

PILE LOAD TEST
ON
WINDERMERE CUT-OFF
AT BURLINGTON BEACH

Copies to:

Mr. A. Doye Bridge Engineer	(2)
Mr. J. Walter Design Engineer	(1)
Mr. R. E. Richardson Div. Eng. Hamilton	(1)
Mr. G. Parantatos	(1)
File	(1)

Project: F 55-4

PE. 1

INTRODUCTION

The present report is written regarding the load tests and driving tests at the intersection of the Q.E.W. and Windermere cut-off near Hamilton.

A rigid frame structure is to be erected on that intersection carrying the Q.E.W. over the Windermere cut-off road which connects Burlington Beach village with the city of Hamilton.

A driving test and a load test were performed on the above mentioned site to determine allowable load and length of piles. Piles to be used were ARHCO pipe 0.141 inches thick and 12 inches in diameter.

PROCEDURE

The contract was awarded to the Franki pile Company.

The hammer to be used was a Delmag D-12.

The contractor was given permission by the Department to drive on the same site two or three Franki driven piles and load test one of them at his own expense.

Drawing 1 shows the positions of the test piles.

The Franki driving method consists of introducing a dry concrete plug into the bottom of the pipe and dropping on it a Franki hammer weighing 3000 lbs., thus forcing plug and pipe into the ground.

The test started October 31st, and ended November 25th, 1955.

DISCUSSION OF THE TESTS

The piles were supplied to the contractor in 20 foot sections.

The first 16 feet of a pile was driven with the D-12. Another 20 foot piece was placed on top and was welded heavily before re-driving.

During re-driving the pile failed. The type of failure was observed after the pile was pulled out. The pile had warped close to the welding as the steel had yielded under heavy driving.

DISCUSSION OF THE TESTS (continued)

A second pipe pile was driven, again with the D-12 with a heavy splice plates bonding the two 20 foot sections of the pile together. The pile failed again first above the splice while the splice was still above the ground. The following day a thicker pipe (.72 inches thick) supplied by the ARMO Company was driven with the D-12. This time a heavy splice was made on the pipe. The driving records and the load test curves are shown in Appendix I. Beside the Delmag driven piles two Franki method piles were driven as shown in Drawing 1. In Appendix II driving records and load test records of the Franki driven piles can be found. The pile driven with the Franki method was 0.141 inches thick and no failure was observed. It is the belief of the undersigned that even thinner sections could be used with this method without danger of failure, because adding height to the concrete plug avoids any bursting of the metal wall of the pipe. A Taylor pipe 0.1345 inches thick was used for demonstration and was driven successfully. The method could be used with a saving in steel.

DISCUSSION OF THE RESULTS

The method used before driving to compute length and size of pipe to be used was the one Dr. G. Meyerhoff proposed at the Canadian Soil Mechanics conference at Ottawa in December 1954.

In our report F-55-4 it can be seen that at 18 feet below ground elevation a standard penetration number of 25 was obtained. At 23 feet below ground 136 blows per foot was obtained. The sand on the site was uniformly graded. From soils computations based on the above theory and observations an 18 foot pile will carry 40 ton load with a safety factor of 2. Using the Hiley formula and observed $C_2 + C_3 = 0.4$ and $S = 0.3$ per blow it was found that a load of 50 tons could be carried with a safety factor of 3.

DISCUSSION OF THE RESULTS (continued)

The Delmag Formula~~s~~ was used with a safety factor of 6.

The load test carried out to failure was used with a safety factor of 2.

The table below shows the results obtained by the various methods used.

<u>Load Test</u>	<u>Hiley</u>	<u>Delmag</u>	<u>Soil Theory</u>
50 - 55 ton	50 ton	45 ton	40 ton

The Franki driven pile was driven to a depth of 24.5 feet. From Dr. G. Meyerhoff's proposed constants it was calculated that the allowable load was 90 tons. From the Hiley formula using $C_2/C_3 = 0.3$ inches and 0.5 inches penetration per blow; it was calculated that the pile would carry a load of 80 tons.

The load test was carried to 140 tons and a gross deflection of 0.4195 inches and a net of 0.1809 inches was observed.

RECOMMENDATIONS

The following computations were based on 60 tons carrying piles.

The Franki method of driving was found more economical due to saving in steel. If it is to be used a penetration of 0.5 inches per blow with a 12 foot drop of the 3000 pound hammer should be used as final set.

If the Delmag is used a penetration of 60 blows per foot should be obtained with the hammer jumping off the cylinder at least 4.5 feet.

The thickness of wall should be at least 0.171 inches and the splice to be used if any should be made with romboidal shape plates welded heavily.

It should also be mentioned that the sandy subsoil might get denser due to vibration while driving. If this happens shorter length piles might be required.

CONCLUSION

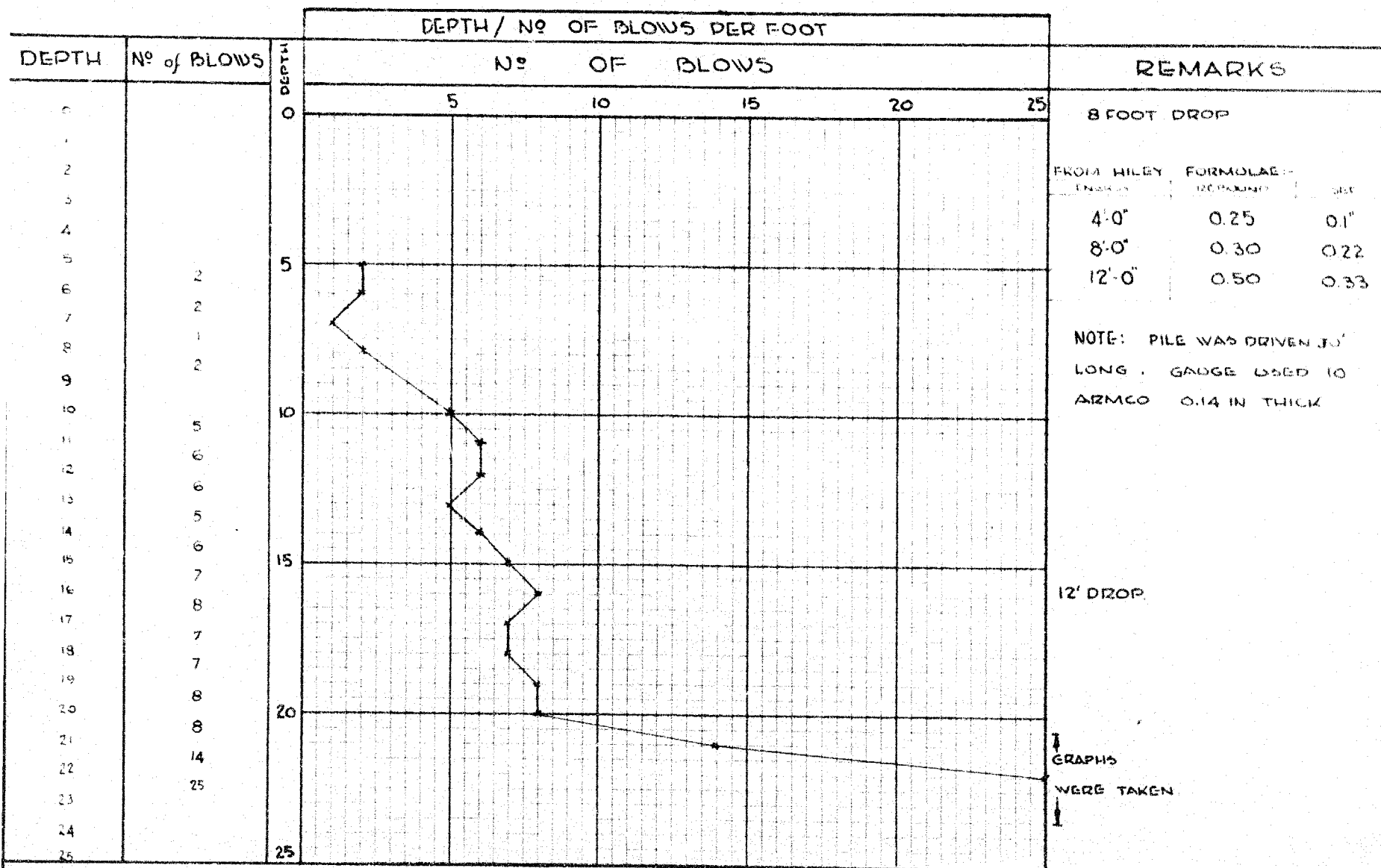
The following length and sets are required for pipe piles carrying 60 tons allowable load.

1. Twentyfive feet long piles for the whole structure will be sufficient.
2. Franki Method (3000 lbs. hammer dropping 12 feet)
 - a) A pipe of .141" thick and 12 $\frac{3}{8}$ " inches in diameter could be used.
 - b) A final set of 24 blows per foot could be used.
3. Dalmag D-12.
 - a) A pipe of at least 0.171 inches thick with heavy splicing if necessary could be used.
 - b) A 60 blows per foot should be used for final set.

G. N. Farantatos
Foundation Engineer.

PILE DRIVEN WITH A FRANKI DROP HAMMER 3000 LB
ON A PLUG 2'-2"
3'-2"

F 55-4 PT 1



PILE Nº 3

PILE DRIVEN WITH A FRANKI DROP HAMMER 3000 LB.

DEPTH	NO. OF BLOW	NO. OF BLOWS	REMARKS
0		0	8' DROP (2'-0" CONCRETE PLUG)
1	1		
2	2		FROM HILEY FORMULAE:-
3	2		BLOW AT 12' DROP SET REBOUND
4	3		12' 0.5" 0.5"
5	3		8' 3/8" 0.5"
6	4		4' 7/32" 3/8"
7	3		NOTE:
8	4		CONCRETE MIX
9	3		1 - 2 - 4
10	5		MAX SIZE AGGREGATE 3/4"
11	7		
12	13		12' DROP
13	12		
14	14		
15	15		
16	15		1" PLUG WAS ADDED.
17			
18			
19			
20			

F-55.4 PT 1

PILE No 4

DELMAG D 12

DEPTH / BLOWS PER FOOT

NOV 1/55

Nº OF BLOWS	DEPTH	Nº OF BLOWS					REMARKS
		10	20	30	40	50	
	0						FROM HILEY GRAPH
1							
2	2						
3							
4	4						NOTE:- PILE WAS DRIVEN 27' LONG WITH A SPLICE GAUGE USED 7 0.17 IN THICK
5							
6	6						
7							
8	8						
9							
10	10						
11							
12	12						
16							
13	14						
14							
20	16						
19							
20	18						
23							
41	20						
19							
20							

TOO SOFT

PILE Nº 5

F 55-4 PT 1

LENGTH OF CONCRETE PLUG 2'-4"

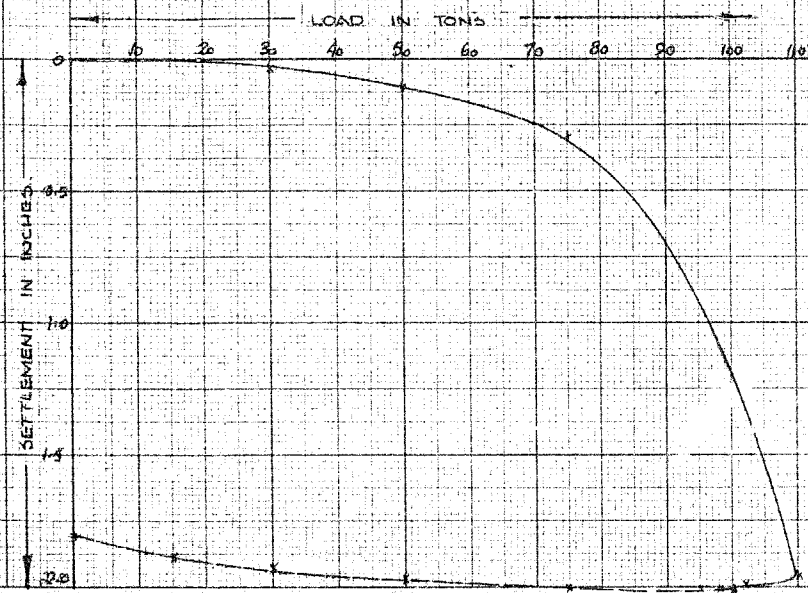
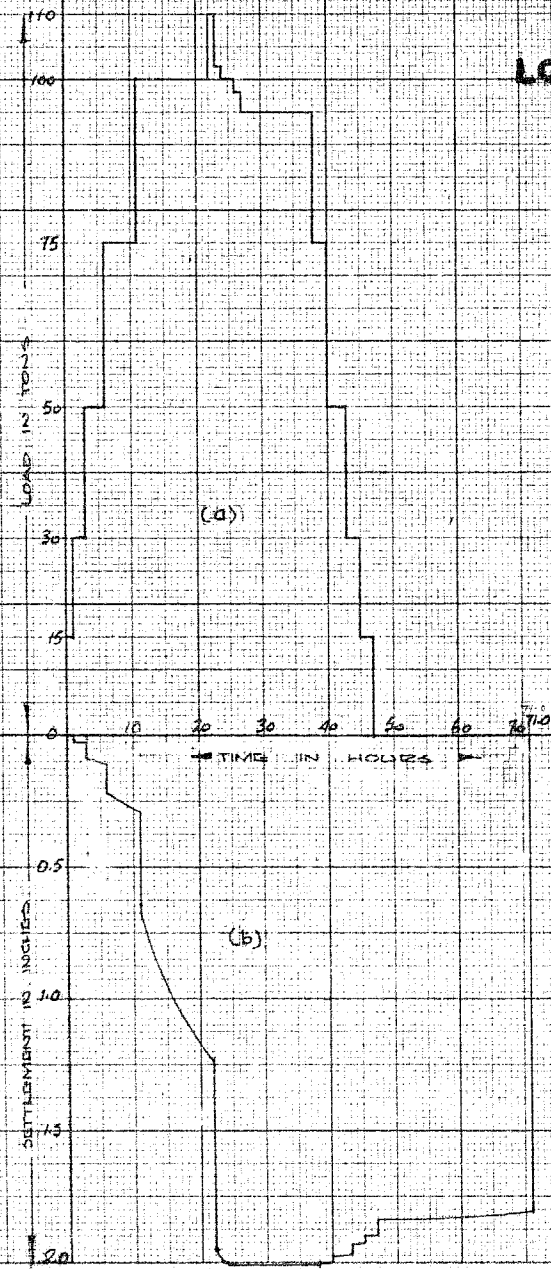
NOTE: THE PILE WAS DRIVEN
TO 19'-0" AND SHOWED NO
SEEPAGE.
TAYLOR-FORBES 0.1345'
THICK

6" OF CEMENT
PLUG ADDED.

PILE NO 6

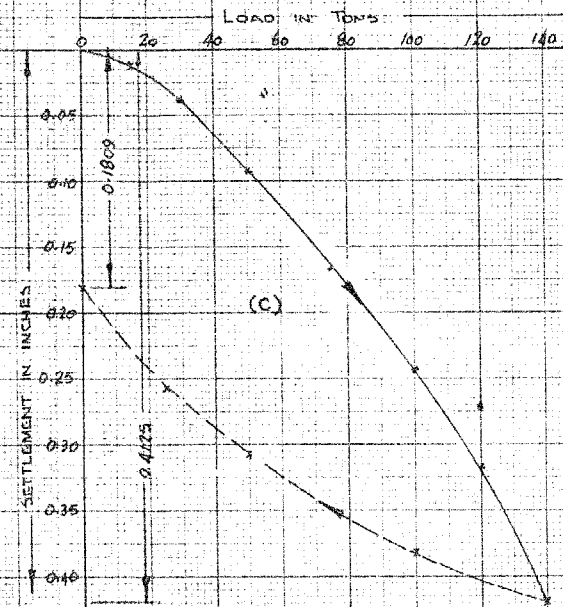
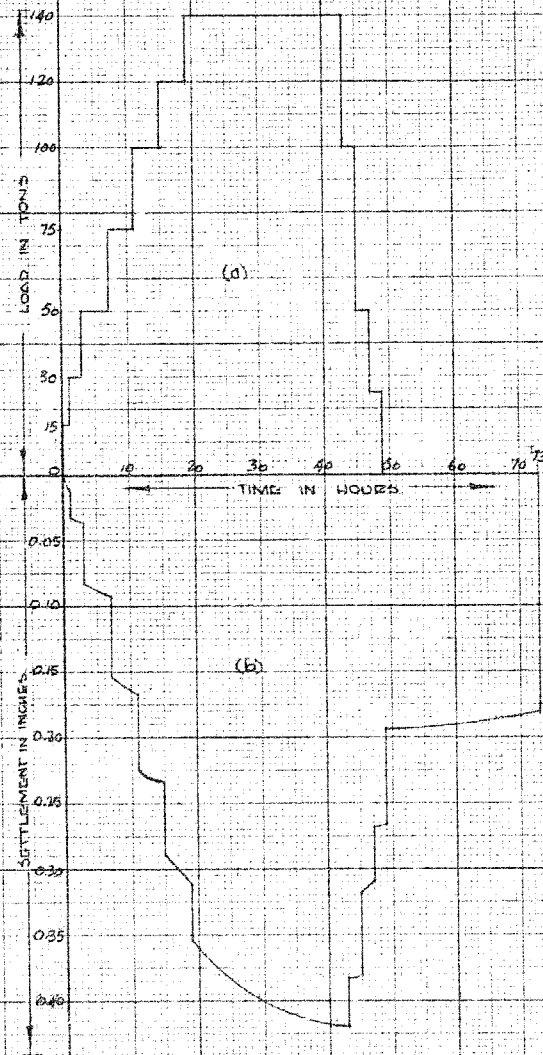
F 55-4 P.T. 1

LOAD TEST RESULTS FOR THE D12 HAMMER DRIVEN PILE AT WINDERMERE CUT-OFF.



LOAD TEST RESULTS FOR THE FRANKI-DRIVEN PILE AT WINDERMERE CUT-OFF.

GROSS SETTLEMENT = 0.4195"
 REBOUND = 0.2326"
 NET SETTLEMENT = 0.1809"





Windermere
Cut Off.

Nov/55

Report of Foundation Investigation For
Windermere Cut-off
at
Burlington Beach.

Copies to:

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Division Engineer, Hamilton (1)

Project F-55-4

Mr. G. Farantatos (1)

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Analysis of Results and Recommendations	1
Conclusion	2

Appendix - in back of book

Plan - F-55-4

Introduction

A bridge is to be constructed on the intersection of Q.E.W. and Windermere cut off at Burlington Beach.

At the present the Windermere cut carries traffic from Hamilton to Burlington Beach and vice versa.

A subsurface investigation was carried out on the proposed site to discover the best founding method for the bridge structure.

Procedure

The exploration started from April 29th to May 9th, 1955.

Four boreholes each with one dynamic cone penetration test were done.

The location of boreholes and their logs are shown on drawing F-55-4 and Appendix I.

Analysis of Results and Recommendations.

In all the boreholes saturated sandy gravel was found except in Borehole #2 where topsoil was observed. The exact depth of the boreholes and the soil identification of the soils could be seen in Appendix I.

From the borehole profile is seen that the elevation of the bottom of the footing should be about 234 i.e. 5'-6" below the peat layer observed on Borehole #3. At the above level the bearing capacity of the saturated sandy gravel was estimated to give 2 tons per square foot.

Analysis of Results and Recommendations (cont.)

If any heavier loads are to be applied the undersigned should be consulted. Calculation for slope stability showed that there is no danger of sliding of the embankment. The water table was observed very close to the surface. The contractors should be notified that they will have to work below the water table.

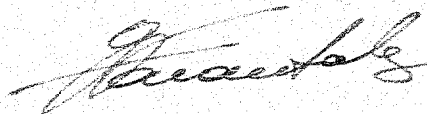
Conclusion

A footing elevation of 234 is recommended.

A load of 2 tons per square foot could be safely applied on the saturated sandy gravel.

F. C. Brownridge
Materials & Research Engineer

Per:



(G. N. Farantatos)

CMF:OD

APPENDIX I

B. A. 431

55-7-4

PILE LOAD TEST
ON
WINDERMERE OUT-OF
AT DUBLINGTON BRIDGE

Copies to:

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Project: P 55-4

PT. 1

INTRODUCTION

The present report is written regarding the load tests and driving tests at the intersection of the U.S. and Wintermere cut-off near Hamilton.

A rigid frame structure is to be erected on that intersection carrying the U.S. over the Wintermere cut-off road which connects Burlington Beach village with the city of Hamilton.

A driving test and a load test were performed on the above mentioned site to determine allowable load and length of piles. Piles to be used were AISC pipe 36.141 inches thick and 12 inches in diameter.

PROCEDURE

The contract was awarded to the Franki pile Company.

The hammer to be used was a Teling 8-12.

The contractor was given permission by the Department to drive on the same site two or three Franki driven piles and load test one of them at his own expense.

Drawing 1 shows the positions of the test piles.

The Franki driving method consists of introducing a dry concrete plug into the bottom of the pipe and dropping on it a Franki hammer weighing 3000 lbs., thus forcing plug and pile into the ground.

The test started October 1st, and ended November 25th, 1933.

CHARACTERISTICS OF THE PILES

The piles were supplied to the contractor in 20 foot sections.

The first 14 feet of a pile was driven with the 8-12. Another 20 foot piece was placed on top and was welded heavily before re-driving.

During re-driving the pile failed. The type of failure was observed after the pile was pulled out. The pile had warped close to the welding as the steel had yielded under heavy driving.

DISCUSSION OF THE PILES (continued)

A second pipe pile was driven, again with the D-12 with a heavy splice plates bonding the two 23 foot sections of the pile together. The pile failed again first above the splice while the splice was still above the ground. The following day a thicker pile (.72 inches thick) supplied by the Abild Company was driven with the D-12. This time a heavy splice was made on the pipe. The driving records and the load test curves are shown in Appendix I. Beside the Delmag driven piles two Franki method piles were driven as shown in Drawing 1. In Appendix II driving records and load test records of the Franki driven piles can be found. The pile driven with the Franki method was 0.141 inches thick and no failure was observed. It is the belief of the undersigned that even thinner sections could be used with this method without danger of failure, because adding height to the concrete plug avoids any bursting of the metal wall of the pipe. A Taylor pipe 0.1345 inches thick was used for demonstration and was driven successfully. The method could be used with a saving in steel.

DISCUSSION OF THE RESULTS

The method used before driving to compute length and size of pipe to be used was the one Dr. C. Meyerhoff proposed at the Canadian Soil Mechanics conference at Ottawa in December 1954.

In our report 8-55-4 it can be seen that at 18 feet below ground elevation a standard penetration number of 25 was obtained. At 23 feet below ground 130 blows per foot was obtained. The sand on the site was uniformly graded. From soils computations based on the above theory and observations an 18-19 foot pile will carry 45 ton load with a safety factor of 3. Using the Hiley formula and observed $C_2-C_3=0.4$ and $R=0.3$ per blow it was found that a load of 50 tons could be carried with a safety factor of 3.

DISCUSSION OF THE RESULTS (continued)

The Welby formula was used with a safety factor of 6.

The load test carried out to failure was used with a safety factor of 2.

The table below shows the results obtained by the various methods used.

<u>Load Test</u>	<u>Hiley</u>	<u>Belzag</u>	<u>Soil Theory</u>
50 - 55 ton	50 ton	45 ton	45 ton

The Franki driven pile was driven to a depth of 24.5 feet. From Dr. C. Meyerhoff's proposed constants it was calculated that the allowable load was 71 tons. From the Hiley formula using 12×0.3 inches and 0.5 inches penetration per blow; it was calculated that the pile would carry a load of 80 tons.

The load test was carried to 140 tons and a gross deflection of 0.4195 inches and a net of 0.1809 inches was observed.

RECOMMENDATIONS

The following computations were based on 50 tons carrying piles.

The Franki method of driving was found more economical due to saving in steel. If it is to be used a penetration of 0.5 inches per blow with a 12 foot drop of the 3000 pound hammer should be used as final set.

If the Belzag is used a penetration of 60 blows per foot should be obtained with the hammer jumping off the cylinder at least 4.5 feet.

The thickness of wall should be at least 0.171 inches and the splice to be used if any should be made with rhomboidal shape plates welded heavily.

It should also be mentioned that the sandy subsoil might get denser due to vibration while driving. If this happens shorter length piles might be required.

CONCLUSION

The following lengths and sets are required for pipe piles carrying 60 tons allowable load.

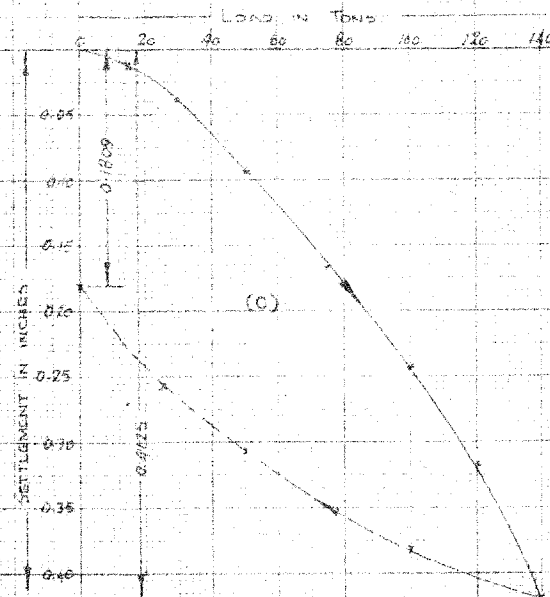
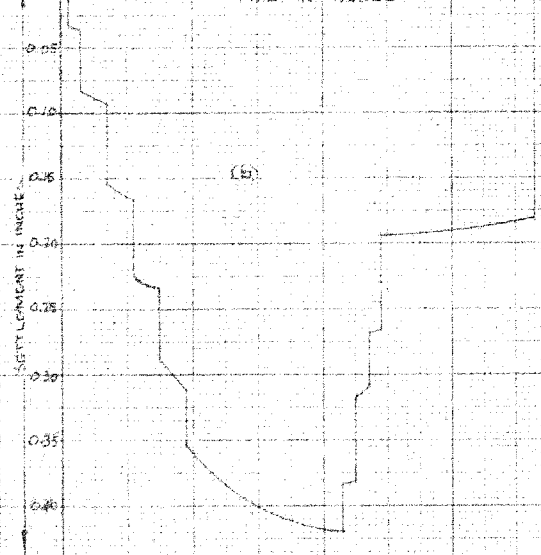
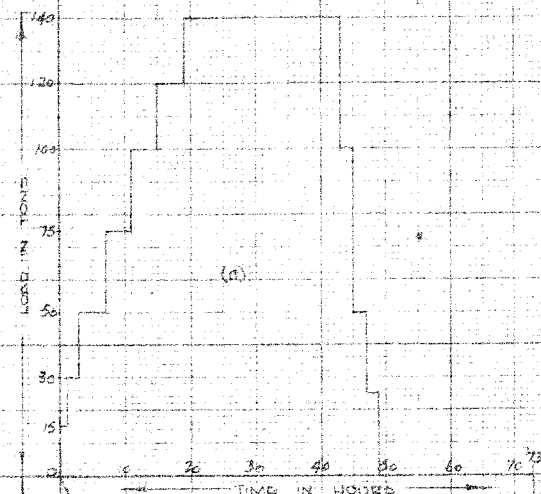
1. Twentyfive feet long piles for the whole structure will be sufficient.
2. Franki Method (3000 lbs. hammer dropping 12 feet)
 - a) A pipe of .141" thick and 12 1/2" inches in diameter could be used.
 - b) A final set of 21 blows per foot could be used.
3. Dohng 8-12.
 - a) A pipe of at least 0.171 inches thick with heavy splicing if necessary could be used.
 - b) A 60 blows per foot should be used for final set.



G. S. Faruhatian
Foundation Engineer.

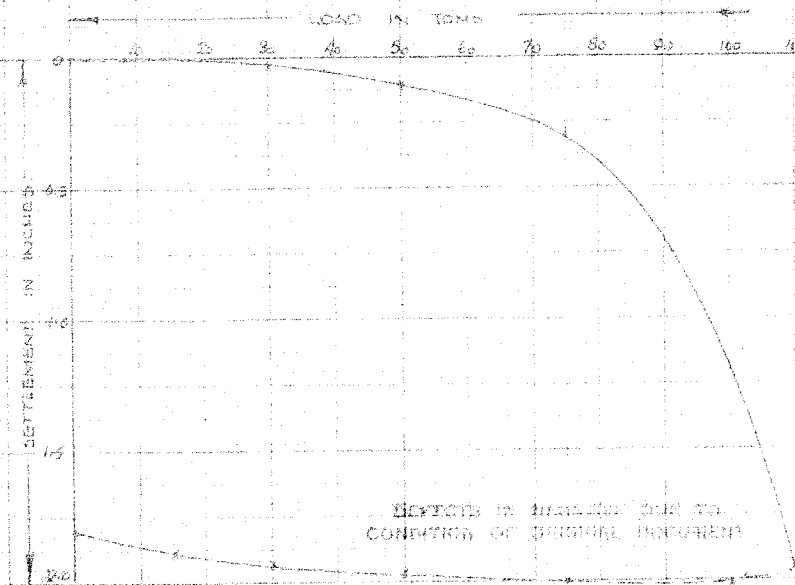
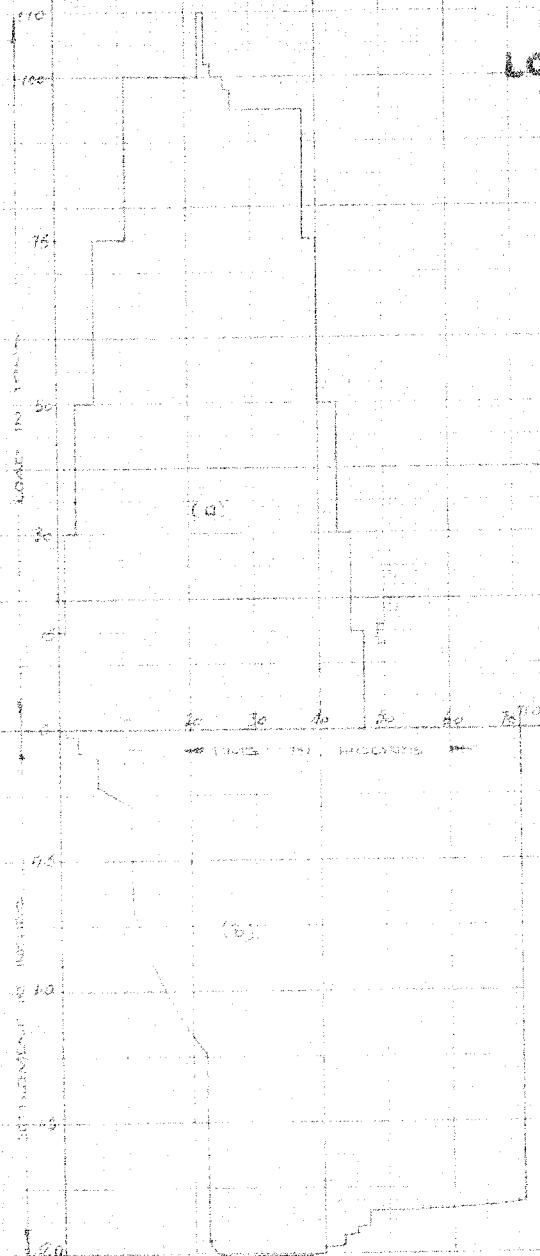
LOAD TEST RESULTS FOR THE FRANKI-DRIVEN PILE AT WINDERMERE CUT-OFF.

GROSS SETTLEMENT = 0.4195"
 REBOUND = 0.2386"
 NET SETTLEMENT = 0.1809"



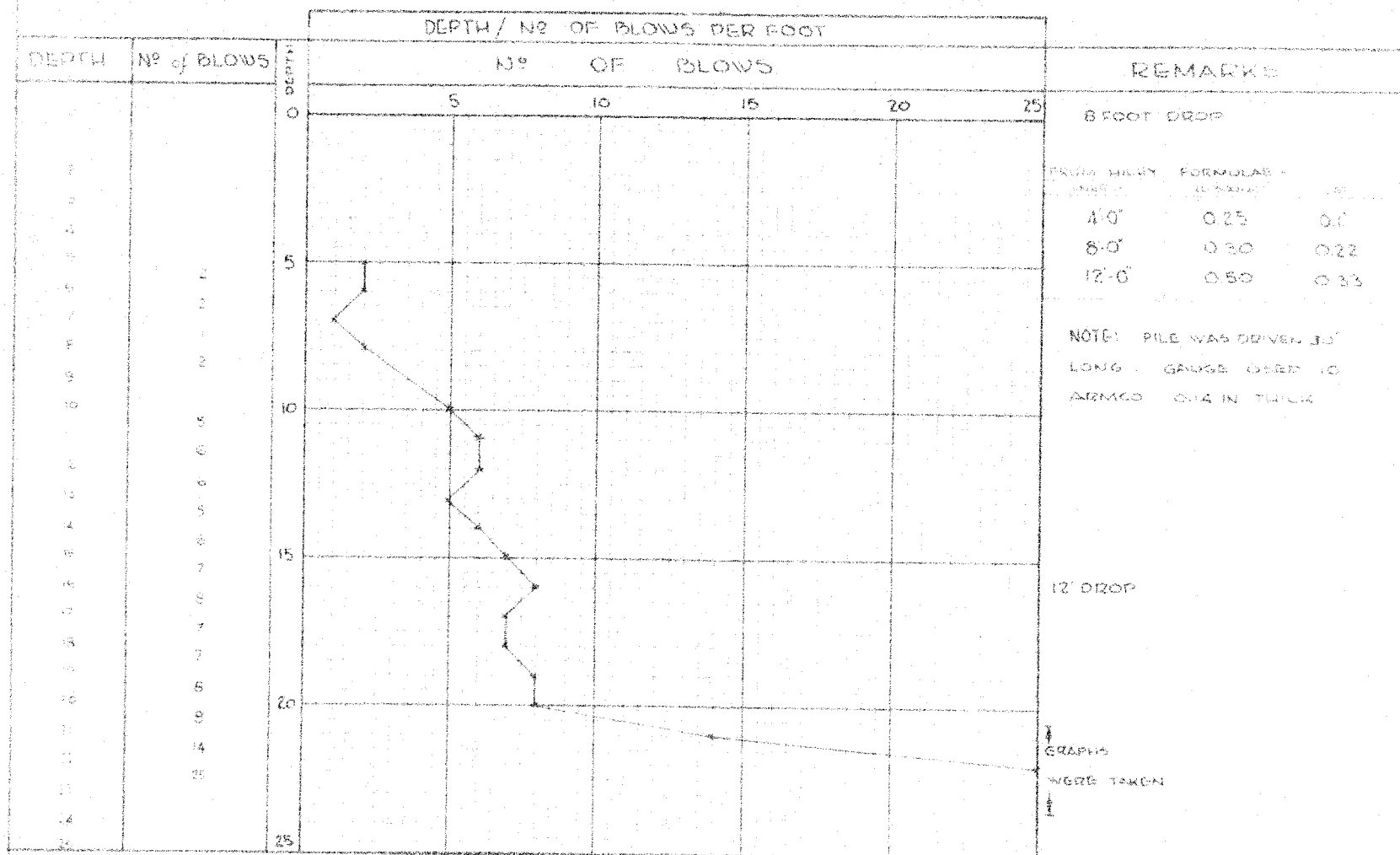
DEFECTS IN NEGATIVE DUE TO
 CONDITION OF ORIGINAL PILE

LOAD TEST RESULTS FOR THE D12 HAMMER DRIVEN PILE AT WINDERMERE CUT-OFF.



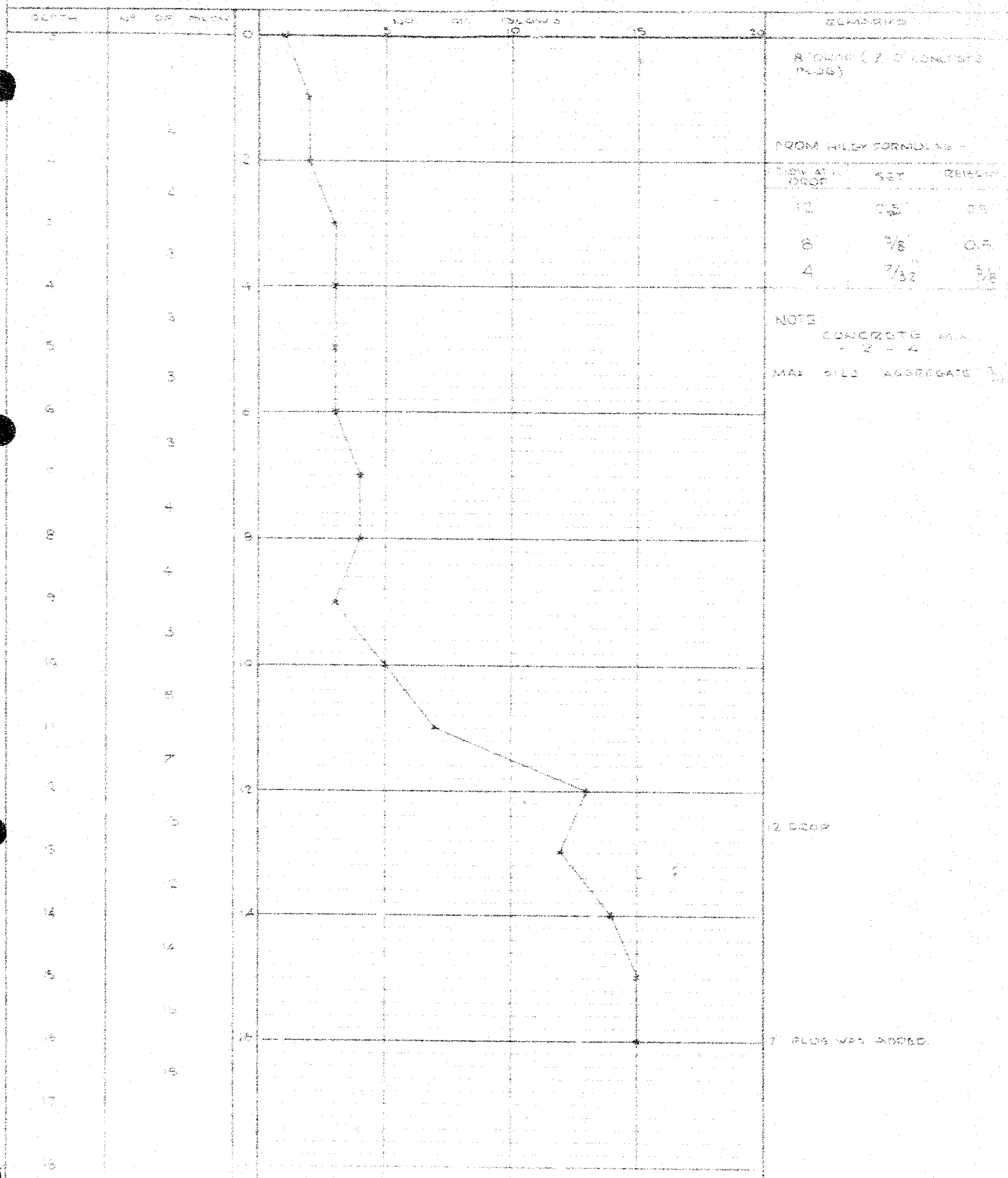
PILE DRIVEN WITH A FRANKI DROP HAMMER 3000 LB
ON A PLUG 2'-2"
3'-2"

F-55-4 PT 1



PILE Nº 3

PILE DRIVEN WITH A FRANKI DROP HAMMER 3000 LB.



DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

F-554 PT1

PILE No 4

DELMAG 012

DEPTH / BLOWS PER FOOT

NOV 1/55

NO OF BLOWS

DEPTH

DEPTH

10

NO

OF

BLOWS

20

30

40

50

REMARKS

FROM HILEY GRAPH

TEST NO. 11-55-01

1-6-5 0.4 0.1

3-6 0.23 0.1

3-6 0.10 0.1

NOTE: PILE WAS DRIVEN

27' LONG WITH A TRIPLE

GAUGE USED 7' TO 10'

IN THICK

TOO SOFT

12

16

20

19

20

21

22

23

24

12

13

14

15

16

17

18

19

20

21

RETURN TO HILEY GRAPH TO
CORRELATE DEPTH TO BLOWS PER FOOT

PILE NO 5

1-55-4

PT 1

PILE DRIVEN WITH A 3000 LB HAMMER - TAYLOR - DROP OF 8'-0"
LENGTH OF CONCRETE PLUG 3'-4"

DEPTH	NO. of BLOW	N° of Blows			REMARKS
		5	10	15	
0	1	1			NOTE: THE PILE WAS DRIVEN TO 10'-0" AND REMOVED THE SURFACE TAYLOR-FOOTING 0.125" THICK
1	2	1			
2	3	1			
3	4	1			
4	5	1			
5	6	1			
6	7	1			
7	8	1			
8	9	1			
9	10	1			
10	11	1			10' OF CEMENT PLUG ADDED
11	12	1			
12	13	1			
13	14	1			
14	15	1			
15	16	1			
16	17	1			
17	18	1			
18	19	1			
19	20	1			
20	21	1			PILE NO 6 F 55-A PT. 1
21	22	1			
22	23	1			
23	24	1			
24	25	1			
25	26	1			
26	27	1			
27	28	1			
28	29	1			
29	30	1			

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

#55-F-4
WINDERMERE,
CUT-OFF AT,
BURLINGTON
BEACH



TL 100
3490

MATERIALS LABORATORY DEPARTMENT OF HIGHWAYS - CHICAGO
OFFICE REPORT ON SOIL EXPLORATION

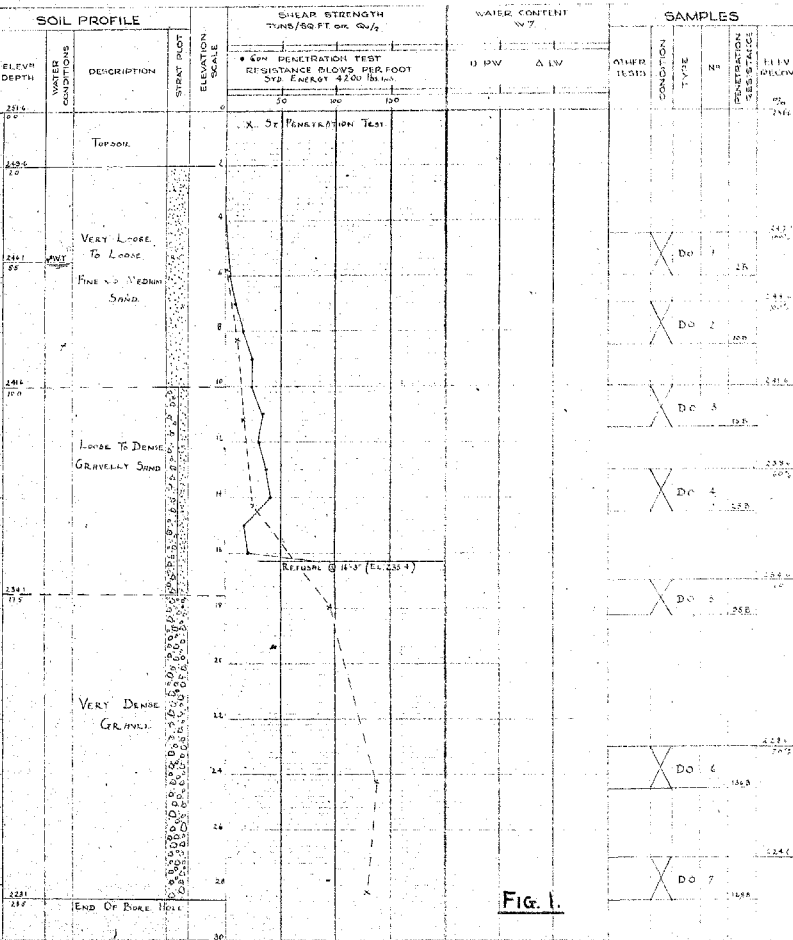
DRILL RIG C-1084 (N11) JOB F-55-4 BORING NO. 1
CASING 3" DIA. (STANDARD SAMPLERS TO FIT UNLESS NOTED) DATE REPORT 27 MAY 1953
SAMPLER HAMMER WT. 150 LBS. DATUM STATION 100.45' ELEV. 2316 COMPILED BY S.T.B. CHECKED BY W.W. BORING DATE 23-JULY APRIL 1953

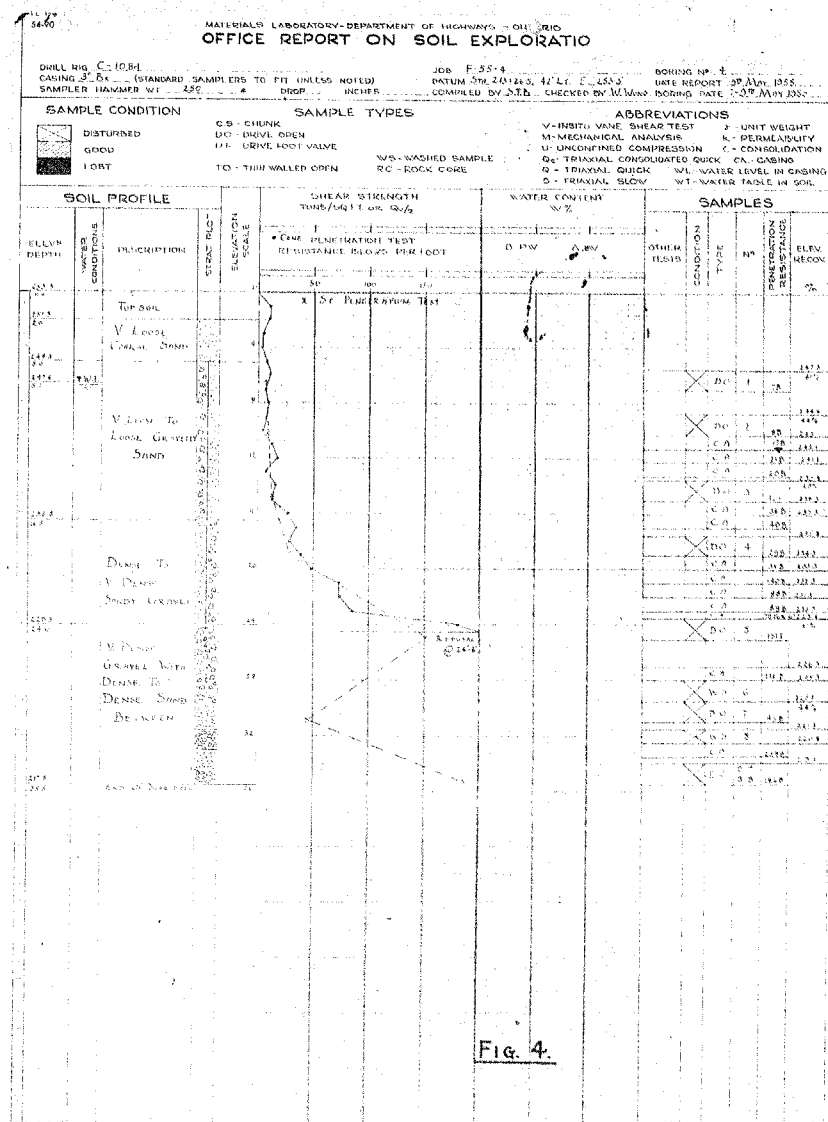
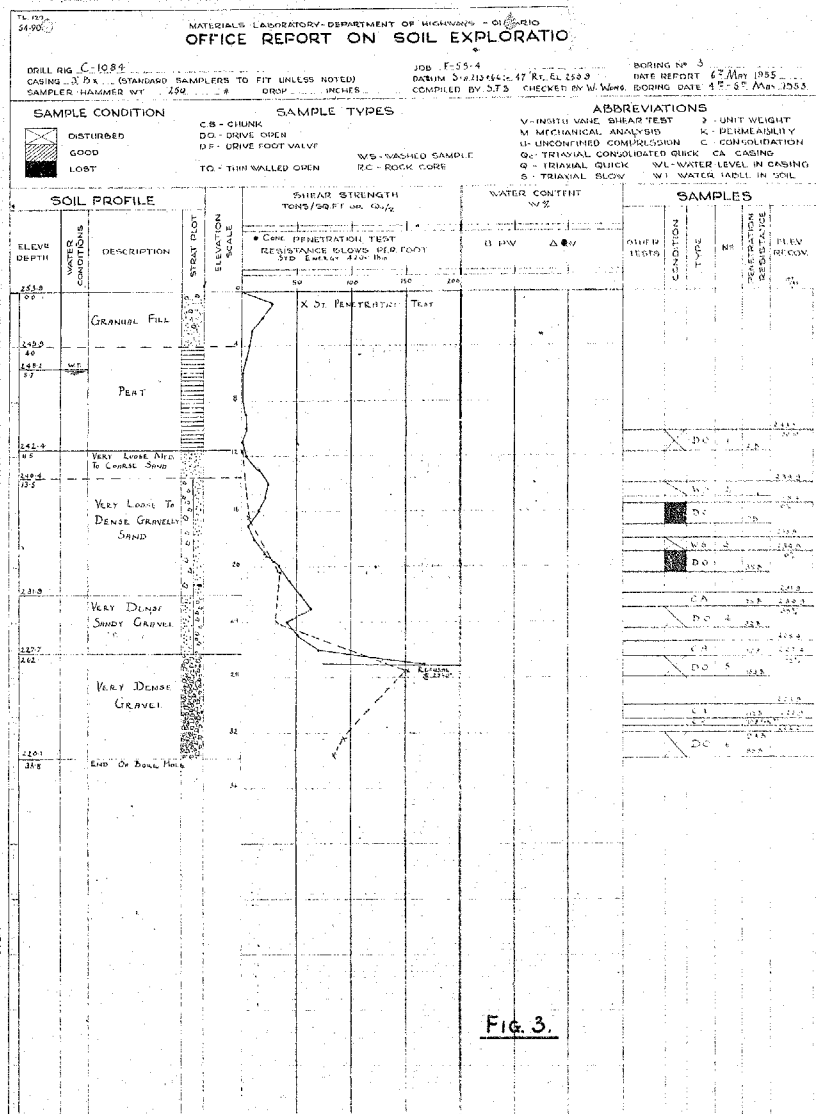
SAMPLE CONDITION
DISTURBED
GOOD
LOST

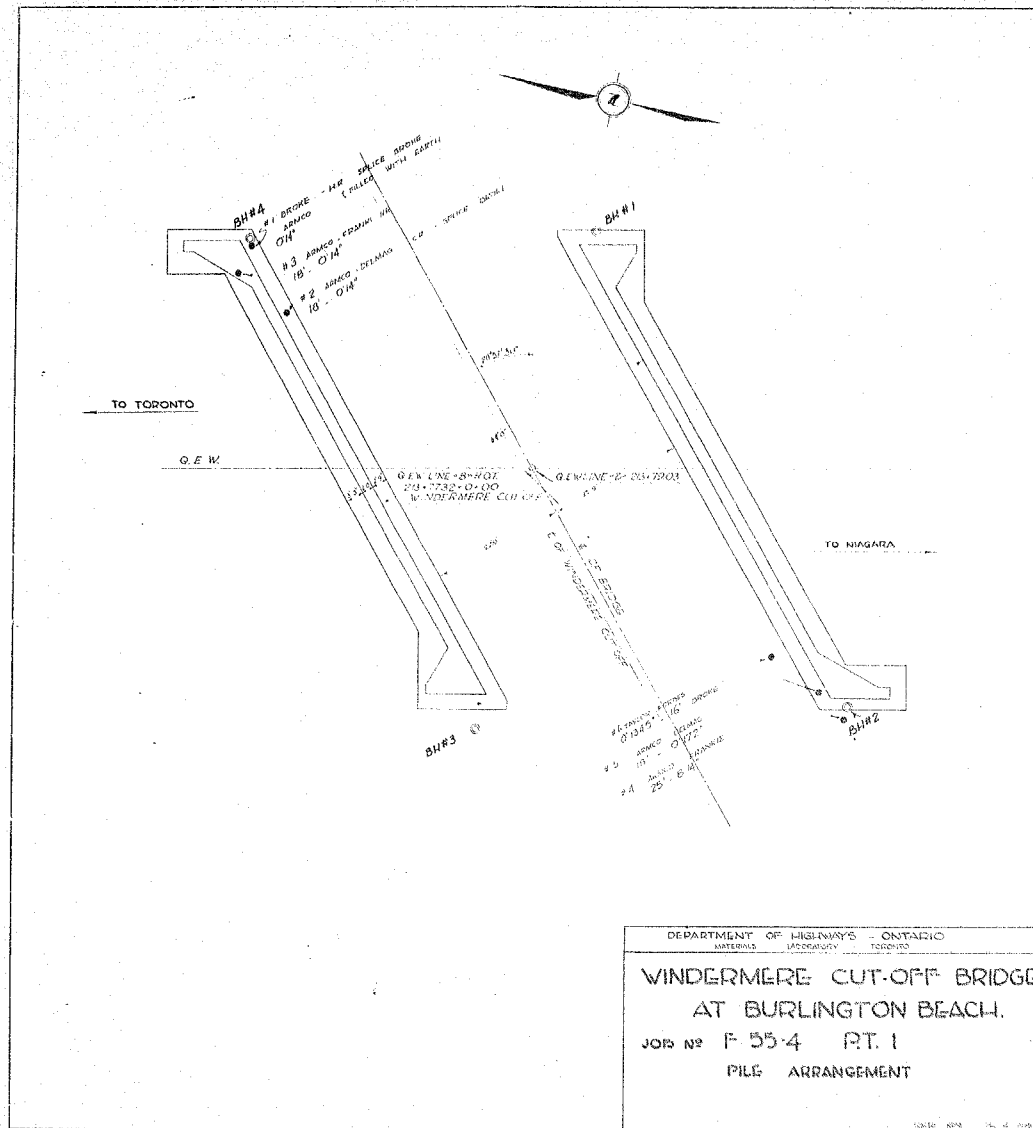
SAMPLE TYPES
CS - CHUNK
DO - DRIVE OPEN
UP - DRIVE FOOT VALVE
TO - THIN WALLED OPEN

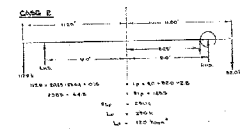
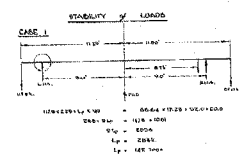
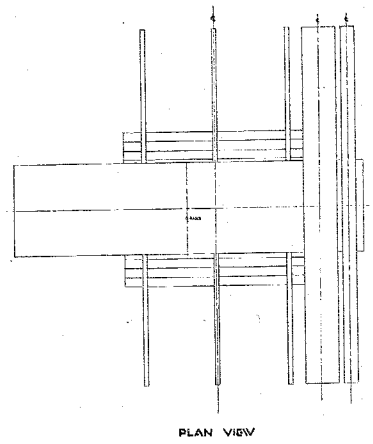
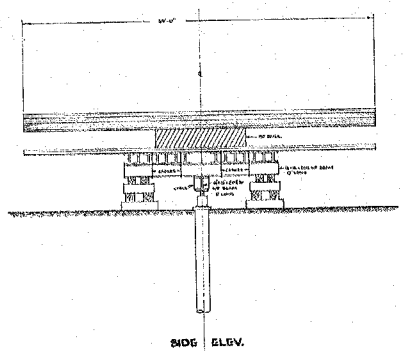
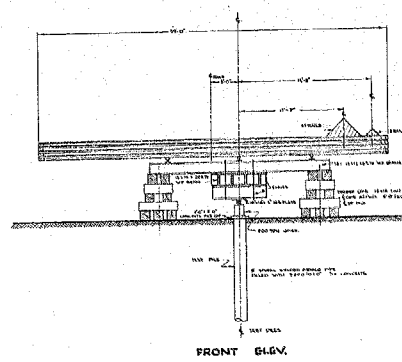
ABBREVIATIONS
V - IN-SITU VANE SHEAR TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
Q - TRIAXIAL CONSOLIDATED QUICK
C - TRIAXIAL QUICK
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION
CA - CASING
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL







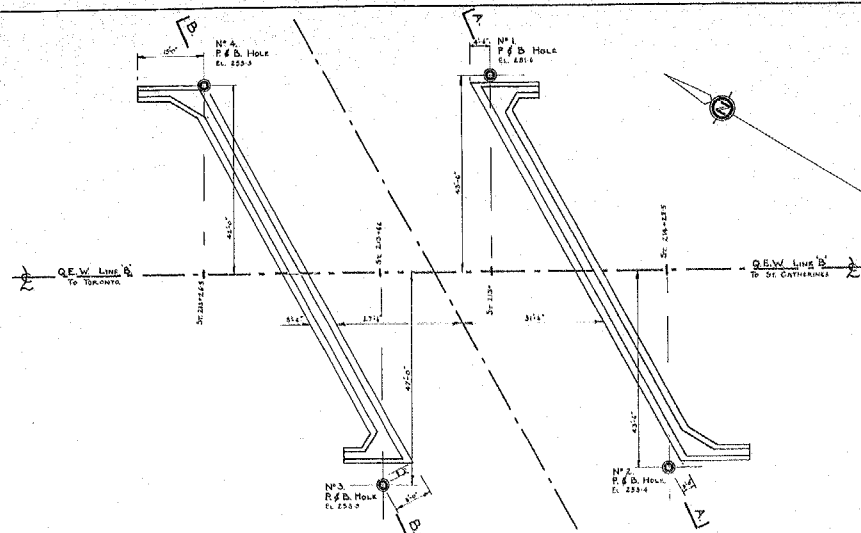


*Because Pile is loaded in place, the ultimate load shall not be placed on the pile, the supporting pile shall be at the ultimate load. (Pile cap) shall be used to transfer the load on the pile.

NOTE:
The pile is loaded in place, the ultimate load shall not be placed on the pile, the supporting pile shall be at the ultimate load. (Pile cap) shall be used to transfer the load on the pile.

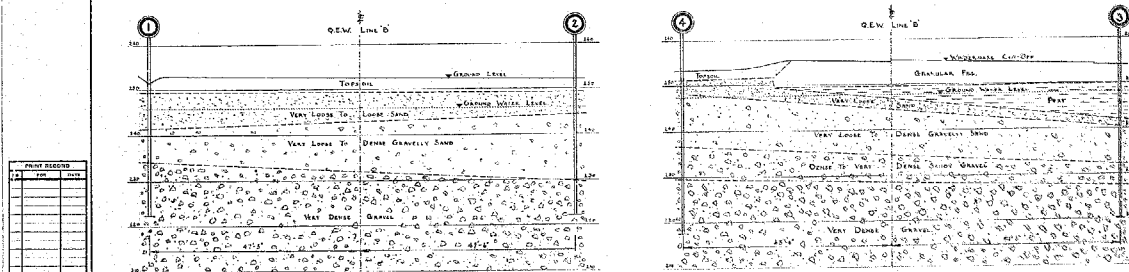
NO.	REV.	DATE

DEPARTMENT OF HIGHWAYS-ONTARIO			
MATERIALS LABORATORY - TORONTO			
SKETCH OF LOADING SYSTEM FOR PILE TEST AT Q.E. HIGHWAY AND WINDERMERE CUTOFF			
THE HIGHWAY NO. Q.E.		SHEET NO.	
CO.		ED.	
ZWD.		ED.	
SCALE: 1 INCH = 10 FEET			
APPROVED			
DATE: 1955			
BY: 55-F-4			



LEGEND -
P & B HOLE - PENETRATION & BORE HOLE.

SCALE - 1 INCH = 10 FEET



SECTIONS SHOWING EARTH STRATA

DEPARTMENT OF HIGHWAYS, ONTARIO			
SOILS OFFICE - TORONTO			
PROPOSED WINDERMERE CUT-OFF BRIDGE			
THE KING'S HIGHWAY No. Q.E.W.		DIV. No. 4	
ON WINDERMERE		LOT 31	
THE SALTWATER		COIL	
POSITIONS & SECTIONS THROUGH PEN. & BORE HOLES			
APPROVED:			
DATE: MAY 26 1955			
F-55-4A			