-------	--

5		6	42.00	
---	--	---	-------	--

5		7	52.00	
---	--	---	-------	--

## SOIL PROPERTIES

SOIL TYPE	COHESION	PHI	BULK DENSITY	SUBMERGED DENSITY
1	0.0	30.0	125.0	63.0
2	0.0	30.0	110.0	48.0
3	350.	0.0	97.0	35.0
4	700.	0.0	97.0	35.0
5	820.	0.0	97.0	35.0
6	550.	0.0	97.0	35.0
7	1150.	0.0	97.0	35.0

# CRITICAL CIRCLE

RADIUS	XC	YC	F. OF S.
48.00	30.00	-14.00	1.212
44.00	28.00	-14.00	1.222
52.00	30.00	-18.00	1.222
48.00	28.00	-14.00	1.225
40.00	28.00	-10.00	1.226
48.00	28.00	-18.00	1.226
44.00	28.00	-10.00	1.227
52.00	28.00	-22.00	1.230
48.00	30.00	-18.00	1.230
40.00	28.00	-8.00	1.230

THIS JOB COMPLETED. RUNNING DATE JAN 22, 1969 TIME ELAPSED # 170 SECONDS



## STABILITY ANALYSIS (COMPLEX SLOPE)

MADE BY.

C. MIRZA

DATE \_\_\_\_\_

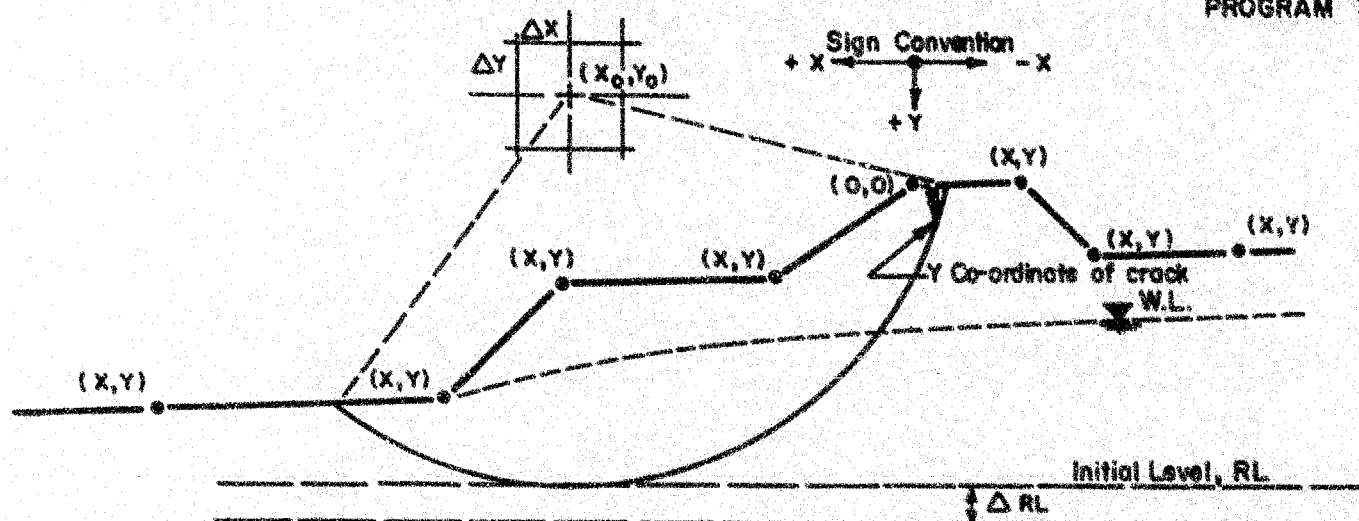
JAN 21/69

INB NO

62-E-11

~~RECORDED - 10-10-61 (encl. 1)~~

PROGRAM 33 (  $\phi = 0$  analysis )



9		15		45		55	
PROG. NO.		JOB TITLE		DATE		JOB NO.	
33		BROOK-WEL-W-APP-SECT DD-FINAL		JAN-21-69		67-F-111	

## GEOMETRY OF SLOPE & INITIAL TRIAL CIRCLE

[illegible]

## SECTION DETAILS

## REMARKS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	14	20 25
1	-200.0	1	0:0	12:0
1	:	2	6:0	:
1	:	3	12:0	:
1	:	4	24:0	:
1	:	5	34:0	:
1	:	6	42:0	:
1	:	7	52:0	:
2	-30:0	1	0:0	12:0
2	:	2	6:0	:
2	:	3	12:0	:
2	:	4	24:0	:
2	:	5	34:0	:
2	:	6	42:0	:
2	:	7	52:0	:
3	27:0	1	0:0	24:0
3	:	2	18:0	:
3	:	3	24:0	:
3	:	4	24:0	:
3	:	5	34:0	:
3	:	6	42:0	:

Bear Brook  
 WBL  
 west App  
 Sect D-D  
 Final

## SECTION DETAILS

## REMARKS

SECTION NO.	X CO-ORDINATE OF SECTION	SOIL TYPE	Y CO-ORD. OF UPPER SOIL BOUNDARY	WATER LEVEL
1	4	11	13	20 23
3	:	7	52:0	:
4	54:0	1	0:0	30:0
4	:	2	24:0	:
4	:	3	30:0	:
4	:	4	30:0	:
4	:	5	34:0	:
4	:	6	42:0	:
4	:	7	52:0	:
5	200:0	1	0:0	30:0
5	:	2	24:0	:
5	:	3	30:0	:
5	:	4	30:0	:
5	:	5	34:0	:
5	:	6	42:0	:
5	:	7	52:0	:
9.9	:		:	:
	:		:	:
	:		:	:
	:		:	:
	:		:	:
	:		:	:

Bear Brook  
WBL  
w/lot App  
Sect D-D  
final



Review of Final Bridge logs  
w B-L structure  
Bear Brook

w J# 67-F-111

w P# 34-66-14

1. Structure E is located on Line 'A'.  
Line 'A' is offset  $7' \pm$  north of  
original line for which foundation  
investigation carried out

a) Shift in line does not affect  
comments previously made

b) Foundation swg should be  
revised to show new line  
& location of Boreholes in relation  
to new line. These are listed  
below.

Borehole	Elev.	Sta (Line 'A')	ofs.
5	217.2	430+69	30' LT
6	222.7	431+69	38' RT
7	224.9	431+96	16' LT
8	250.5	433+26	9' RT
11	227.5	429+53	9' RT.

2. Dwg D-6578-1 shows top of ftg. at elevation 219.0 for Pier #3.

Dwg D-6578-3 shows top of ftg. at elevation 215.5 for Pier #3.

It appears that the elevation given on the Table in Dwg 6578-3 is in error, & should therefore be corrected accordingly.

(Note: In the Preliminary stage, Dwg D-6578-P1 showed elev. of top of ftg, Pier #3 as 215.50).

PSF

67-F-111

Jan 13/69

CM

Settlement Calc's

Review of Final Design  
Conditions E, E. approach

240

220

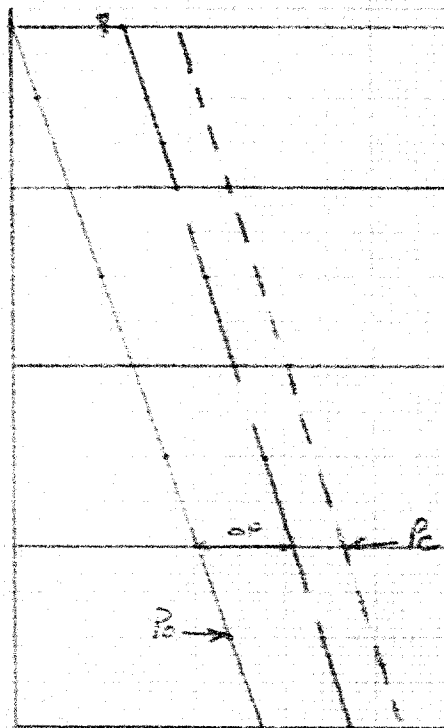
200

180

160

140

0 2000 4000 6000 8000



2

3

4

Since  $P_0 + \Delta P < P_c$ , settlement can be  
taken on basis of  $C_r$

Layer	$P_0$	$P_0 + \Delta P$	$\log \frac{P_0 + \Delta P}{P_0}$
1	300	1500	0.699
2	1000	2150	0.332
3	1700	2800	0.217
4	2400	3400	0.151

$$\Sigma = 1.399$$

$$S = \frac{20 \times 12}{13.0} \times 1.399 \times C_r = 112 C_r$$

$$C_r = 0.02$$

$$S = 2.24"$$

$$C_r = 0.04$$

$$S = 4.48"$$

$$C_r = 0.06$$

$$S = 6.72"$$

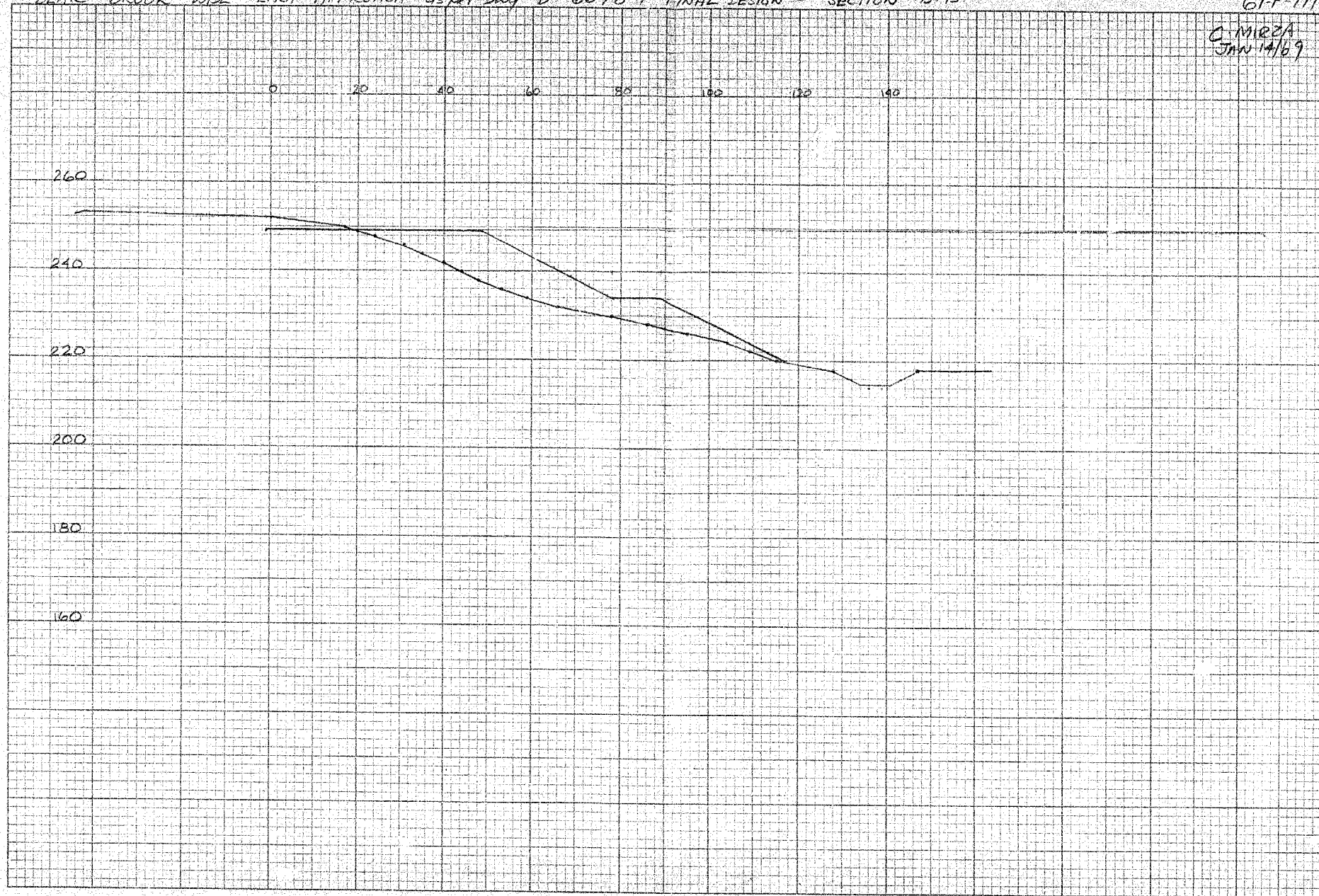
Settlements will  
be in the order of  
4-6". (maximum).



BEAR BROOK-WBL-EAST APPROACH as per DWG D-6578-1 FINAL DESIGN SECTION B-B

67-F-111

C. MIRZA  
JAN 14/69



Advised by M. Devata  
to Mr. S. McCombie that  
shifting the location of  
the W. Abut of the WBL  
structure is not advisable.

Move

F.S.

0 ft

1.21

15 ft

1.13

30 ft

1.14

Department of Highways Ontario

Copy for the information of

Foundation Section

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

Bridge Office,  
Downsview, Ontario

January 10, 1969

Bear Brook Bridge - W.B.L. Structure  
1 Mile South of Carlsbad Springs  
W.P. 34-66-14, Site 3-266  
Highway 417, District No. 9

67-F-111

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

C.S. Grebski,  
Bridge Design Engineer

Attach.

c.c. Foundation Section



CABLE ADDRESS  
ADRESSE TELEGRAPHIQUE

"RESEARCH"

PLEASE QUOTE FILE NO. M43-2-48  
NO DE DOSSIER À RAPPELER

NATIONAL RESEARCH COUNCIL OF CANADA  
CONSEIL NATIONAL DE RECHERCHES DU CANADA

67-F-111

DIVISION OF BUILDING RESEARCH  
DIVISION DES RECHERCHES EN BATIMENT

OTTAWA 7.

16 May 1968

Mr. A. G. Stermac,  
Department of Highways,  
Materials and Testing Division,  
Hwy. 401 and Keele Street,  
DOWNSVIEW, Ontario.

Dear Tony,

Thanks very much for your letter of 10 May with which you have sent your foundation investigation reports for Highway 417. We shall study these with interest and look forward to the possibility of some cooperative and fruitful research on some of the foundation problems of the highway.

With best regards.

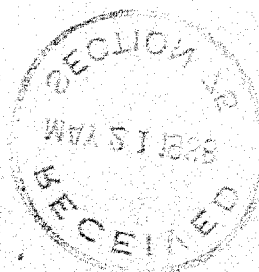
Yours sincerely,

Carl

CBC:nl

Carl B. Crawford,  
Head,  
Soil Mechanics Section.

68-SM-382



*Handwritten:*  
Could you file this somewhere.

22/5/68

*Handwritten:*  
Thanks Jim

cc: Gen. Files

RE-PROPOSED

E.B.L. & B.L. STR.  
AT CROSSING OF  
Hwy 417 & Bear  
Brook

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

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

Attention: Mr. S. McCosbie

February 13, 1968

Proposed E.B.L. and W.B.L. Structures at  
The Crossing of Hwy. 417 and Bear Brook  
District No. 9 (Ottawa)  
W.F. 34-56-05 -- W.J. 67-F-111

A grade revision has been proposed for the W.B.L. structure by the Regional Bridge Location Section, and this will affect the recommendations contained in our interim foundation report submitted on January 30, 1968.

The grade has been increased approximately 11 ft. above the original grade (elev. 251'). An increase of this magnitude necessitates a complete re-evaluation of the stability of the approach fills of the W.B.L. structure, and our preliminary computations indicate berms will be required both in longitudinal and transverse directions. The exact details will be discussed in our final foundation report.

RD/MdeP

cc: Messrs. B. B. Davis (2)  
E. A. Tregaskes  
D. W. Farren  
G. J. Markiewicz  
G. Scott  
C. H. Robertson  
J. E. Graspier  
B. A. Cizh  
Foundations Files  
Gen. Files.

M. Devata

M. Devata,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. G. Starnas,  
PRINCIPAL FOUNDATION ENGR.

ck

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. McCorbie

DATE: January 30, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

**INTERIM  
FOUNDATION INVESTIGATION REPORT  
For  
The Proposed E.B.L. and W.B.L.  
Structure Crossings of Bear Brook  
Proposed Highway 417  
District No. 9 (Ottawa)  
W.J. 67-P-111 -- W.P. 34-66-05**

**1. Introduction:**

A request for a foundation investigation at the above mentioned site, was contained in a memo from Mr. G. Scott, Regional Bridge Location Engineer, dated August 25, 1967. The site is located immediately north of 8th Line Road and west of Halls Road in the Township of Gloucester, County of Carleton.

The field investigation phase of this project will be completed this week. Due to the urgency of this project, we have been requested to submit our written recommendations as soon as the field and laboratory testing has been completed. The final report will, therefore, be submitted after the completion of drawings and borehole logs.

In the interim, we are submitting this memo which contains preliminary information on the subsoil and groundwater conditions, together with our recommendations for the structure foundations and approach fills.

**2. Site:**

The bridge structures will cross over a valley, some 170 feet wide, the floor of which is at about elevation 224. The crest of the valley banks, which are standing at about 3 horizontal to 1 vertical, is at about elevation 250 - i.e., the banks are some 24 to 26 feet high. The valley floor and banks are covered with light brush cover.

cont'd. /2 ...



2. Site: (cont'd.) ...

Bear Brook meanders along the valley floor. This brook is some 25 feet wide and about 7 feet deep. During normal flow conditions the depth of water in the brook is about 4 to 5 feet.

3. Subsoil Conditions:

A brief description of the soil conditions follows.

The surficial cover along the valley floor and valley banks is composed of a firm to stiff red-brown to grey-brown clayey silt with some sand and gravel. This deposit is some 9 to 12 feet thick. Underlying the clayey silt deposit is the predominant overburden stratum across the site, a sensitive grey clay of high plasticity. The base of the clay stratum is between about elevations 150 and 154 - i.e., it is about 60 feet and 90 feet thick along the valley floor and beneath the crest of the valley banks, respectively.

The undrained shear strength of the stratum is about 800 p.s.f. immediately below the surficial deposits, increasing linearly with depth to a maximum of about 1,300 p.s.f. Based on this shear strength profile, the consistency of the stratum varies from firm near the top, increasing to stiff with depth.

Directly underlying the clay stratum is a basal till deposit composed of very stiff to hard grey clayey silt with sand and gravel. The thickness of this deposit across the site varies from about 20 to 30 feet. The till is in turn underlain by shale bedrock, the surface of which is encountered between about elevations 123 and 132. The upper 2 to 3 feet of the bedrock is in a fractured condition; below this depth the rock is basically sound.

4. Groundwater Conditions:

At the time of the investigation, the piezometric groundwater level in the clay was encountered at a depth of about 7 to 8 feet below ground surface - i.e., at about elevation 217 on the valley floor, rising to about elevation 242 at the top of the bank. An artesian groundwater head was encountered within the lower portion of the basal till along the valley floor. The stabilized piezometric head for this artesian condition was at about elevation 234; in other words, about 10 feet above the valley floor.

cont'd. /3 ...



5. Recommendations:

It is proposed to construct twin parallel 3-span overpass structures over Bear Brook: one for the Eastbound lane (E.B.L., 60'-60'-60'), and one for the Westbound lane (W.B.L., 70'-70'-70') of proposed Highway 417. The W.B.L. structure will be about 400 feet north of the E.B.L. structure. The proposed grade of the W.B.L. and E.B.L. is at elevations 251 and 262, respectively.

a) Foundations:

The subsoil conditions across the site are not favourable for spread footing type of foundations. For this reason, it is recommended that the proposed piers and abutments be supported on end-bearing piles driven to practical refusal within the dense basal till, or to the shale bedrock. The allowable loads will depend on the pile section chosen (e.g., 12 BP 74 steel H-piles may be designed for 90 tons per pile.)

b) Approach Embankments:

Preliminary stability computations carried out, indicate that the approach embankments to the Westbound Lane structure can be built on the subsoil without danger of base failure, provided standard side slopes of 2 horizontal to 1 vertical are employed. However, computations indicate that once the height of the approach embankments to the Eastbound Lane exceed 25 feet, berms may be required in both the longitudinal direction as well as the transverse direction. The exact details of the berm requirements will be discussed in our final foundation report.

Due to the fact that the subsoil consists of compressible cohesive material, settlements will occur due to the imposed loads of the embankment. This will be discussed in detail in our final report.

The complete foundation report for this project will be forwarded to you as soon as possible. If you have any further queries, or if any of the foregoing requires clarification, please do not hesitate to call us.

BD/MdeF

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
S. J. Markiewicz  
G. Scott  
C. R. Robertson  
J. E. Gruspier  
B. A. Singh  
Foundations Files  
Gen. Files

*M. Devata*  
M. Devata,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

Re-computations → 67-F-111- Dwg 6U78-1 Final Design - WBL - West Approach - Abut moved 30' East.

Jan 13/69  
C. MIRZA

128+60 180 129+00 120 140 160 180 129+00

① N. AB. BRG

260

240

220

200

180

160

140

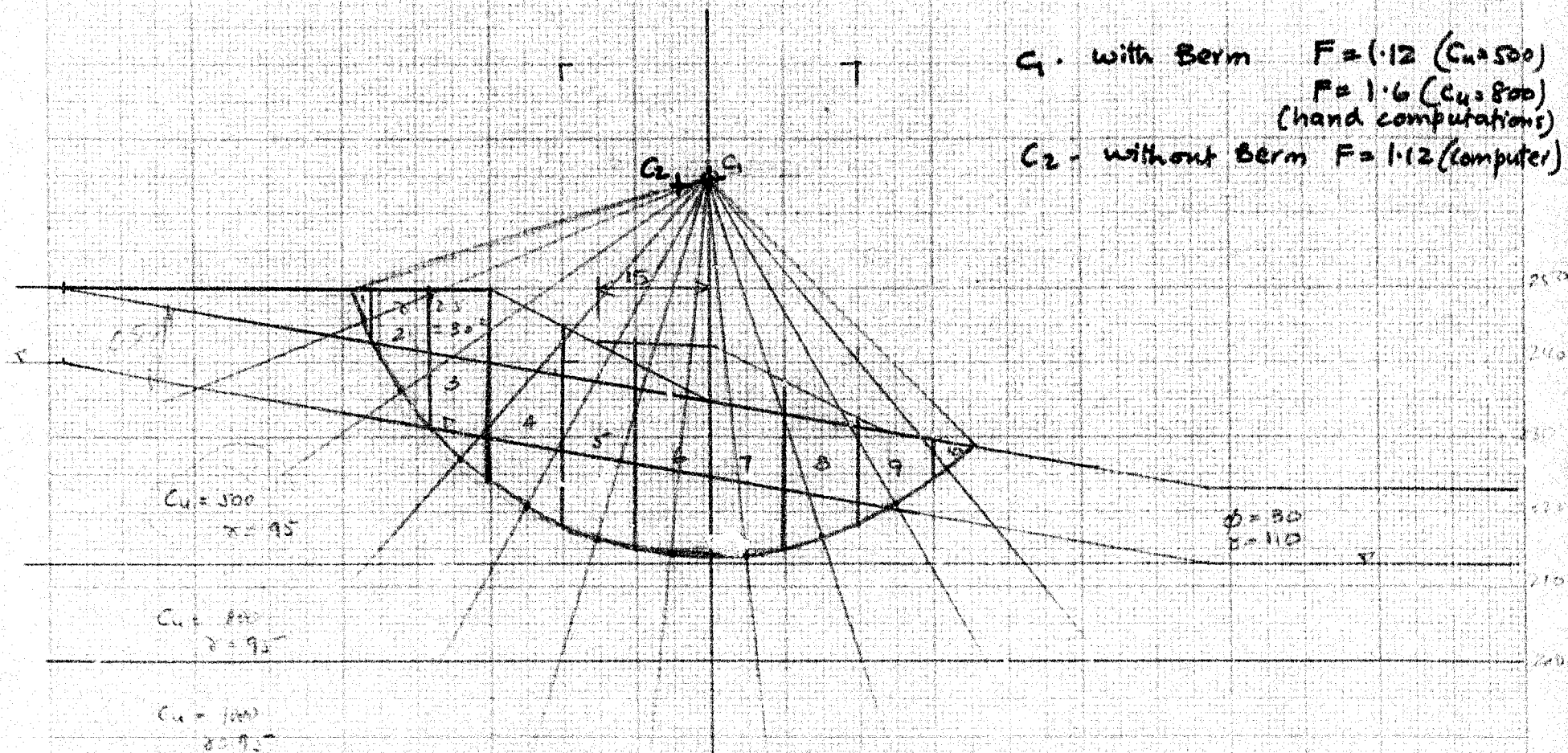
Profile along C

67 F M  
 Bear Brook  
 EBL  
 Revised Grade  
 Stability Check

Oct 26/68

C. M. A. A.

C<sub>1</sub> - with Berm  $F = 1.12$  ( $C_u = 500$ )  
 $F = 1.6$  ( $C_u = 800$ )  
 (hand computations)  
 C<sub>2</sub> - without Berm  $F = 1.12$  (computer)



Scale 1" = 20'

HEARBROOK-REVISED-EBL-LONG-STAB OCT22-68 67-F-111

RUN DATE OCT 23, 1968

SLICES	X-INIT.	Y-INIT.	DELX	DELY	TANG. R.L.	INCR.	NO. R	TENSION CRACK	NO. PTS. 3-X<	NO. PTS. 3&X<	CUT-OFF 3-X<	CUT-OFF 3&X<
30	30	-10	4.0	4.0	20.0	5.0	8	0.0	1	3	-200.0	200.0

X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD	X COORD	Y COORD
-200.00	0.0	30.00	15.00	97.00	27.00	200.00	27.00						

SECTION	X COORD	SOIL TYPE	Y COORD	WATER TABLE
1	-200.00	1	0.0	10.00
1		2	0.0	
1		3	10.00	
1		4	37.00	
1		5	50.00	
2	-58.00	1	0.0	10.00
2		2	0.0	
2		3	10.00	
2		4	37.00	
2		5	50.00	
3	97.00	1	0.0	37.00
3		2	27.00	
3		3	37.00	
3		4	37.00	
3		5	50.00	
4	200.00	1	0.0	37.00
4		2	27.00	
4		3	37.00	
4		4	37.00	
4		5	50.00	

67-F-111

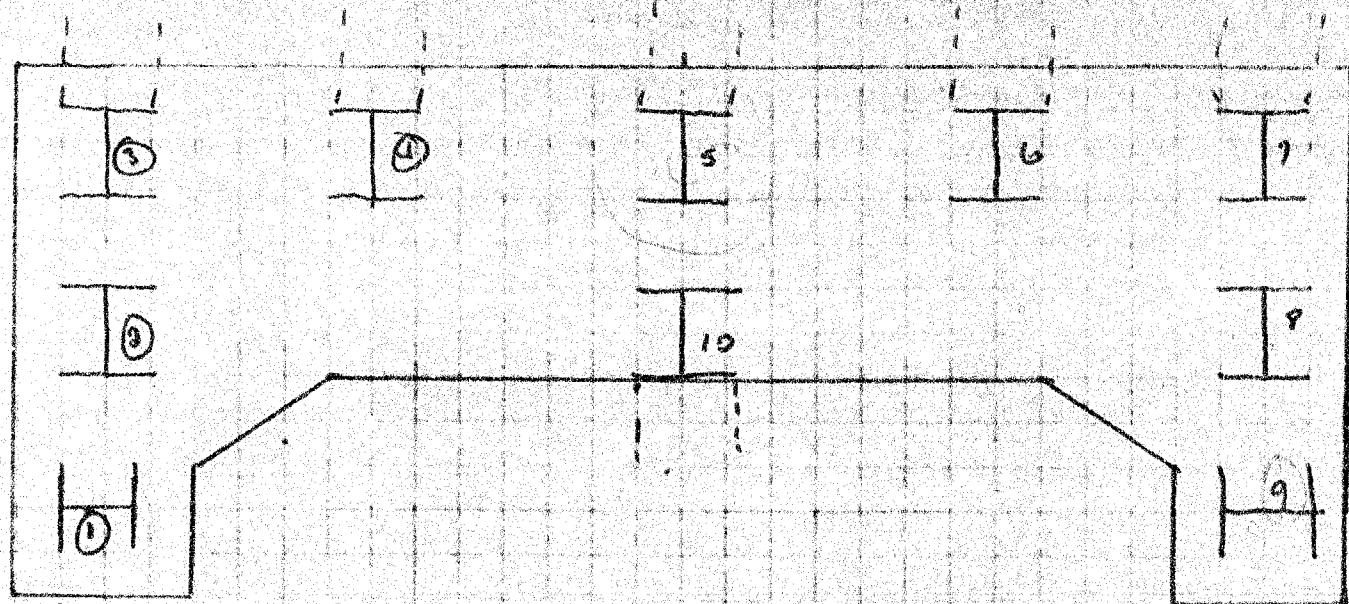
SOIL PROPERTIES				
SOIL TYPE	COHESION	PHI	BULK DENSITY	SUBMERGED DENSITY
1	0.0	30.0	125.0	63.0
2	0.0	30.0	110.0	48.0
3	500.	0.0	95.0	33.0
4	800.	0.0	95.0	33.0
5	1000.	0.0	95.0	33.0



# CRITICAL CIRCLE

RADIUS	XC	YC	F. OF S.
49.00	26.00	-14.00	1.122
45.00	26.00	-10.00	1.124
45.00	22.00	-10.00	1.126
53.00	26.00	-18.00	1.126
41.00	22.00	-6.00	1.129
49.00	22.00	-14.00	1.130
53.00	30.00	-18.00	1.134
57.00	26.00	-22.00	1.134
41.00	26.00	-6.00	1.135
49.00	30.00	-14.00	1.136

THIS JOB COMPLETED. RUNNING DATE OCT 23, 1968 TIME ELAPSED # 86 SECONDS



West Abut. FTG  
BEAR BROOK  
DISTRICT 9 OTTAWA

ATTACHED TO REPORT #1

10/11

*m*

N 15

APRIL 1961

DEPARTMENT OF HIGHWAYS

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

For A. G. STERNA

ATT: M. DEWATA

DISTRICT NO. 9

WEEK ENDING

July 6, 1969

CONTRACT NO.

69 28

CONTRACTOR

Mulligan Const. - W. O. LAFARRE LTD.

NAME OF STRUCTURE

Bene Basin

WEIGHT OF HAMMER

1.30 Ton

TYPE OF HAMMER

DOLMAG D 12

DATE DRIVEN	PILE NO.	TOTAL LENGTH	PILE DIAMETER		LENGTH IN PLACE	LENGTH IN GROUND	FALL OF HAMMER	GRAVITY HAMMER PENETRATION LAST 5 BLOWS					STEAM HAMMER PENETRATION LAST 5 SERIES OF 20 BLOWS				
			TIP	BUTT				5	4	3	2	LAST	5	4	3	2	LAST
July 2	2	118	12AP 73		107' 4"	106' 10"											1/2
	3	114			107' 5"	105' 11"											7/8
	4	114			104' 9"	103' 3"											3/4
	5	114			109' 6"	108' 0"											3/8
	1	114			107' 4"	105' 10"											3/8
	6	114			106' 7"	105' 1"											3/8
	7	114			105' 10"	104' 4"											1/2
	8	114			107' 11"	106' 5"											1/2
	9	114			103' 8"	101' 11"											1/2
	10	114			105' 9"	104' 3"											1/2

NOTE

REPORT TO BE MADE IN TRIPLICATE

NO. 1 TO BE MAILED TO DISTRICT ENGINEER

NO. 2 TO BE MAILED TO BRIDGE ENGINEER D.H.O. TORONTO

NO. 3 TO BE RETAINED BY THE INSPECTOR

SIGNED

*[Signature]*  
July 7

INSPECTOR

DATE

ATTACHED TO REPORT NO. 1



MATERIALS AND TESTING OFFICE  
FOUNDATION SECTION

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 69-28 STRUCTURE Bass Brook  
 CONTRACTOR W.D. LaSalle DESIGN LOAD OF PILE 90 Ton  
 HAMMER DETAILS: TYPE Delmag WEIGHT 1.38 Ton HEIGHT OF FALL OR ENERGY  
 TYPE OF ANVIL OR CAP Hardwood WEIGHT OF ANVIL OR CAP 0.25 Ton  
 PILE DETAILS 12 AP 73 - 2034 x 10 1/2  
 PILE NO. 4 LOCATION West Abut. Fig. DATE DRIVEN July 3/69

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.
34	1		34	26	4	68	61	6	114	76	10
34	2		34	27	5	68	62	5	114	77	11
34	3		34	28	4	68	63	7	114	78	12
34	4		34	29	4	68	64	7	114	79	10
34	5		34	30	5	68	65	7	114	80	12
34	6		34	31	5	68	66	7	114	81	11
34	7		34	32	6	68	67	7	114	82	12
34	8		34	33	4	68	68	6	114	83	7
34	9		34	34	8	68	69	5	114	84	10
34	10		68	35	8	68	60	4	114	85	11
34	11		68	36	9	68	61	6	114	86	12
34	12		68	37	8	68	62	6	114	87	12
34	13	5	68	38	11	68	63	6	114	88	13
34	14	4	68	39	11	68	64	6	114	89	15
34	15	5	68	40	8	68	65	6	114	90	18
34	16	6	68	41	8	68	66	5	114	91	21
34	17	8	68	42	6	68	67	6	114	92	39
34	18	5	68	43	7	68	68	12	114	93	40
34	19	4	68	44	5	114	69	13	114	94	41
34	20	3	68	45	6	114	70	14	114	95	51
34	21	6	68	46	6	114	71	10	114	96	68
34	22	3	68	47	5	114	72	11	114	97	69
34	23	5	68	48	5	114	73	13	114	98	89
34	24	4	68	49	4	114	74	13	114	99	106
34	25	3	68	50	5	114	75	14	114	100	119

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	24	24				32
MEASURED REBOUND IN INCHES	3/8	3/8				3/8
FINAL LENGTH OF PILE	104' 9"					FINAL CUT OFF ELEVATION

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER  
 MATERIALS & TESTING DIVISION  
 DEPARTMENT OF HIGHWAYS  
 DOWNSVIEW, ONTARIO

SIGNED

NAME (PRINT)

DATE

ATTACH SKETCH OF PILE NUMBERING SYSTEM

## DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND TESTING OFFICE  
FOUNDATION SECTION

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 69-28 STRUCTURE Bear Brook  
 CONTRACTOR W.D. LaFlamme DESIGN LOAD OF PILE 90 Ton  
 HAMMER DETAILS: TYPE DALMAN WEIGHT 1.38 T HEIGHT OF FALL OR ENERGY \_\_\_\_\_  
 TYPE OF ANVIL OR CAP HARDWOOD WEIGHT OF ANVIL OR CAP 0.25  
 PILE DETAILS 12 Bp 73 - 2 @ 34; 1 @ 46  
 PILE NO. 4 LOCATION WEST ABUT. FTG. DATE DRIVEN July 3/67

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
114	101	135		26			51			76	
114	102	151		27			52			77	
	3			28			53			78	
	4			29			54			79	
	5			30			55			80	
	6			31			56			81	
	7			32			57			82	
	8			33			58			83	
	9			34			59			84	
	10			35			60			85	
	11			36			61			86	
	12			37			62			87	
	13			38			63			88	
	14			39			64			89	
	15			40			65			90	
	16			41			66			91	
	17			42			67			92	
	18			43			68			93	
	19			44			69			94	
	20			45			70			95	
	21			46			71			96	
	22			47			72			97	
	23			48			73			98	
	24			49			74			99	
	25			50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	24	24				32
MEASURED REBOUND IN INCHES	3/8	3/8				5/8
FINAL LENGTH OF PILE	109.9"					FINAL CUT OFF ELEVATION 236.00

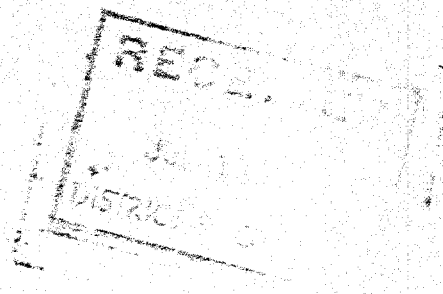
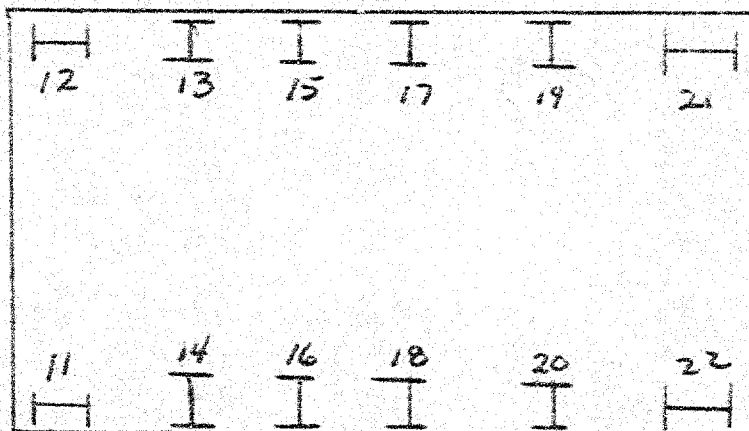
REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER  
 MATERIALS & TESTING DIVISION  
 DEPARTMENT OF HIGHWAYS  
 DOWNSVIEW, ONTARIO

SIGNED J. Hall  
 NAME (PRINT) JAMES HALL  
 DATE July 7

ATTACH SKETCH OF PILE NUMBERING SYSTEM

69-28-8

Pier № 1



## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 90730-20WEEK ENDING JULY 11, 1962CONTRACT NO. 69-28CONTRACTOR G. MULLIGAN - W. D. LAFLAMME (SUN)NAME OF STRUCTURE BEAR BRIDGE

WEIGHT OF HAMMER			TYPE OF HAMMER																
1.38 TON			DALMAG 212																
DATE DRIVEN	PILE NO.	TOTAL LENGTH	PILE DIAMETER		LENGTH IN PLACE	LENGTH IN GROUND	FALL OF HAMMER	PENETRATION LAST 5 BLOWS					STEAM HAMMER PENETRATION LAST 5 SERIES OF 20 BLOWS						
			TIP	BUTT				5	4	3	2	1st	5	4	3	2	LAST		
JUL 7	7	114	12	BP 74	105'10"	104'4"													
	6	114			106'7"	105'1"													
	9	114			103'5"	101'11"													
	8	114			107'11"	106'5"													
8	5	114			109'6"	107'0"													
9	11	100			95'0"	93'6"													
	12	100			95'5"	93'11"													
	14	100			95'0"	93'6"													
	16	100			94'6"	93'0"													
10	13	100			96'6"	95'0"													
	15	99			95'6"	94'0"													
	17	100			95'4"	94'0"													
	19	100			95'4"	96'10"													
11	27	100			93'9"	96'8"													
	18	100			93'9"	92'3"													
	20	100			95'4"	93'10"													
	21	100			92'4"	93'10"													

## NOTE

REPORT TO BE MADE IN TRIPLICATE

NO. 1 TO BE MAILED TO DISTRICT ENGINEER

NO. 2 TO BE MAILED TO BRIDGE ENGINEER D.H.O. TORONTO

NO. 3 TO BE RETAINED BY THE INSPECTOR

x Check figures &amp; calculations

SIGNED

DATE

*[Signature]*  
JULY 14, 1962

INSPECTOR

ATTACHED TO REPORT NO.



MATERIALS AND TESTING OFFICE  
FOUNDATION SECTION

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 69-76 STRUCTURE Pile BCONTRACTOR M. J. ... DESIGN LOAD OF PILE 30 THAMMER DETAILS: TYPE ... WEIGHT 131 T HEIGHT OF FALL OR ENERGYTYPE OF ANVIL OR CAP ... WEIGHT OF ANVIL OR CAP 175 TPILE DETAILS 12 B-76 20 50PILE NO. 14 LOCATION Pile 1 DATE DRIVEN July 9, 1976

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
	1			26			51			76	
	2			27			52			77	
	3			28			53			78	
	4			29			54			79	
	5			30			55			80	
	6			31			56			81	
	7			32			57			82	
	8			33			58			83	
	9			34			59			84	
	10			35			60			85	
	11			36			61			86	
	12			37			62			87	
	13			38			63			88	
	14			39			64			89	
	15			40			65			90	
	16			41			66			91	
	17			42			67			92	
	18			43			68			93	
	19			44			69			94	
	20			45			70			95	
	21			46			71			96	
	22			47			72			97	
	23			48			73			98	
	24			49			74			99	
	25			50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH						
MEASURED REBOUND IN INCHES						
FINAL LENGTH OF PILE	95.0			FINAL CUT OFF ELEVATION		

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER  
MATERIALS & TESTING DIVISION  
DEPARTMENT OF HIGHWAYS  
DOWNSVIEW, ONTARIOSIGNED [Signature]NAME (PRINT) J. F. ...DATE July 9, 1976DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Pier # 2.

24	25	27	29	31	33
H	I	I	I	I	H

23	26	28	30	32	34
H	I	I	I	I	H

## DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND TESTING OFFICE  
FOUNDATION SECTION

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 69-28 STRUCTURE BEAR BRIDGECONTRACTOR W D L. L. L. LTD. DESIGN LOAD OF PILE 90 TONHAMMER DETAILS: TYPE DAIRYAG 0.2 WEIGHT 1.38 HEIGHT OF FALL OR ENERGYTYPE OF ANVIL OR CAP HARROW WEIGHT OF ANVIL OR CAP .25 TONPILE DETAILS 12 B P 74PILE NO. 23 LOCATION Pier No 2 DATE DRIVEN July 16 1966

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.
49	1		49	26		98	51	2	98	76	54
	2			27			52	2		77	58
	3			28			53	3		78	56
	4			29			54	5		79	47
	5			30			55	2		80	48
	6			31			56	3		81	46
	7			32			57	3		82	52
	8			33			58	2		83	49
	9			34			59	3		84	48
	10			35			60	4		85	52
	11			36			61	3		86	56
	12			37			62	3		87	61
	13			38			63	2		88	69
	14			39			64	3		89	52
	15			40			65	4		90	58
	16			41			66	3		91	176
	17			42			67	3		92	
	18			43			68	4		93	
	19			44			69	3		94	
	20			45			70	3		95	
	21			46			71	6		96	
	22			47			72	10		97	
	23			48			73	16		98	
	24			49			74	20		99	
	25		98	50			75	57		100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH						
MEASURED REBOUND IN INCHES						
FINAL LENGTH OF PILE	92'6"			FINAL CUT OFF ELEVATION 221.00		

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER  
MATERIALS & TESTING DIVISION  
DEPARTMENT OF HIGHWAYS  
DOWNSVIEW, ONTARIOSIGNED [Signature]  
NAME (PRINT) JAMES F. [unclear]  
DATE July 16 1966

ATTACH SKETCH OF PILE PLACEMENT



PIER # 3.

36	37	39	41	43	45
H	I	I	I	I	H

35	38	40	42	44	46
H	I	I	I	I	H

MATERIALS AND TESTING OFFICE  
FOUNDATION SECTION

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 61-26 STRUCTURE 1302250012  
 CONTRACTOR W.D. Kaufmann DESIGN LOAD OF PILE 30 Ton  
 HAMMER DETAILS: TYPE Danbury D-2 WEIGHT 130 HEIGHT OF FALL OR ENERGY  
 TYPE OF ANVIL OR CAP Hardwood WEIGHT OF ANVIL OR CAP .25 Ton  
 PILE DETAILS 12 63 74  
 PILE NO. 36 LOCATION Pier 4 DATE DRIVEN July 18/69

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
45	1		45	26		50	31	3	90	76	20
	2			27			32			77	25
	3			28			33			78	26
	4			29			34			79	28
	5			30			35			80	28
	6			31			36			81	28
	7			32			37			82	28
	8			33			38			83	28
	9			34			39			84	28
	10			35			40	5		85	28
	11			36			41	5		86	28
	12			37			42	5		87	28
	13			38			43	5		88	28
	14			39			44	5		89	28
	15			40			45	5		90	28
	16			41			46	5		91	28
	17			42			47	5		92	28
	18			43			48	5		93	28
	19			44			49	5		94	28
	20			45			50	5		95	28
	21			46			51	5		96	28
	22			47			52	5		97	28
	23			48			53	5		98	28
	24			49			54	5		99	28
✓	25		✓	50	3	✓	55	30		100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH						
MEASURED REBOUND IN INCHES						
FINAL LENGTH OF PILE	FINAL CUT OFF ELEVATION					

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER  
 MATERIALS & TESTING DIVISION  
 DEPARTMENT OF HIGHWAYS  
 DOWNSVIEW, ONTARIO

SIGNED

NAME (PRINT)

DATE

DEFECTS IN NEGATIVE DUE TO  
 CONDITION OF ORIGINAL DOCUMENT

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. \_\_\_\_\_

WEEK ENDING \_\_\_\_\_ CONTRACT NO. \_\_\_\_\_

CONTRACTOR Milliers Const (W.O. Laflamme)NAME OF STRUCTURE ISLEA GEAR

WEIGHT OF HAMMER				TYPE OF HAMMER															
138				DALmag D 12															
DATE DRIVEN	PILE NO.	TOTAL LENGTH	PILE DIAMETER		LENGTH IN PLACE	LENGTH IN GROUND	FALL OF HAMMER	GRAVITY HAMMER PENETRATION LAST 5 BLOWS					STEAM HAMMER PENETRATION LAST 5 SERIES OF 20 BLOWS						
			TIP	BUTT				5	4	3	2	LAST	5	4	3	2	LAST		
July 14	32	98.0	120p	74	92.0	90.6													
"	30	98.0	"	"	88.9	87.3													
"	31	98.0	"	"	93.4	91.10													
"	33	98.0	"	"	90.3	88.9													
"	34	98.0	"	"	90.4	88.10													
15	26	98.0	"	"	89.5	87.11													
"	27	98.0	"	"	92.10	91.4													
"	28	98.0	"	"	89.4	87.10													
"	29	98.0	"	"	90.4	88.10													
July 16	25	98.0	"	"	92.10	91.4													
	23	98.0	"	"	92.6	91.0													NIL
	24	95.0	"	"	93.2	91.8													
July 17	37	90.4	"	"	87.1	85.7													
	39	90.5	"	"	88.5	86.11													
	38	90.4	"	"	87.9	86.8													
	40	90.4	"	"	88.4	86.10													
July 18	35	90.9	"	"	88.5	86.11													
	36	90.2	"	"	87.0	85.6													NIL
	50	92.0	"	"	90.7	89.1													
	52	92.0	"	"	90.6	89.0													

## NOTE

REPORT TO BE MADE IN TRIPPLICATE

NO. 1 TO BE MAILED TO DISTRICT ENGINEER

NO. 2 TO BE MAILED TO BRIDGE ENGINEER D.H.O. TORONTO

NO. 3 TO BE RETAINED BY THE INSPECTOR

SIGNED

*Alfred Smith*

INSPECTOR

DATE

*July 21, 1961*

ATTACHED TO REPORT NO.

*5*

I<sub>48</sub> I<sub>49</sub> I<sub>51</sub> I<sub>53</sub> I<sub>55</sub> I<sub>57</sub>

I<sub>47</sub> I<sub>50</sub> I<sub>52</sub> I<sub>54</sub> I<sub>56</sub> I<sub>58</sub>

Pier #4

I<sub>65</sub> I<sub>64</sub> I<sub>63</sub> I<sub>62</sub> I<sub>61</sub>

I<sub>66</sub> I<sub>68</sub> I<sub>60</sub>

I<sub>67</sub> I<sub>59</sub>

EAST ABUT.

BEAR BRACK  
WEEK ENDING JULY 25  
REPORT # 2

J. Hawerty



APRIL 1961

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO 9

WEEK ENDING July 25, 1969 CONTRACT NO. 69

CONTRACTOR W.D. LAFLAMME LTD.

NAME OF STRUCTURE **PEARL BOND**

WEIGHT OF HAMMER			TYPE OF HAMMER																
1.38			DALMAC D12.																
DATE DRIVEN	PILE NO.	TOTAL LENGTH	PILE DIAMETER		LENGTH IN PLACE	LENGTH IN GROUND	FALL OF HAMMER	GRAVITY HAMMER PENETRATION LAST 5 BLOWS					STEAM HAMMER PENETRATION LAST 5 SERIES OF 20 BLOWS						
			TIP	BUTT				5	4	3	2	LAST	5	4	3	2	LAST		
July 21	51	92	12BP	74	90' 7"	89' 1"													N.L.
	69	92			89' 9"	88' 3"													N.L.
	48	92			89' 5"	88' 11"													1/8
	47	92			89' 5"	88' 11"													1/8
22	41	91' 4"			90' 4"	86' 10"													1/8
	42	91' 4"			87' 11"	86' 5"													1/4
	43	91' 4"			88' 8"	87' 2"													1/4
	44	91' 4"			89' 2"	87' 8"													N.W.
	45	91' 4"			89' 0"	87' 6"													N.W.
	46	91' 4"			90' 7"	89' 1"													N.W.
23	57	91' 4"			90' 11"	89' 5"													N.W.
	58	91' 4"			90' 11"	89' 5"													N.W.
	55	91' 4"			90' 10"	89' 4"													N.W.
	56	91' 4"			89' 9"	88' 3"													1/8
	54	91' 8"			89' 5"	87' 11"													1/4
	53	91' 8"			90' 0"	88' 6"													1/4
24	67	114' 0"			105' 0"	103' 6"													1/4
	66	107' 0"			104' 0"	102' 6"													N.W.
	65	111' 0"			109' 5"	108' 3"													1/4
25	64	111' 0"			108' 11"	107' 6"													1/4

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

NOTE REPORT TO BE MADE IN TRIPPLICATE  
NO. 1 TO BE MAILED TO DISTRICT ENGINEER  
NO. 2 TO BE MAILED TO BRIDGE ENGINEER O.N.O. TORONTO  
NO. 3 TO BE RETAINED BY THE INSPECTOR

1515

DATE \_\_\_\_\_

ATTACHED TO REPORT NO.

## DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND TESTING OFFICE

## FOUNDATION SECTION

## BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 69-28 STRUCTURE BEAR BRIDGECONTRACTOR W. D. LAFLAMME DESIGN LOAD OF PILE 90 TONHAMMER DETAILS: TYPE DOLMAG D-2 WEIGHT 1.38 HEIGHT OF FALL OR ENERGYTYPE OF ANVIL OR CAP HARD WOOD WEIGHT OF ANVIL OR CAP .25PILE DETAILS 12 BP 74PILE NO. 55 LOCATION PIER # 4 DATE DRIVEN JULY 23, 69

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.
45' 8"	1		45' 8"	26		91' 4"	61	5	91' 4"	76	15
	2			27			62	5		77	15
	3			28			63	5		78	20
	4			29			64	5		79	20
	5			30			65	5		80	30
	6			31			66	6		81	30
	7			32			67	6		82	30
	8			33			68	6		83	30
	9			34			69	6		84	30
	10			35			70	6		85	30
	11			36			71	6		86	33
	12			37			72	6		87	33
	13			38			73	6		88	30
	14			39			74	6		89	70
	15			40			75	6		90	30
	16			41			76	5		91	30
	17			42			77	5		92	
	18			43			78	5		93	
	19			44	3		79	5		94	
	20			45	4		80	5		95	
	21		35' 2"	46	4		81	5		96	
	22		91' 4"	47	4		82	5		97	
	23			48	4		83	5		98	
	24			49	4		84	5		99	
	25			50	4		85	5		100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH						
MEASURED REBOUND IN INCHES						
FINAL LENGTH OF PILE	FINAL CUT OFF ELEVATION <u>220.00</u>					

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER  
MATERIALS & TESTING DIVISION  
DEPARTMENT OF HIGHWAYS  
DOWNSVIEW, ONTARIO

SIGNED \_\_\_\_\_

NAME (PRINT) \_\_\_\_\_

DATE 10/23/69

DEFECTS IN - NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

ATTACHMENT OF PILE DRIVING RECORD



FORMERLY PL-00-77

APRIL 1951

# BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9

WEEK ENDING Aug 1, 1969 CONTRACT NO. 69

CONTRACTOR W. D. KAELAMME LTD

NAME OF STRUCTURE BEAR BROOK

WEIGHT OF HAMMER			TYPE OF HAMMER																					
1.38 TONS			DALLMAN D-12																					
DATE DRIVEN	PILE NO.	TOTAL LENGTH	PILE DIAMETER		LENGTH IN PLACE	LENGTH IN GROUND	FALL OF HAMMER	GRAVITY HAMMER PENETRATION LAST 5 BLOWS					STEAM HAMMER PENETRATION LAST 5 SERIES OF 20 BLOWS											
			TIP	BUTT				5	4	3	2	LAST	5	4	3	2	LAST							
JULY 28	68	111	12	13	76	106'6"	105'0"																	
	62	114				110'4"	108'11"										1/8	1/8	1/8					
	61	117				109'7"	108'1"										1/4	1/4	1/4					
	60	114				108'2"	104'0"																	
	59	112				104'6"	103'0"																	

1415

COMPLETES

BEAR

BROCK STREET

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

NOTE REPORT TO BE MADE IN TRIPLICATE  
NO. 1 TO BE MAILED TO DISTRICT ENGINEER  
NO. 2 TO BE MAILED TO BRIDGE ENGINEER D.H.O. TORONTO  
NO. 3 TO BE RETAINED BY THE INSPECTOR

SIGNED

DATE \_\_\_\_\_

ATTACHED TO REPORT

1955



total length

EBL

West abut.

Pile #5

~~108~~ in ground.

Pile #9

~~102~~ 103.4

Station

433+30 #5

433+20 #9

cut off: 236.00

Pier #1

Pile #11

95.0

~~83.5~~

Pile #8

107.8

~~106.4~~

cut off 223.0

Sta 433+90

Pier #2

Pile #28

89.3

~~87.8~~

#31

~~91.8~~

cut off 221.0

Sta 434+50

~~93.4~~

Pier #3

#36

~~83.5~~ 87.0

#39

~~86.9~~ 88.4 216.5

Sta 435+20

Pier #4

#43

88.7

~~87.2~~

cut off 220.0

Sta 435+90

#51

~~89.1~~

90.6

East Abut.

#66

~~102.5~~ 104.0

#64

~~107.3~~

108.9

cut off 238.0

Sta 436+50

#67-F-111

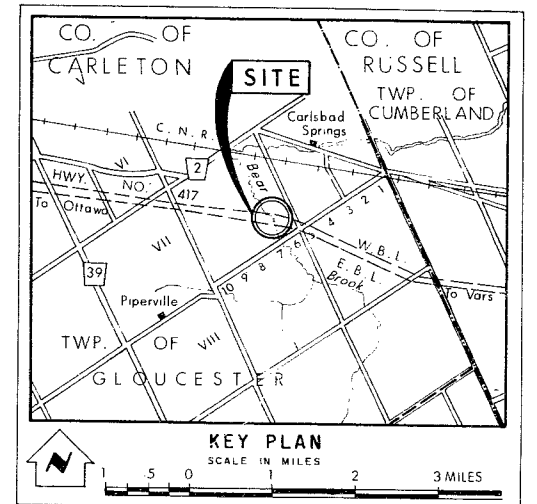
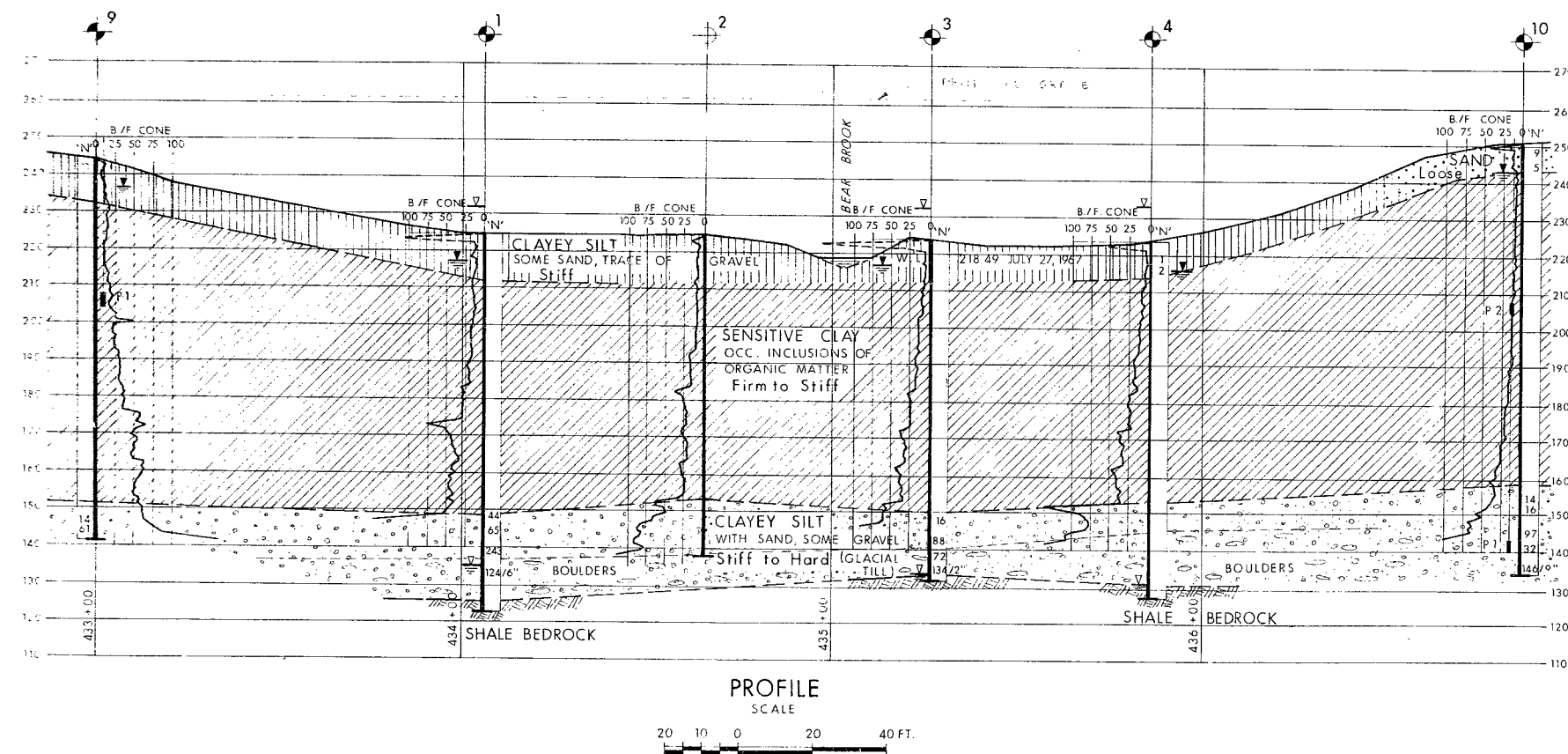
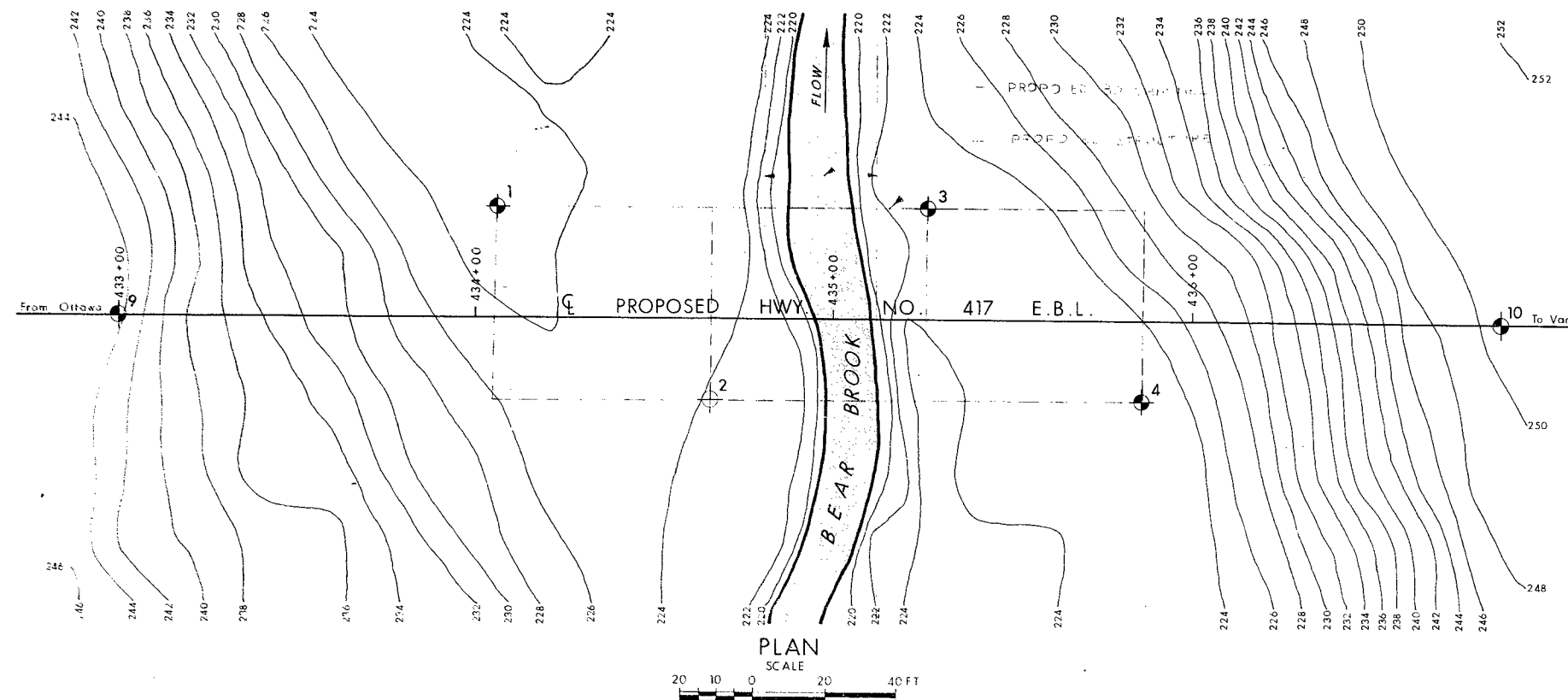
W.P. #34-66-05

W.P. #34-66-14

HWY. #417

BEAR BROOK

BRIDGE



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation		
	Piezometer		Head
			Arterial Water
			Encountered
NO.	ELEVATION	STATION	OFFSET
1	223.5	434+06	31' LT
2	223.1	434+66	23' RT
3	223.9	435+26	31' LT
4	223.1	435+86	23' RT
9	244.0	433+00	CL
10	250.5	436+80	CL

**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

**BEAR BROOK**

KING'S HIGHWAY NO. 417 E.B.L. DIST. NO. 9  
CO. CARLETON  
TWP. GLOUCESTER LOT 6 CON. VII

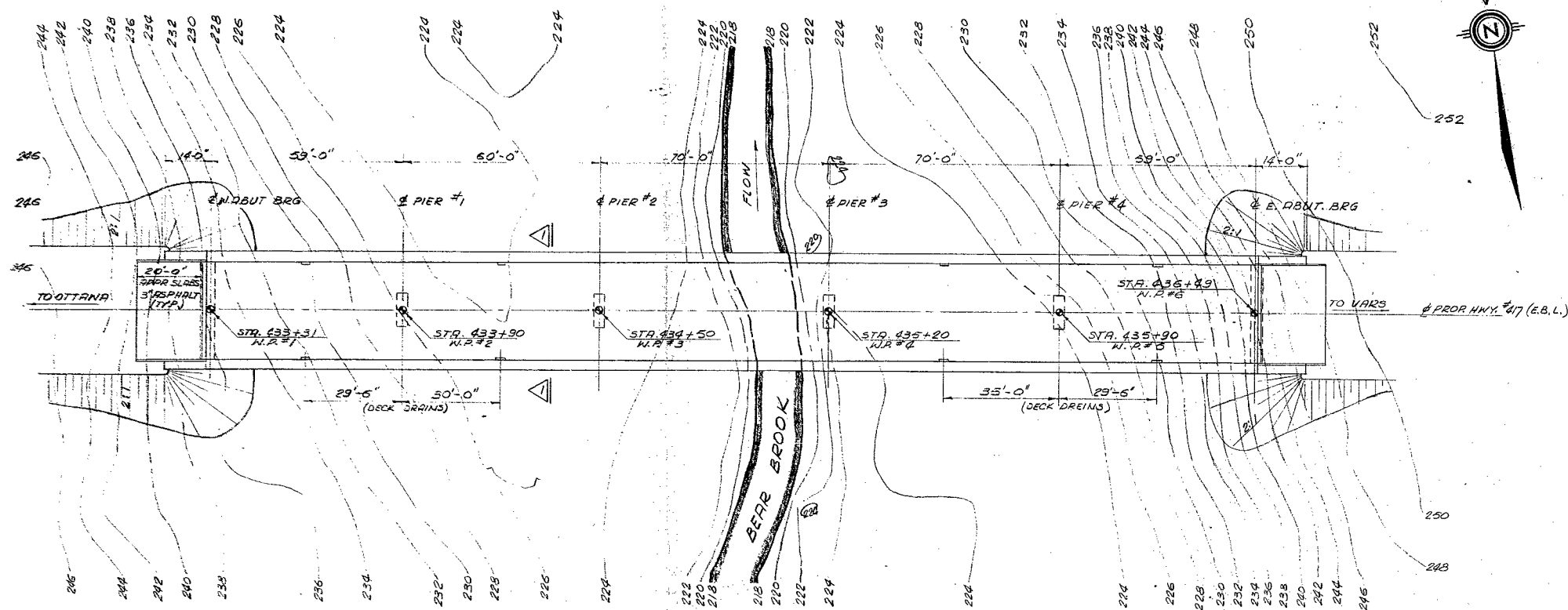
**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D B.D. CHECKED <i>[Signature]</i>	W.P. NO. 34 - 66-05	W.B.T. DRAWING NO.
DRAWN G.P. CHECKED <i>[Signature]</i>	JOB NO. 67 - F-111	67-F-111A
DATE FEB. 19 1968	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT NO.	

REF. NO. E-4642-1

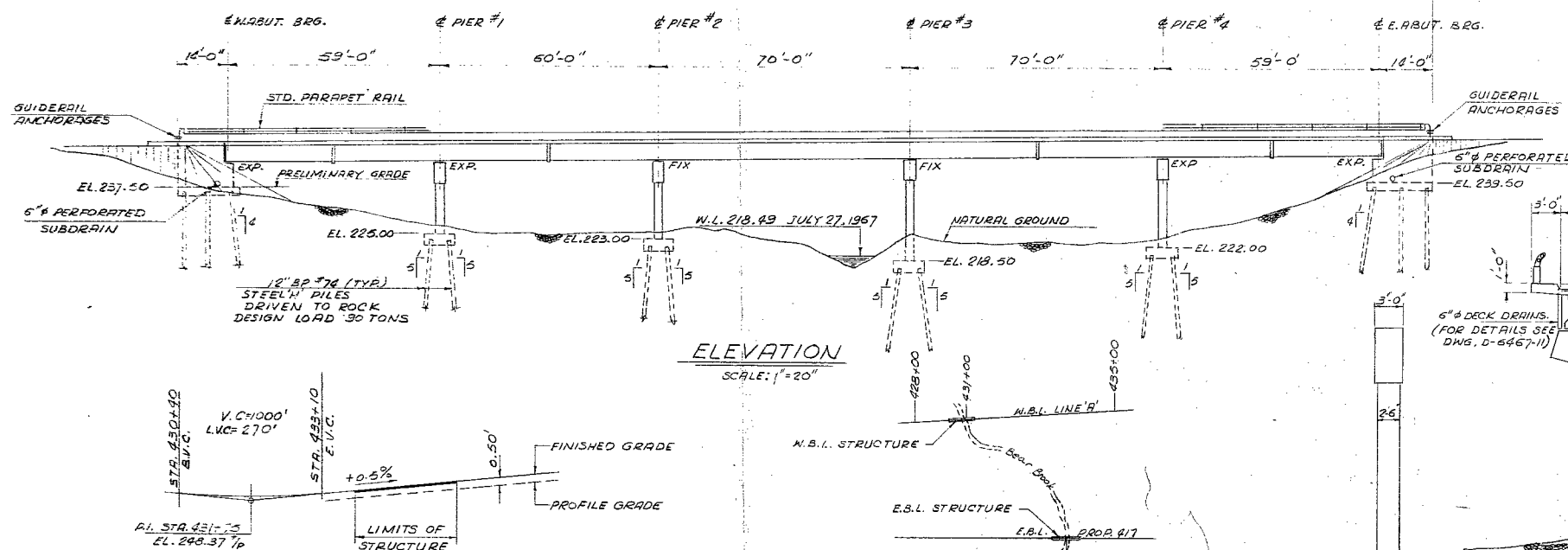




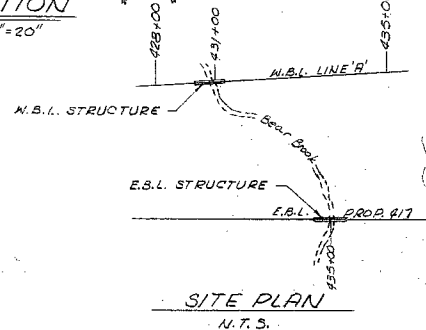


PLAN  
SCALE: 1" = 20'-0"

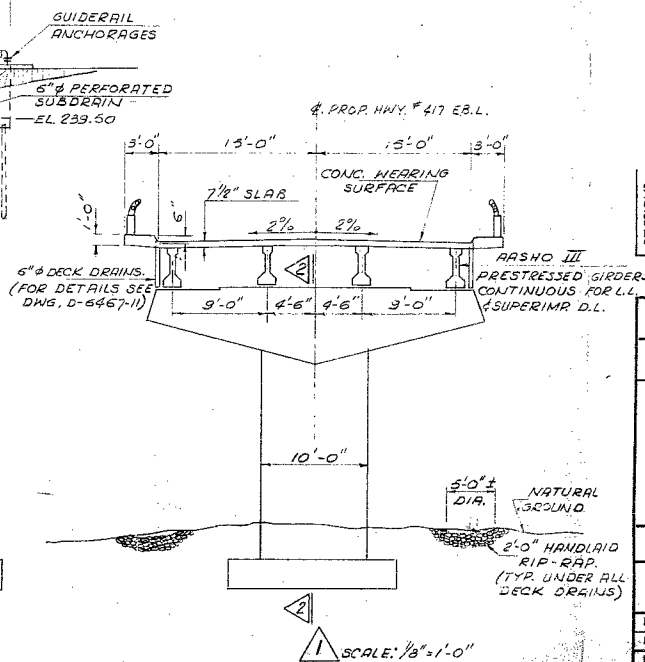
B.M. 245.34  
GEOLOGIC DATUM  
N. 44° W. IN W. ROOT OF 1' ELM  
114' RT. OF 433+24 (E.B.L.)



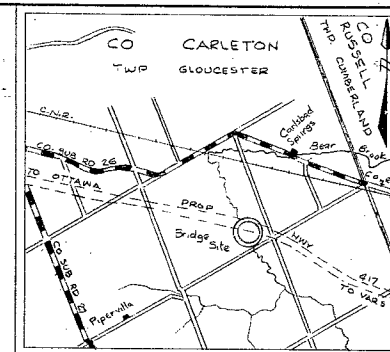
ELEVATION  
SCALE: 1" = 20'



SITE PLAN  
N.T.S.



SCALE: 1/8" = 1'-0"



KEY PLAN  
SCALE - 1 INCH = 1 MILE

#### NOTES:

##### 1. CLASS OF CONCRETE:

PRECAST MEMBERS - 5000 P.S.I.  
DECK, CURBS & PARAPET WALLS - 4000 P.S.I.  
REMAINDER - 3000 P.S.I.

##### 2. CLEAR COVER ON REINFOR. STEEL:

FTGS. ABUTTS & PIERS	CURBS	PARAPET WALLS	DECK
3"	2"	1 1/2"	TOP - 1 1/2" BOT. - 1"

##### 3. CONSTRUCTION NOTES:

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF  $\pm 1/8"$ .  
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

#### LIST OF DRAWINGS

1. GENERAL PLAN
2. BOREHOLE LOCATIONS & SOIL STRATA
3. FOOTING LAYOUT & REINFORCEMENT
4. ABUTMENTS & WINGWALLS
5. PIERS
6. PRESTRESSED GIRDERS & BEARINGS
7. DECK DETAILS & ELEVATIONS
8. PARAPET WALL DETAILS
9. STD. STEEL PARAPET RAIL
10. APPROACH SLABS
11. STANDARD DETAILS

PROTECT PILE CAP PIER 3 WITH  
RIP RAP COVER ON STREAM  
BANK



REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO  
BRIDGE DIVISION

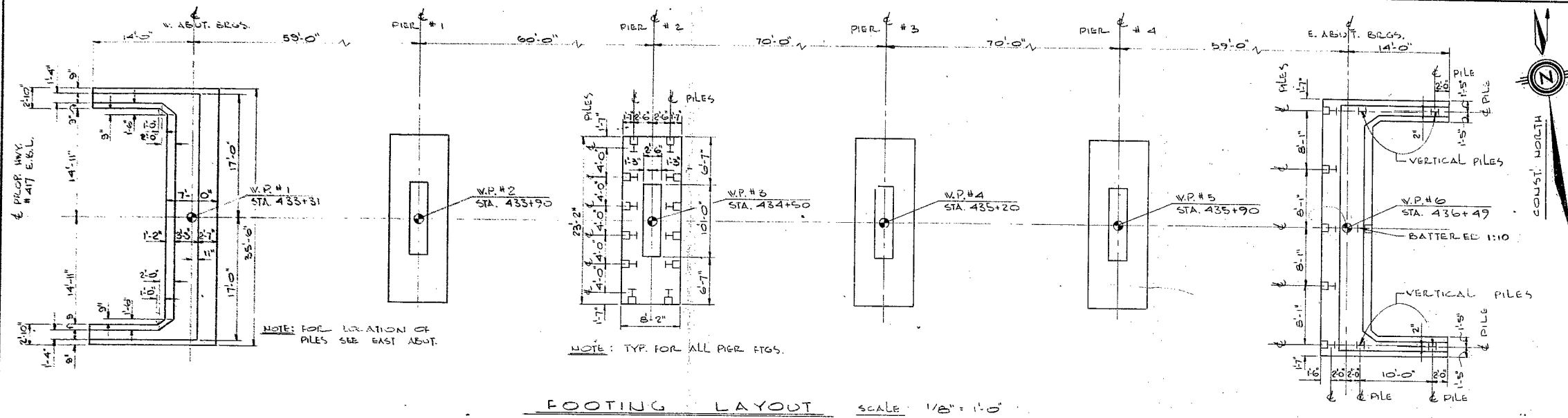
67-F-111

**BEAR BROOK BRIDGE**  
(E.B.L. STRUCTURE)

KING'S HIGHWAY No. 417 (E.B.L.) DIST. No. 9  
CO. CARLETON  
TWP. GLOUCESTER LOT 5 CON. VII

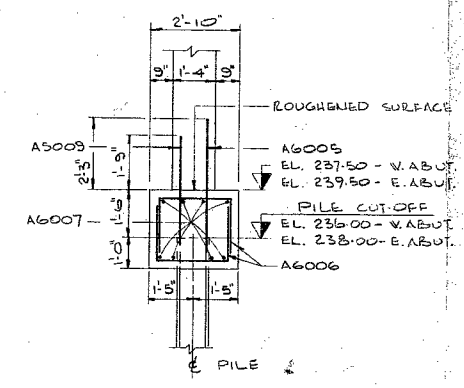
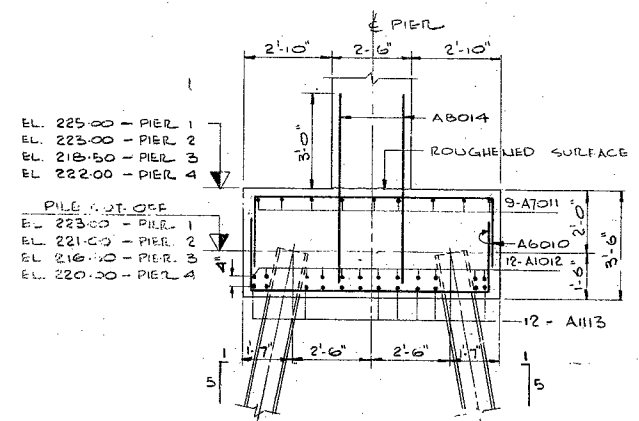
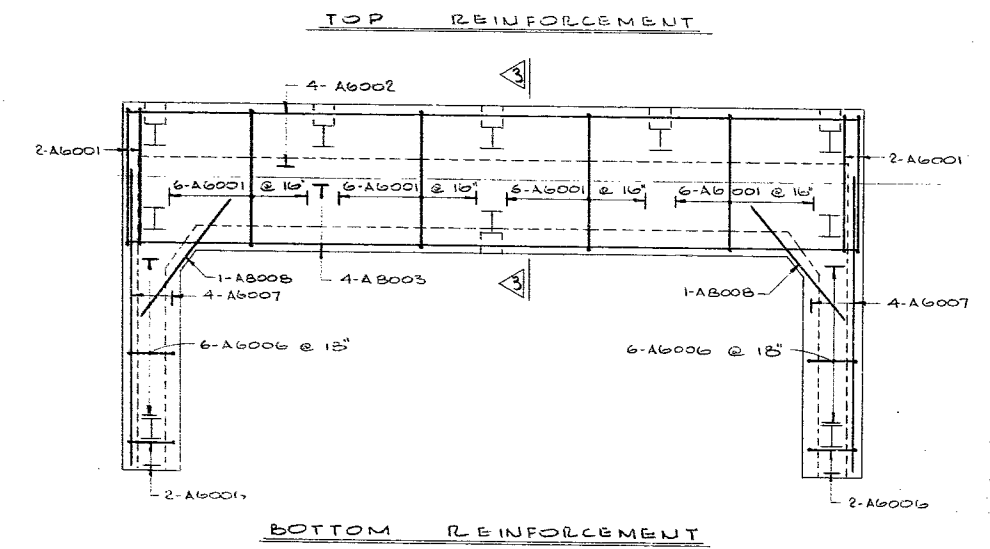
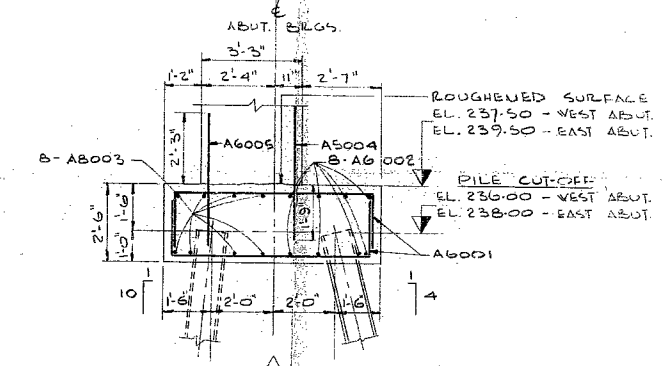
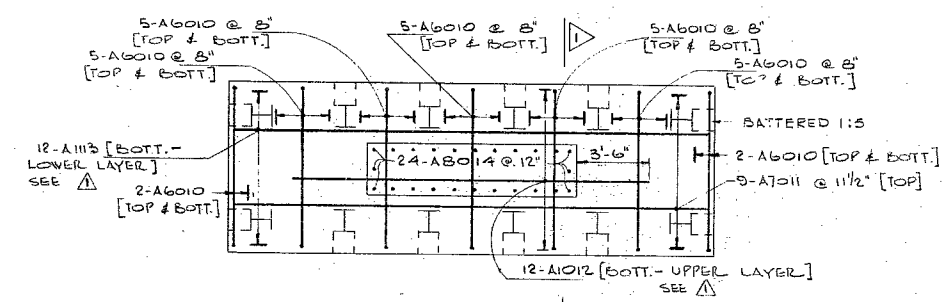
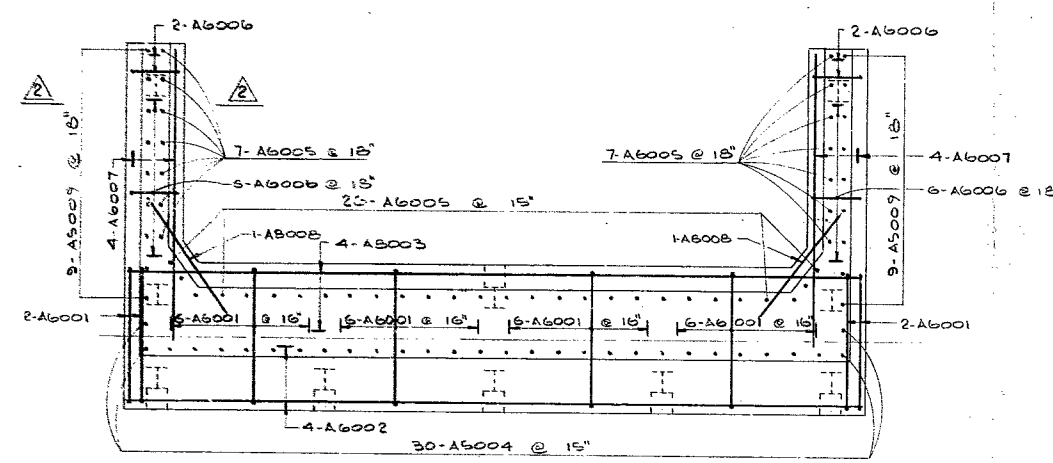
GENERAL PLAN

APPROVED	BRIDGE ENGINEER	CONTRACT No.	SITE No. 3-255	W.P. No. 33-66-05
DESIGN J.S.	CHECK S.B.D.			
DRAWING B.S.	CHECK S.B.D.			
DATE NOV. 1968	LOADING 1520-44	DRAWING No. D-6467-1		



STEEL H-PILE DATA			
LOCATION	NO.	LENGTH	TYPE
WEST ABUT.	10	114'-0"	
PIER 1	12	100'-0"	
PIER 2	12	97'-0"	H-PILES
PIER 3	12	88'-0"	12Bx74
PIER 4	12	92'-0"	
EAST ABUT.	10	111'-0"	
DESIGN LOAD - 90 TONS PER PILE			

NOTE:  
ALL PILES TO BE DRIVEN TO PRACTICAL REFUSAL.



PLAN OF ABUTMENT FOOTINGS  
SCALE: 1/4" = 1'-0"

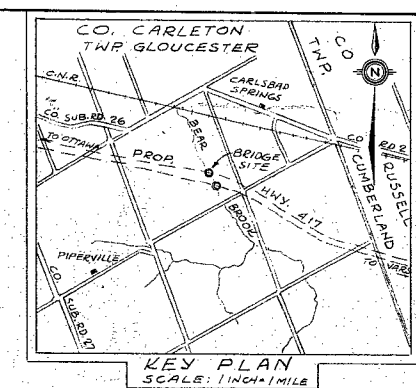
SCALE: 3/8" = 1'-0"

SCALE: 3/8" = 1'-0"



REVISIONS		DATE		BY		DESCRIPTION	
DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION 67-F-111 <b>BEAR BROOK BRIDGE</b> E.B.L. STRUCTURE KING'S HIGHWAY No. 417 E.B.L. DIST. No. 9 CO. CARLETON TWP. GLOUCESTER LOT 6 CON. VII <b>FOOTING LAYOUT &amp; REINFORCEMENT</b> APPROVED _____ DESIGN J.S. CHECK S.B.D. CONTRACT No. _____ DRAWING P CHECK S.B.D. DRAWING No. D-6467-3 DATE NOV. 1965 LOADING H.S.20-44							





# LIST OF DRAWINGS

1. GENERAL PLAN
2. BOREHOLE LOCATIONS & SOIL STRATA
3. FOOTINGS LAYOUT & REINFORCEMENT
4. ABUTMENTS & WINGWALLS
5. PIERS
6. PRESTRESSED GIRDERS & BEARINGS
7. DECK DETAILS & ELEVATIONS
8. PARAPET WALL DETAILS
9. STD. STEEL PARAPET RAIL
10. APPROACH SLABS
11. STANDARD DETAILS



DEPARTMENT OF HIGHWAYS ONTARIO  
BRIDGE DIVISION

67-F-111

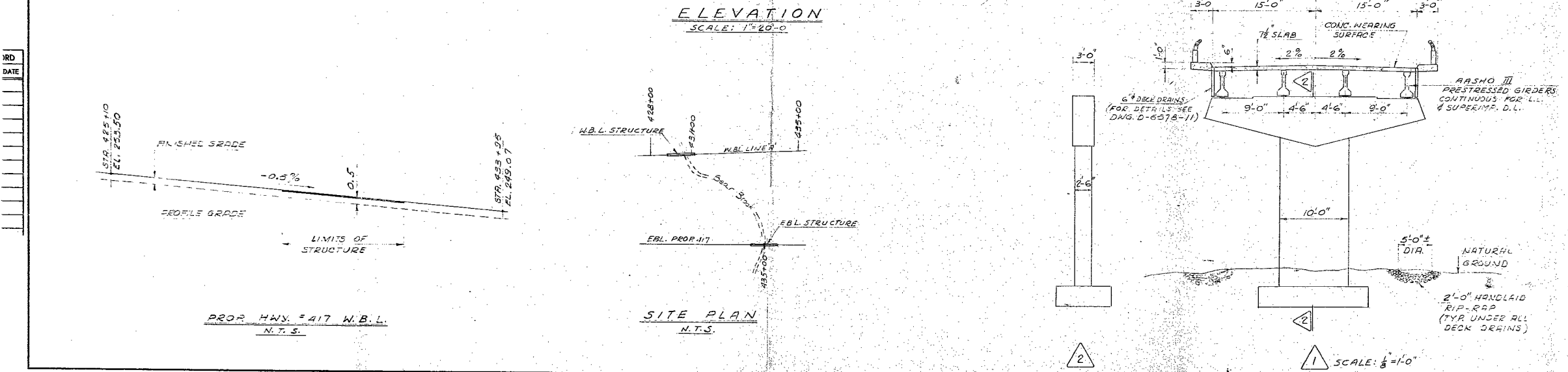
BEAR BROOK BRIDGE  
W. B. L. STRUCTURE  
1 MILE SOUTH OF CARLSBAD SPRINGS

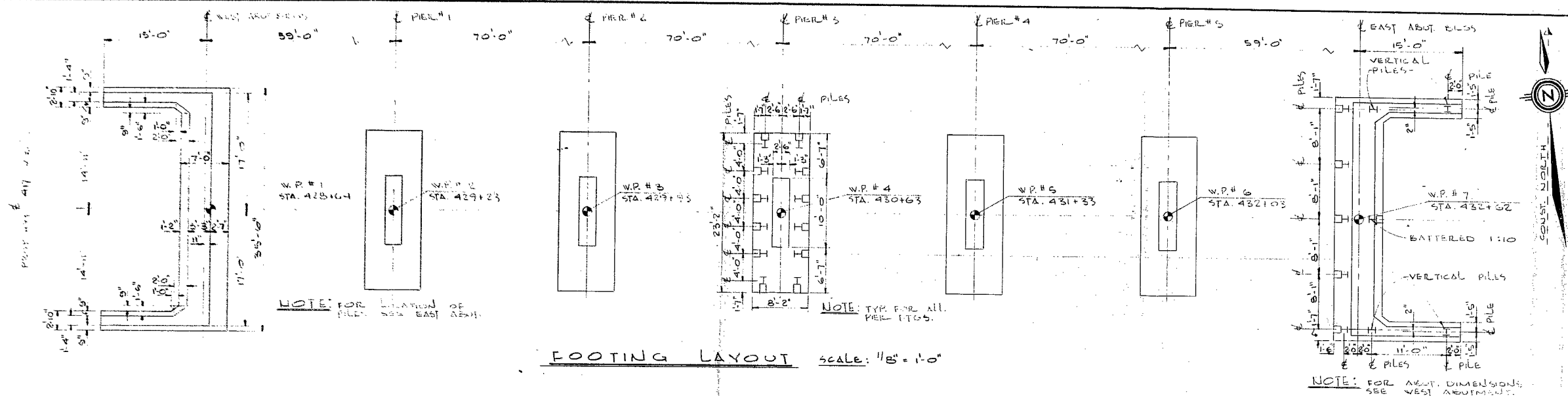
KING'S HIGHWAY No. 417 DIST. No. 9

CO. CARLETON

TWP. GLOUCESTER LOT 6 CON. VI

GENERAL PLAN				
APPROVED			SITE No. 3-266	W.F. No. 34-66-14
BRIDGE ENGINEER				
DESIGN	J. J.	CHECK	S. D.	CONTRACT No.
DRAWING	S. J. B. S.	CHECK	S. D.	
DATE	DEC. 68	LOADING	4520-44	DRAWING No. D-6578-1

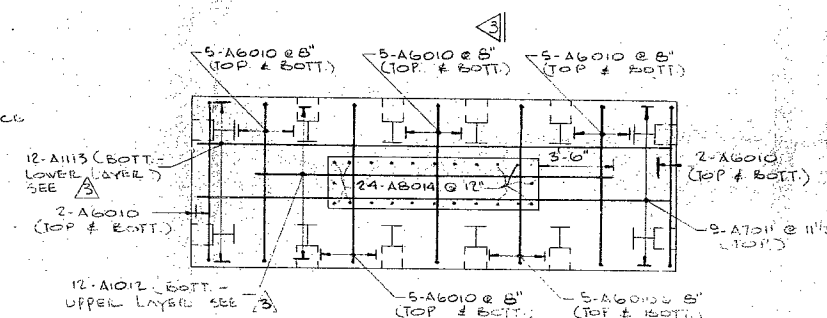
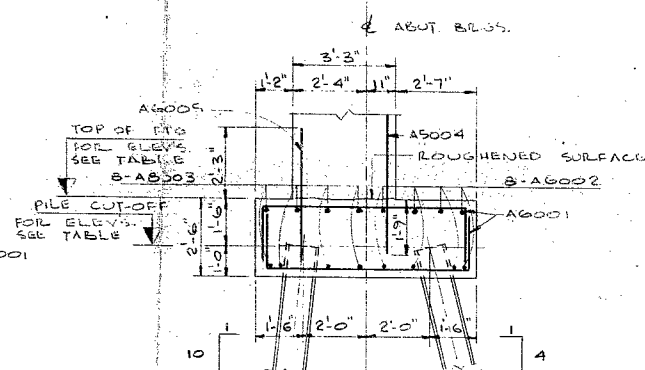
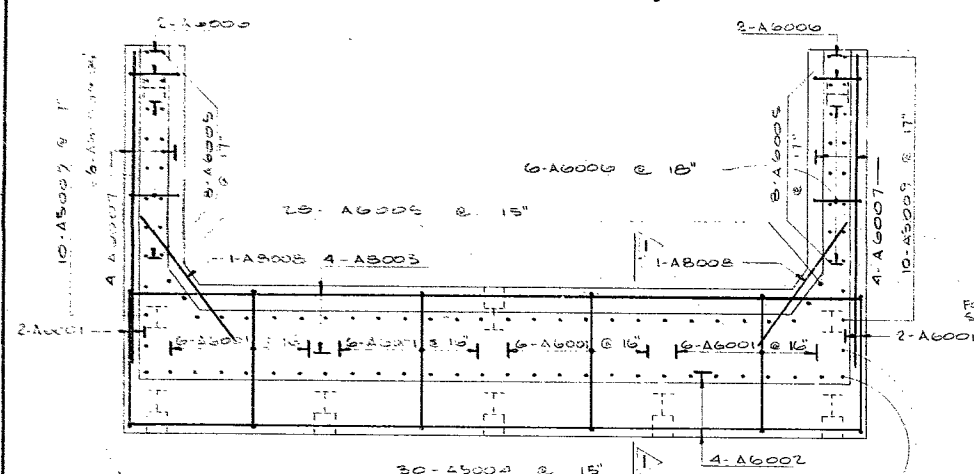




STEEL H-PILE DATA			
LOCATION	NO	LENGTH	TYPE
WEST ABUT.	10	120'-0"	H-PILE 12-BP7
PIER # 1	12	107'-0"	
PIER # 2	12	101'-0"	
PIER # 3	12	95'-0"	
PIER # 4	12	102'-0"	
PIER # 5	12	102'-0"	
EAST ABUT.	10	113'-0"	

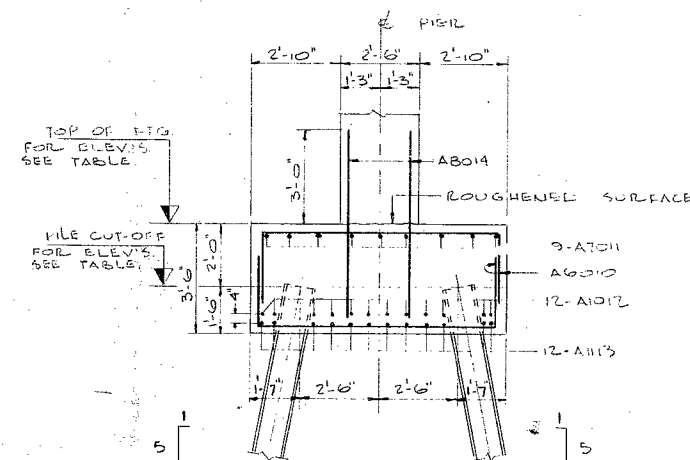
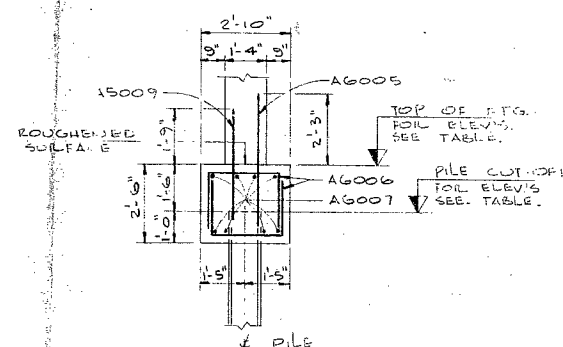
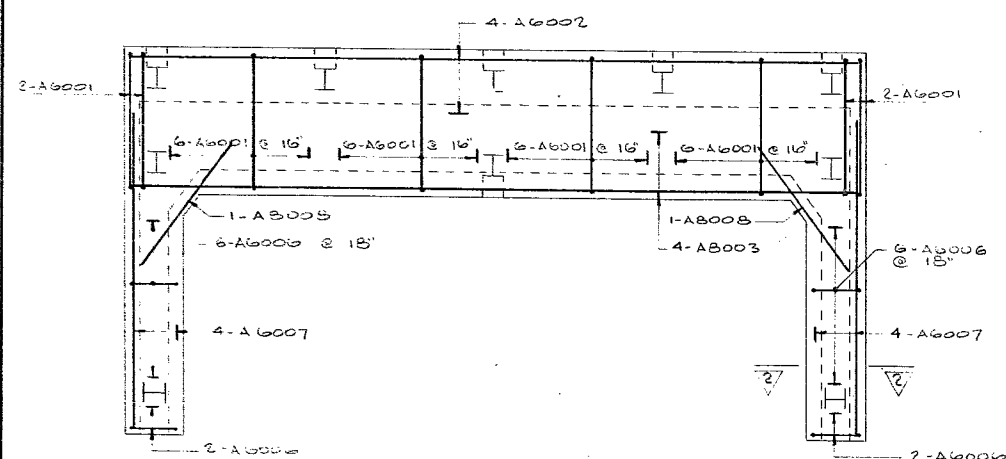
DESIGN LOAD - 90 TONS PER PILE

NOTE:  
ALL PILES TO BE DRIVEN TO  
PRACTICAL REFUSAL.



FOOTING ELEVATIONS		
LOCATION	TOP OF FTG. ELEVATION	PILE CUT-OFF ELEVATION
WEST ABUT.	240.00	235.00
PIER #1	228.00	236.00
PIER #2	222.00	236.00
PIER #3	215.00	213.50
PIER #4	221.00	219.00
PIER #5	223.00	221.00
EAST ABUT.	238.00	236.50

cler. does not agree  
with that shown  
on orig D-6578-1

[illegible]

DEPARTMENT OF HIGHWAYS ONTARIO  
BRIDGE DIVISION

67-F-111

BEAR BROOK BRIDGE

### IV. B. L. STRUCTURE

1 MILE SOUTH OF CARLSBAD SPRINGS

KING'S HIGHWAY No. 417 W.B.L. DIST No 9

CO. CARBON

TWP. CLOSURE	STERIL	LOT	6	CON	511
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### FOOTING LAYOUT & REINFORCEMENT

APPROVED

APPROVED	BRIDGE ENGINEER	CONTRACT			
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DESIGN	J. G.	CHECK	S. B. D.	Nos.		
DRAWING	D.	CHECK	S. B. D.			

DRAWING	R	CHECK	S.B.D.	DRAWING	D-6578-3
DATE	DEC 1965	LOADING	1635-14	No.	