cc. GEN. FILES

23-65-239.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

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

DATE: April 27, 1965

OUR FILE REF.

IN REPLY TO

SUBJECT:

REPORT ON PILE LOAD AND EXTRACTION
TEST AT THE SITE OF THE PROPOSED
HWY. #400 AND JANE ST. INTERCHANGE
DISTRICT #6, TORONTO

W.J. 64-F-14 W.P. 113 & 114-63

Attached, we are sending you the above-mentioned report for your use. We believe that it contains all information necessary for your future design work and that also, adequate data for construction purposes is provided.

However, if there are any queries in connection with this project, please feel free to contact our Office.

K. Y. Lo,
SUPERVISING FOUNDATION ENGINEER

KGS/MdeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
J. C. Thatcher
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

TABLE OF CONTENTS

REPORT ON PILE LOAD AND EXTRACTION TEST AT THE SITE OF THE PROPOSED HWY. #400 AND JANE ST. INTERCHANGE DISTRICT #6, TORONTO

W.J. 64-F-14 W.P. 113 & 114-63

1. INTRODUCTION:

The Foundation Section were requested by Mr. J. Keene, Senior Bridge Design Engineer, to initiate and subsequently carry out a series of pile load and extraction tests at the site of the proposed Hwy. #400 and Jane St. interchange in Metropolitan Toronto. The purpose of the tests was to determine the most suitable type and length of pile to be used in the proposed Ramp N-W and Black Creek crossing, and to provide information so that recommendations relating to piles might be made for the other structures in the interchange.

This report contains a description of the various tests, together with a discussion of the test results.

2. DESCRIPTION OF THE SITE:

The site is located in Metropolitan Toronto, Twp. of North York at the intersection of Rustic Road and Jane Street, some 300 ft. east of the existing Jane Street and Black Creek crossing. The area in the immediate vicinity of the site forms the flood plain of Black Creek and is generally flat and grass covered.

Physiographically, the site lies in the South Slope Region which is the South slope of an interlobate moraine. This moraine consists of a clay till deposited during the Pleistocene Ice Epoch.

cont'd. /2 ...

3. SUBSOIL CONDITIONS:

Detailed descriptions of subsoil conditions at the site are given in Foundation Reports #63-F-95 and #63-F-109. Logs of B.H.'s #4 and #14 from Report #63-F-95, and B.H. #2 from Report #63-F-109 are included in the Appendix of this present report, together with a log of B.H. #P which was drilled specifically for this project after the completion of pile testing. Briefly, the subsoil consists of about 10 ft. of silty sand followed by at least 100 ft. of various cohesive glacial till deposits composed of heterogeneous mixtures of clay, silt, sand and gravel in varied proportions. Generally speaking, the consistency of the deposit ranges from stiff to hard. Down to about 60 feet, the average undrained shear strength of the deposit is estimated to be in the order of 1,500 p.s.f., whilst below this depth, the strength is estimated to range from 2,000 to 4,000 p.s.f. with an average of about 3,000 p.s.f.

4. PILE DRIVING:

Eight 12¾-inch O.D. steel tubes fitted with circular flat plate shoes and one Class 'A' untreated timber pile were driven at the site by means of a Delmag D 12 pile driving hammer. The steel tubes are designated as Piles #1 - #8, incl. and the timber pile as Pile #9. Piles #1, #2, #6, and #7 were approximately 90 feet long and were used as anchor piles in the test set-up. Piles #3, #4, and #5 were 52.1, 100.5, and 51.6 feet long, respectively. Both load and extraction tests were carried out on these three piles.

cont'd. /3 ...

4. PILE DRIVING: (cont'd.) ...

Pile #8 approximately 74 ft. long, was driven some 300 ft. west of the load test location in order to obtain a comparison of driving conditions at the different locations. No load or extraction test was carried out on Pile #8. Pile #9 was 48.9 feet long and was driven and load tested after completion of the extraction tests on Piles #3, #4, and #5.

In order to ascertain the effect of a protruding shoe plate on the capacity of a pile in this type of soil, a standard shoe plate which has a diameter 3/4" larger than the pile was fitted to Pile #3 and a smaller shoe plate with the same diameter as that of the pile was fitted to Pile #5. These piles, of course, were equal in all other respects.

All records pertaining to the driving of the piles are included in the Appendix of this report. Details of the various piles are summarized in Table I, as follows:

cont'd. /4 ...

TABLE I

Pile	Type of Pile	Shoe Details	Length in Ground	Tip El.	Driving Time
1	12¾" x 0.203" Steel Tube	13½" x 1" Plate	84.0'	313.4	100 minutes
2	12¾" x 0.203" Steel Tube	12¾" x 1" Plate	84.5'	312.9	83 "
3	12¾" x 0.203" Steel Tube	13½" x 1" Plate	49.5'	347.5	41 "
4	12¾" x 0.250" Steel Tube	13½" x 1" Plate	98.5'	299.1	178 "
5	12¾" x 0.203" Steel Tube	12¾" x 1" Plate	49.5'	348.1	49 "
6	12¾" x 0.203" Steel Tube	12¾" x 1" Plate	83.0'	313.1	75 "
7	12¾" x 0.203" Steel Tube	12¾" x 1" Plate	70.0'	327.8	71 "
8	12¾" x 0.250" Steel Tube	13½" x 1" Plate	75.6'	325.3	220 "
9	Class "A" - Timber	None	47.5'	350.6	35 "

cont'd. /5 ...

5. PILE TESTING:

Five load tests and three extraction tests were carried out at the site. Loads were applied to the particular pile under test by means of a hydraulic jack acting between the pile head and a 36 W.F. x 230 reaction beam attached to four anchor piles #1, #3, #6, and #7. Extraction tests were performed by jacking between the top of the reaction beam and the upper beam of a rectangular steel yoke which was attached to the pile under test. Drawing #64-F-14E shows the details of the reaction beam and the extraction yoke and is included in the Appendix of this report.

The load tests were carried out, in general, in accordance with the provisions of the National Building Code of Canada, the loads being applied in increments ranging from 2.5 tons to 12.5 tons depending on the prevailing rate of settlement of the pile. After each increment was added, the prevailing load was maintained for a period of two hours or until such time as the rate of settlement fell below 0.01 inches per hour, whichever was the shorter period. Loading was continued in this manner until the pressure on the hydraulic jack could no longer be maintained due to rapid vertical displacement and hence, failure of the pile. At this stage, the load was removed in increments of 50%, 25%, 15%, and 10% of the maximum load achieved.

During the application and removal of the loads, a record of load time and settlement was constantly maintained. The vertical deflections were measured by means of four dial gauges, one mounted at each corner of the pile head and attached to two independently supported reference beams. During the tests the elevations of the reference beam supports were frequently checked by means of a level

cont'd. /6 ...

5. PILE TESTING: (cont'd.) ...

to ensure that they were not being affected by the settlement of the pile under load.

The extraction tests were carried out using similar procedures regarding application and removal of extraction forces and measurement of pile deflection to those followed for the load tests.

For each test, curves of Load versus Time, Load versus Deflection, and Deflection versus Time, have been plotted and are included in the Appendix of this report.

A Table showing the order and type of testing, together with the test results and pertinent dates for the various pile tests is given below:

TABLE II

Pile	Driving Date	Load Test Date	Extraction Test Date	Failure Load	Failure Pull
3	May 12, 1964	June 1, 1964	June 5, 1964	26	27.5
4	May 11, 1964	May 27, 1964	June 2, 1964	120	115
5	May 12, 1964	May 29, 1964 July 17, 1964	June 4, 1964	32 30	32.5
9	June 22, 1964	July 9, 1964	None	80	None

cont'd. /7 ...

6. DISCUSSION OF TEST RESULTS:

General:

The load and extraction test programme was carried out with the following specific purposes in mind:

(1) To measure and compare the ultimate capacities of 12¾" O.D. steel tube piles and Class "A" timber piles.

(2) To measure and compare the adhesion between the pile skin and the surrounding soil for steel and timber piles.

(3) To determine the effect of a protruding shoe plate on the steel tube piles.

(4) To compare the driving conditions at the load test site with the driving conditions at an adjacent site some 300 feet west.

A discussion of each aspect of the test programme is given below.

(1) Ultimate Capacities of Piles:

The test results clearly show that timber piles are more than twice as efficient as steel tube piles of comparable shaft area and length, at this particular site.

The conclusions to be drawn from the tests regarding pile capacities are as follows:

From ground level to a depth of about 60 feet, Class 'A' timber piles can be expected to support an ultimate load of about 1,000 pounds per square foot of embedded shaft area. The corresponding figure for 12¾" O.D. steel tubes ranges from 300 to 350

cont'd. /8 ...

6. DISCUSSION OF TEST RESULTS: (cont'd.) ...

(1) (cont'd.) ...

pounds per sq. ft. In the case of steel tubes which are longer than 60 feet, that portion of the pile which is at a greater depth than 60 feet can be expected to contribute about 1,100 pounds per square foot of shaft area.

Insofar as the future structure is concerned and without consideration of the effects of long-term settlement, design loads in the case of 45 feet long Class 'A' timber piles and 90 feet long $12\frac{3}{4}$" O.D. steel tubes, should be 35 tons and 50 tons, respectively. The safety factor in both cases would be approximately 2.0.

(2) Adhesion Between Pile Skin and Surrounding Soil:

The ultimate capacity of friction piles driven into cohesive subsoil, can be expressed by the following equation:

$Q = 9 A_b C_b + A_s C_a$ - where

Q is the ultimate pile capacity

A_b is the tip area of the pile

A_s is the embedded shaft area of the pile

C_b is the shear strength of the soil at the pile tip

C_a is the average adhesion of the soil along the pile shaft.

From the results of the load and extraction tests, it is possible using the above equation, to compute the average adhesion C_a and hence, compare this value with the shear strength measurements made during soil investigations. Table III shows a comparison of these values. In this Table, C is the estimated average shear

cont'd. /9 ...

6. DISCUSSION OF TEST RESULTS: (cont'd.) ...

(2) (cont'd.) ...

strength determined by soil tests, and the value C_b is obtained in the same way.

TABLE III

Pile	Length (Feet)	A_s ($Ft.^2$)	A_b ($Ft.^2$)	C p.s.f.	C_b p.s.f.	C_a p.s.f.	C_a/C %
3	0 - 49.5	165	0.995	1,500	1,500	333	22.2
* 4	0 - 60.0	200	-	1,500	-	300	20.0
	60 - 98.5	129	0.995	3,000	3,000	1,100	36.7
	0 - 98.5	329	0.995	2,000	3,000	700	35.0
5	0 - 49.5	165	0.889	1,500	1,500	303	20.2
9	0 - 47.5	143	0.350	1,500	1,500	1,085	72.5

* In the case of Pile #4, a soil boundary occurs at about 60.0 feet. The Table, therefore, shows the strength contributions of the upper and lower portions of the pile as well as the averages for the whole length.

It will be observed that the adhesion in the case of the timber pile is much greater than that of the steel piles. It is believed that the reason for this is due to two factors - shape and material. The action of pile driving causes a pile to whip and in consequence, a slightly larger soil volume than its own is displaced. The result of this is that voids are formed around the pile shaft which tend to fill with water forced out from the soil pores. In the case of timber piles which have a natural taper, the voids formed

cont'd. /10 ...

6. DISCUSSION OF TEST RESULTS: (cont'd.) ...

(2) (cont'd.) ...

by whipping are closed or reduced as the pile is driven further into the ground and some of the water which collects around the shaft may be absorbed into the pile itself. In the case of constant diameter steel tubes, voids formed by whipping are maintained and even accentuated as the pile penetrates. No water can be absorbed into the pile. Since the presence of water-filled voids around a pile shaft is extremely detrimental from a strength point of view, the conclusions to be reached from the foregoing argument, are self-evident.

(3) Effect of Protruding Shoe Plates:

Since it was believed that a protruding shoe plate has a detrimental effect on the strength of a friction pile with a constant shaft diameter driven into cohesive soil, two piles were fitted with different shoes in order that a comparison might be made. Pile #3 was fitted with a shoe plate having a diameter 3/4" greater than the pile, and Pile #5 was fitted with a shoe plate of the same diameter as the pile. The results of the extraction tests on these piles which were identical in all respects other than the shoes, indicate that the effect of the end protrusion is negligible. For the actual comparisons, the reader is referred to Table II.

(4) Comparison of Driving Conditions - Pile #4 & Pile #8:

Pile #8 was driven so that pile driving conditions could be compared at the separate sites of the Hwy. #400/Jane St. structure and the Ramp N-W/Black Creek structure, the latter being the site of

cont'd. /11 ...

6. DISCUSSION OF TEST RESULTS: (cont'd.) ...

(4) (cont'd.) ...

the load and extraction tests. For this purpose, a comparison can be made between Pile #8 and Pile #4 since these piles are of the same type and size. A plot of blows/ft. versus penetration for both piles is included in the Appendix of this report and shows that on the average, Pile #8 required about twice the energy and time to penetrate to any particular depth, as Pile #4.

A prediction of the permanent strength of friction piles driven into cohesive soils cannot be made on the basis of driving resistance alone, since the governing factor is the shear strength of the subsoil (Chellis - Pile Foundations - page 27). Taking into account both factors, the following conclusions are drawn:

Where subsoil conditions are similar to those at the location of Pile #8, Class 'A' timber piles with an embedded length of 45 feet, should attain a safe load of 35 tons per pile. For 12¾" O.D. steel tubes, an embedded length of about 75 feet should be sufficient to provide a safe load of 50 tons/pile.

7. SUMMARY:

The results of a series of pile load and extraction tests carried out at the site of the proposed Hwy. #400 - Jane St. interchange in Metropolitan Toronto, are reported.

Subsoil at the site consists of at least 100 feet of firm to hard cohesive glacial till deposits, the predominant material being clayey silt with an average undrained shear strength of about 1,500 p.s.f. down to a depth of approximately 60 feet and below that, an average strength of about 3,000 p.s.f.

cont'd. /12 ...

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

The load and extraction tests showed that Class 'A' timber piles are more than twice as efficient as 12¾" steel tubes in this particular soil. For Class 'A' timber piles, an embedded length of 45 feet should achieve a design capacity of 35 tons per pile. For 12¾" steel tubes, an embedded length of 90 feet will be required to achieve a design capacity of 50 tons per pile. In the case of the steel tubes, a pile wall thickness of 0.203" will suffice.

The test results of Piles #3 and #5 indicate that the protruding edge of a standard shoe plate of diameter 3/4" larger than the pile shaft has a negligible effect on the capacity of the pile in soils, as described in the report.

A comparison of driving resistance between Pile #4 and Pile #8, together with a comparison between the respective subsoil conditions, indicates that a slightly shorter tube pile (75 feet) will be required at the location of Pile #8 to achieve a design capacity of 50 tons per pile. For timber piles, requirements will be the same at both sites.

In order to apply the results of this testing programme to individual structures of the entire proposed interchange, a careful comparison of subsoil conditions is necessary.

cont'd. /13 ...

8. MISCELLANEOUS:

The field work for the pile testing programme was carried out during the period May 12 - July 9, 1964.

The pile driving, installation of test set-up and subsequent testing, was performed by Bermingham Construction Ltd. under W.O. #64-30056, and was supervised by Mr. Paul Payer, Project Foundation Engineer of this Section. This report was written by Mr. K. G. Selby, Senior Foundation Engineer, also of this Section.

April 1965

APPENDIX I.

Form OB-ML-285
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 6 CONTRACT NO. STRUCTURE Jane St & Hwy 400

CONTRACTOR Bermingham Construction DESIGN LOAD OF PILE To be determined

HAMMER DETAILS: TYPE Delmag D-12 WEIGHT 1.38 Tons HEIGHT OF FALL OR ENERGY 22500 ft/lb

TYPE OF ANVIL OR CAP Standard Delmag WEIGHT OF ANVIL OR CAP 500 lb

PILE DETAILS 12¾ O.D. x 0.203 Steel Tube - 13½" Ø x 1" Shoe

PILE NO. 3 LOCATION Jane St. & Hwy 400 DATE DRIVEN 12 May 1964

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 GRO'IND	PENETRATION BLOWS / FT.
46'	1	1		26	11		50'-2½"	12		76	
8:50 AM	2	1		27	12		52			77	
	3	4		28	16		53			78	
	4	3		29	16		54			79	
	5	2		30	19		55			80	
	6	2		31	22		56			81	
	7	7		32	23		57			82	
	8	7		33	25		58			83	
	9	6		34	29		59			84	
	10	5		35	30		60			85	
	11	4		36	34		61			86	
	12	6		37	32		62			87	
	13	5		38	39		63			88	
	14	1		39	36		64			89	
	15	8		40	36		65			90	
	16	8	92'	41	40		66			91	
	17	8	Splicing	42	41		67			92	
	18	6	from 9:07 PM	43	54		68			93	
	19	9	to	44	61		69			94	
	20	10	10:06AM	45	86		70			95	
	21	10		46	77		71			96	
	22	11		47	85		72			97	
	23	10		48	73		73			98	
	24	11		49	84		74			99	
	25	14	10:30AM	50	58		75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH			4	6	4	6
MEASURED REBOUND IN INCHES						

FINAL LENGTH OF PILE 52-12' FINAL CUT OFF ELEVATION 399.58'

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED

NAME (PRINT) P. Payer

DATE 19 May 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Form OB-ML-225
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 6 CONTRACT NO. _____ STRUCTURE Jane St & Hwy 400

CONTRACTOR Bermingham Construction DESIGN LOAD OF PILE To be determined.

HAMMER DETAILS: TYPE Delmag D-12 WEIGHT 1.38 Tons HEIGHT OF FALL OR ENERGY 22500 ft/lb

TYPE OF ANVIL OR CAP Standard Delmag WEIGHT OF ANVIL OR CAP 500 lb

PILE DETAILS 12¾ O.D. x 0.25 Steel Tube - 13½" Ø x 1" Shoe

PILE NO. 4 LOCATION Jane St & Hwy 400 DATE DRIVEN 11 May 1964

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.
46'	1	1		26	19		51	63		76	124
1:10PM	2	1		27	20		52	70		77	140
	3	1		28	25		53	65		78	202
	4	1		29	24		54	77		79	165
	5	1		30	29		55	78		80	139
	6	1		31	31		56	88		81	158
	7	4		32	35		57	103		82	156
	8	6		33	37		58	116		83	167
	9	6		34	40		59	143		84	230
	10	6		35	38		60	101		85	238
	11	6		36	38		61	111		86	196
	12	6		37	49		62	136	138'	87	209
	13	6		38	50		63	197 Splicing from 4:55 PM to		88	234
	14	8		39	51 Recess from 2:45 PM to		64	203 6:04 PM		89	215
	15	6		40	48 3:15 PM		65	148		90	278
	16	6	92'	41	49		66	116		91	175
	17	8 Splicing from		42	52		67	119		92	144
	18	7 1:36 PM to		43	66		68	127		93	158
	19	8 2:27 PM		44	85		69	103		94	215
	20	10		45	97		70	114		95	266
	21	11		46	85		71	142		96	305
	22	15		47	54		72	115		97	318
	23	14		48	61		73	136	6:36 PM	98	286
	24	16		49	65		74	144		98.6"	105
	25	18		50	66		75	107		100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	18	19	16	23	27	23
MEASURED REBOUND IN INCHES	1.0"	1.0"	1.0"	1.0"	1.0"	1.0"

FINAL LENGTH OF PILE 100.50' FINAL CUT OFF ELEVATION 399.58

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED _____
NAME (PRINT) P. Payer
DATE 19 May 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Form OB-ML-285
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 6 CONTRACT NO. _____ STRUCTURE Jane St & Hwy 400

CONTRACTOR Bermingham Construction DESIGN LOAD OF PILE To be determined.

HAMMER DETAILS: TYPE Delmag D-12 WEIGHT 1.38 Tons HEIGHT OF FALL OR ENERGY 22500 ft/lb

TYPE OF ANVIL OR CAP Standard Delmag WEIGHT OF ANVIL OR CAP 500 lb

PILE DETAILS 12¾ O.D. x 0.25 Steel Tube - 13½" Ø x 1" Shoe

PILE NO. 4 LOCATION Jane St & Hwy 400 DATE DRIVEN 11 May 1964

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.
40'	1	1		26	19		51	63		76	124
1:10PM	2	1		27	20		52	70		77	140
	3	1		28	25		53	65		78	202
	4	1		29	24		54	77		79	165
	5	1		30	29		55	78		80	139
	6	1		31	31		56	88		81	158
	7	4		32	35		57	103		82	156
	8	6		33	37		58	116		83	167
	9	6		34	40		59	143		84	230
	10	6		35	38		60	101		85	238
	11	6		36	38		61	111		86	196
	12	6		37	49		62	136	138'	87	209
	13	6		38	50		63	197 Splicing from 4:55 PM to		88	234
	14	8		39	51 Recess f.om 2:45 PM to		64	203 6:04 PM		89	215
	15	6		40	48 3:15 PM		65	148		90	278
	16	6	92'	41	49		66	116		91	175
	17	8 Splicing from		42	52		67	119		92	144
	18	7 1:36 PM to		43	66		68	127		93	158
	19	8 2:27 PM		44	85		69	103		94	215
	20	10		45	97		70	114		95	266
	21	11		46	85		71	142		96	305
	22	15		47	54		72	115		97	318
	23	14		48	61		73	136	6:36 PM	98	286
	24	16		49	65		74	144		98.6"	105
	25	18		50	66		75	107		100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	18	19	16	23	27	23
MEASURED REBOUND IN INCHES	1.0"	1.0"	1.0"	1.0"	1.0"	1.0"

FINAL LENGTH OF PILE 100.50' FINAL CUT OFF ELEVATION 399.58

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED _____
NAME (PRINT) P. Payer
DATE 19 May 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Form OB-ML-285
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 6 CONTRACT NO. _____ STRUCTURE Jane St & Hwy 400

CONTRACTOR Bermingham Construction DESIGN LOAD OF PILE To be determined

HAMMER DETAILS: TYPE Delmag D-12 WEIGHT 1.38Tons HEIGHT OF FALL OR ENERGY 22500 ft/lb

TYPE OF ANVIL OR CAP Standard Delmag WEIGHT OF ANVIL OR CAP 500 lb

PILE DETAILS 12¾" O.D. x 0.203 Steel Tube - 12¾" Ø x 1" Shoe

PILE NO. 5 LOCATION Jane St & Hwy 400 DATE DRIVEN 12 May 1964

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"	1	1		26	17		50-1	1/5" 7		76	
2:16 P.M.	2	1		27	14		52			77	
	3	1		28	18		53			78	
	4	2		29	16		54			79	
	5	4		30	21		55			80	
	6	7		31	25		56			81	
	7	7		32	23		57			82	
	8	9		33	24		58			83	
	9	8		34	26		59			84	
	10	12		35	31		60			85	
	11	9		36	45		61			86	
	12	9		37	38		62			87	
	13	10		38	51		63			88	
	14	8		39	54		64			89	
	15	9		40	67		65			90	
	16	7	83'	41	69		66			91	
	17	9	Splicing from 2:45 PM to 3:05 pm	42	56		67			92	
	18	9		43	55		68			93	
	19	8		44	69		69			94	
	20	14		45	60		70			95	
	21	9		46	61		71			96	
	22	9		47	53		72			97	
	23	14		48	68		73			98	
	24	15		49	69		74			99	
	25	15	3:45 PM	50	79		75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	4	7	7	7	4	10
MEASURED REBOUND IN INCHES	1.25	1.25	1.25	1.25	1.25	1.25

FINAL LENGTH OF PILE 51.57' FINAL CUT OFF ELEVATION 399.62'

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED _____
NAME (PRINT) P. Payer
DATE 19 May 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Form OB-ML-285
300 Pads — 61-6625

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 6 CONTRACT NO. _____ STRUCTURE Jane St & Hwy 400

CONTRACTOR Bermingham Const. DESIGN LOAD OF PILE To be determined.

HAMMER DETAILS: TYPE Delmag D-12 WEIGHT 1.38 T HEIGHT OF FALL OR ENERGY 22500 ft/lb

TYPE OF ANVIL OR CAP Standard Delmag WEIGHT OF ANVIL OR CAP 500 lb.

PILE DETAILS 12¾" O.D. x 0.25" Steel Tube, 13½" Ø x 1" Shoe

PILE NO. 8 LOCATION Jane St & Hwy 400 DATE DRIVEN 13 May '64

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.
37'7"	1	1		26	46		51	166		76	
2:20	2	1		27	45		52	193		77	
	3	1		28	45		53	180		78	
	4	1		29	50		54	185		79	
	5	1		30	60		55	210		80	
	6	3		31	70		56	196		81	
	7	5	3:20	32	94		57	220		82	
	8	9	83'7"	33	101		58	258		83	
	9	11	4:00	34	99		59	208		84	
	10	9		35	110	5:30	60	197		85	
	11	14		36	101 14	May '64	61	136		86	
	12	14		37	92	7:35	62	128		87	
	13	15		38	90		63	164		88	
	14	16		39	100		64	168		89	
	15	17		40	102		65	190		90	
	16	23		41	105		66	194		91	
	17	22		42	100		67	199		92	
	18	24		43	102		68	200		93	
	19	28		44	101		69	190		94	
	20	30		45	98		70	210		95	
	21	33		46	109		71	231		96	
	22	38		47	107		72	240		97	
	23	37		48	135		73	241		98	
	24	41		49	114	8:45	74	226		99	
	25	45		50	162		75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	19	19	14	14	10	20
MEASURED REBOUND IN INCHES					1.1	1.1

FINAL LENGTH OF PILE 75.92' FINAL CUT OFF ELEVATION 401.25

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED _____
NAME (PRINT) P. Payer
DATE 19 May '64

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Form OB-ML-225
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 6 CONTRACT NO. _____ STRUCTURE Jane St & Hwy 400

CONTRACTOR Bermingham Construction DESIGN LOAD OF PILE To be determined

HAMMER DETAILS: TYPE Delmag D-12 WEIGHT 1.38Tons HEIGHT OF FALL OR ENERGY 22500 ft/lb

TYPE OF ANVIL OR CAP Standard Delmag WEIGHT OF ANVIL OR CAP 500 lb.

PILE DETAILS Timber Pile (8" Ø TO 15" Ø)

PILE NO. 9 LOCATION Jane St & Hwy 400 DATE DRIVEN 22 June 1964

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.
50'-02"	1	1		26	15		51			76	
8:20 AM	2	2		27	16		52			77	
	3	5		28	17		53			78	
	4	3		29	18		54			79	
	5	2		30	19		55			80	
	6	3		31	21		56			81	
	7	3		32	22		57			82	
	8	4		33	30		58			83	
	9	3		34	30		59			84	
	10	3		35	34		60			85	
	11	4		36	36		61			86	
	12	4		37	35		62			87	
	13	5		38	37		63			88	
	14	7		39	41		64			89	
	15	5		40	42		65			90	
	16	6		41	40		66			91	
	17	7		42	46		67			92	
	18	10		43	47		68			93	
	19	9		44	60		69			94	
	20	10		45	60		70			95	
	21	12		46	66		71			96	
	22	12		47	65		72			97	
	23	12	9:25 AM	47.6"	42		73			98	
	24	14		49			74			99	
	25	14		50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH					8	7
MEASURED REBOUND IN INCHES					0.4	0.5

FINAL LENGTH OF PILE 48.9 FINAL CUT OFF ELEVATION 399.52'

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED _____

NAME (PRINT) P. Payer

DATE 22 June 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. P

FOUNDATION SECTION

Job 64-F-14 LOCATION Sta. 158+47 242' Rt. Hwy. 400 ORIGINATED BY P.P.

W.P. 113 & 114-63 BORING DATE June 25, 26 & 27, 1964. COMPILED BY P.P.

DATUM G.S.C. BOREHOLE TYPE Washboring - NX Casing. CHECKED BY H.S.

ELEV. DEPTH	SOIL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOWS/FOOT	ELEV. SCALE
398.0	Groundlevel				
0.0	Silty sand with some gravel. Loose	1	SS	6	
390.0		2	SS	7	390
8		3	SS	14	
		4	TW	PH	
		5	TW	PH	
		6	TW	PH	380
		7	TW	PH	
		8	TW	PH	
		9	SS	16	370
		10	TW	PH	
	Clayey silt with sand and traces of gravel containing occasional layers of silt and sand.	11	TW	PH	
		12	TW	20	360
		13	TW	PH	
		14	TW	PH	
		15	TW	PH	
	Firm to v. stiff.	16	TW	PH	350
		17	TW	PH	
		18	TW	PH	
		19	TW	PH	
		20	TW	PH	340
		21	TW	PH	
		22	TW	PH	
		23	TW	PH	330
		24	SS	28	
322.0		25	TW	23	
76.0					320
	Silt with traces of gravel. Compact to dense	26	SS	21	
		27	SS	40	
309.0					310
89'		28	SS	40	
		29	SS	39	
		30	SS	42	300
		31	SS	40	
		32	SS	54	
	Clayey silt with sand.	33	SS	63	
	V. stiff to hard.	34	SS	22	290
286.5		35	SS	45	
111.5	End of borehole.				
					280

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
25 50 75 100 125
STANDARD PENETRATION TEST
+ Field Vane Test △ CU
○ Unconfined Compr. (w/c)
● Triax. " (u.u)
500 1000 1500 2000 2500

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %
10 20 30

DRY UNIT WEIGHT p.c.f.	REMARKS
	Gr 15% Sa 70 Si) Cl) 15%
120	
131	
124	
132	
139	
140	
140	
139	
139	
138	
139	
140	
133	
124	Gr 6% Sa 60 Si) Cl) 34%
127	
	Gr 8% Sa 21 Si 48% Cl 23%
	Gr 8% Sa 22% Si) Cl) 70%
	Gr 0% Sa 25% Si) Cl) 75%

(3360)
(3340)
○ (Disturbed)
○ NP

MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 2

FOUNDATION SECTION

JOB 63-F-109 | LOCATION ℄, Sta. 160+70 | ORIGINATED BY R.M.

W P 113-63 | BORING DATE Sept. 12 & 13, 1963. | COMPILED BY R.M.

DATUM 407.2 | BOREHOLE TYPE Washboring | CHECKED BY M.D.

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F. + Field Vane O Unconfined Comp. Test (500 1000 1500 2000 2500)	LIQUID LIMIT — PLASTIC LIMIT — WATER CONTENT — WATER CONTENT % (10 20 30)	DRY DENSITY P.C.F.	REMARKS
407.2	Groundlevel									
0	Silty Sand.		1	SS	5					
			2	SS	10	400				
397.2	Loose to compact.		3	SS	26					Gr0% Sa24% Si49% Cl 27%
10.0	Heterogenous mixture of clay, silt, sand and gravel, containing occasional pockets and seams of sand and silt.		4	TW	H					▼ 11.8'
			5	SS	23	390			136	Gr1% Sa44% Si44% Cl 11%
			6	TW	P					
			7	SS	20				127	
			8	SS	29	380				
			9	TW	H					
			10	SS	21				130	
			11	SS	21	370				
	GLACIAL TILL		12	SS	27					
			13	SS	34	360				
			14	TW	H					
			15	SS	37				137	
			16	SS	28	350				
			17	SS	29					Gr5% Sa22% Si53% Cl 20%
			18	TW	H					
			19	SS	18	340				
			20	TW	H					
			21	SS	26					
			22	SS	20	330				
			23	TW	H					
			24	SS	50				124	Gr2% Sa 4% Si54% Cl 40%
	Stiff to Hard.		25	SS	>100	320				
318.2										
89.0	Heterogenous mixt. of silt and sand.		26	SS	74					
310.7	Very dense.		27	SS	90	310				
96.5	End of borehole.									

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 63-F-95 LOCATION Sta. 158/65 (180' Rt.) ORIGINATED BY B.K.

W P 113-63 BORING DATE Sept. 6, 1963. COMPILED BY B.K.

DATUM 397.8 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ● - Triaxial comp + - Field Vane ○ - Unconf. compr. 500 1000 1500 2000 2500	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WP W WL WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
397.8	Groundlevel									
0.0	Silty fine sand.		1	SS	5					▼ W.L. 4.0'
390.3	Loose		2	SS	9	390				
7.5	Silty clay to clayey silt.		3	TW	P					
			4	SS	15		>2000		123.9	
380.3	Stiff to very stiff.		5	TW	P	380	>2000		131.8	
17.5	Glacial till (Het. mixture of clayey silt, sand and traces of fine gravel)-Occasional seams and pockets of sand and silt.		6	SS	15					
			7	SS	15		>2000			
			8	TW	H					
			9	SS	17	370			129.2	Si 96% Cl 4%
			10	SS	15					
			11	SS	14		>2000			
	Stiff to very stiff.					360				
354.8			12	SS	16		>2000			
43.0	End of borehole.					350				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 63-F-95 LOCATION 230' Rt. Sta. 158+00 ORIGINATED BY R.M.

W.P 114-63 BORING DATE Jan. 7, 1964 COMPILED BY R.M.

DATUM 398.0 BOREHOLE TYPE Washboring and Cone Penetration CHECKED BY

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
398.0	Groundlevel					
0	Silty sand.		1	SS	8	
387.5	Loose		2	SS	11	390
10.5	Clayey silt		3	SS	13	
378.0	Stiff		4	SS	18	380
20	Heterogeneous mixture of clay, silt, sand, traces of fine gravel with occasional seams and pockets of sand and silt.		5	SS	17	
			6	SS	21	370
			7	SS	24	
			8	SS	21	360
			9	SS	23	
			10	SS	28	350
			11	SS	20	
	GLACIAL TILL		12	SS	21	340
			13	SS	22	
			14	SS	23	330
			15	SS	23	
			16	SS	36	320
			17	SS	34	
			18	SS	54	310
			19	SS	52	
			20	SS	85	300
			21	SS	49	
290.0	Stiff to hard					290
100			22	SS	76	
	Heterogeneous mixture of sand and silt.		23	SS	51	280
			24	SS	32	
			25	SS	23	270
			26	SS	23	
261.5	Compact to v. dense.		27	SS	12	260
136.5	End of borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F. + Vane Test 500 1000 1500 2000 2500

LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w

WATER CONTENT % 10 20 30

BULK DENSITY P.C.F.

REMARKS

WL 3.8'

Gr5%Sa16% Si56%Cl 23%

Gr 5% Sa31% Si47%Cl 17%

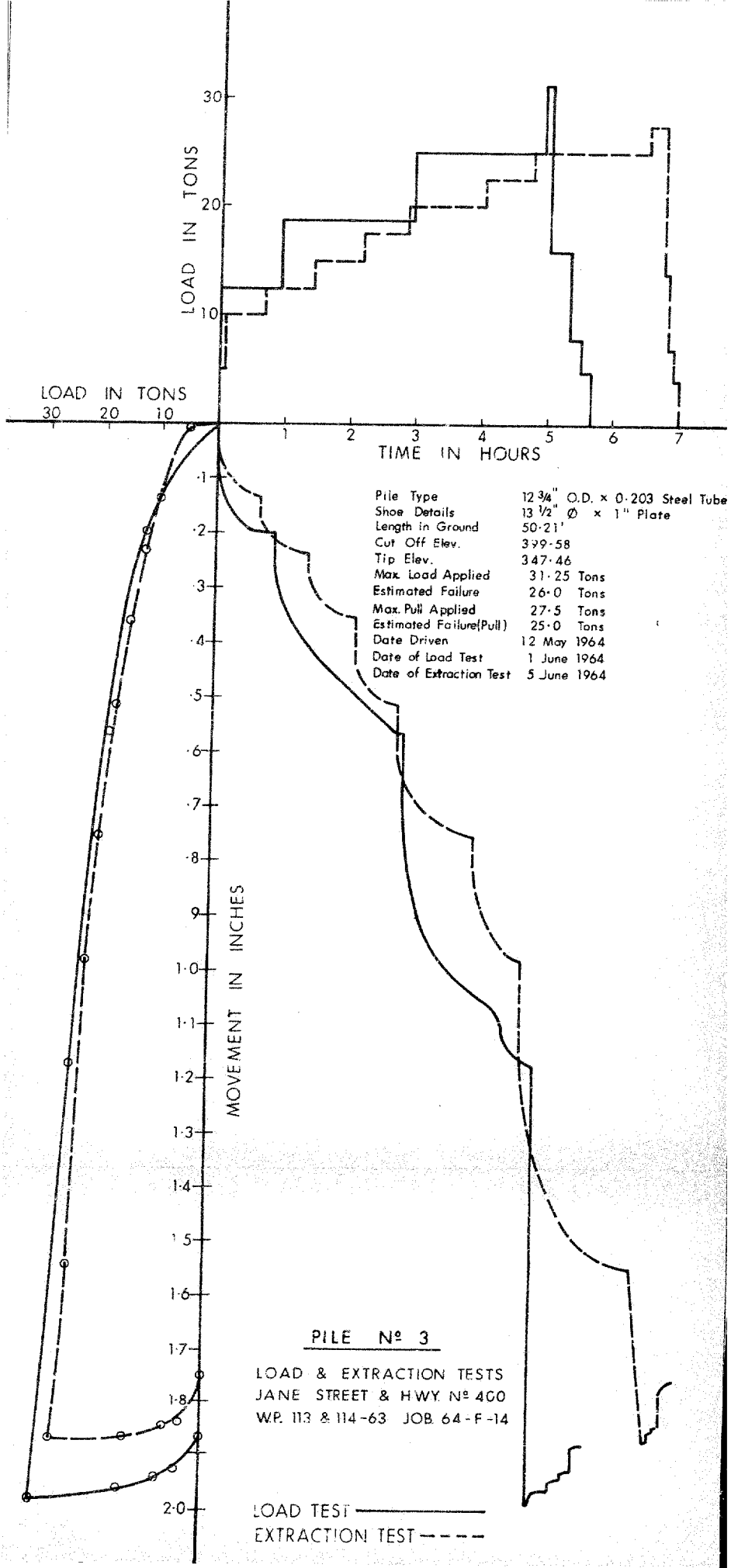
Sa29%Si49% Cl 22%

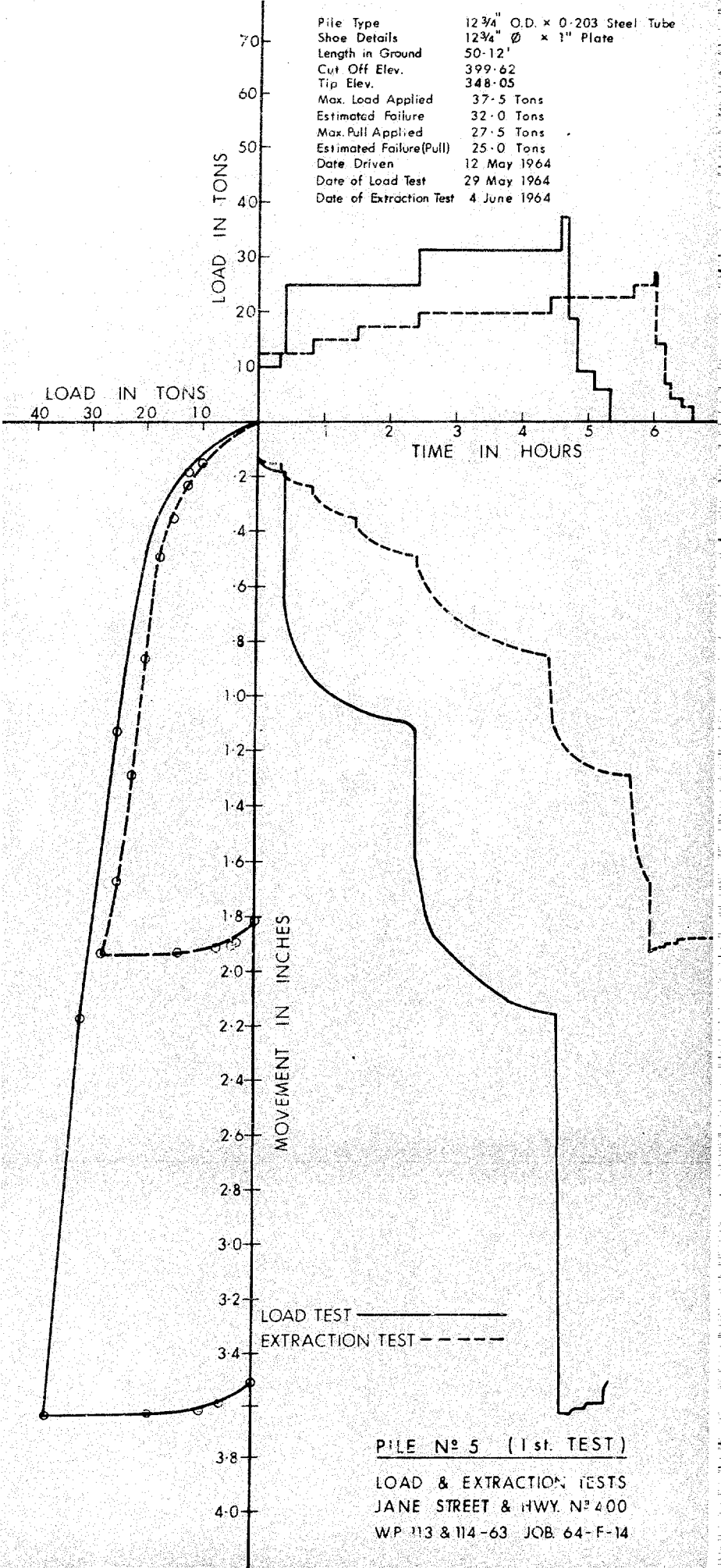
Sa5%Si70% Cl 25%

Gr2%Sa28% Si52%Cl 18%

Gr4%Sa16% Si59% Cl 21

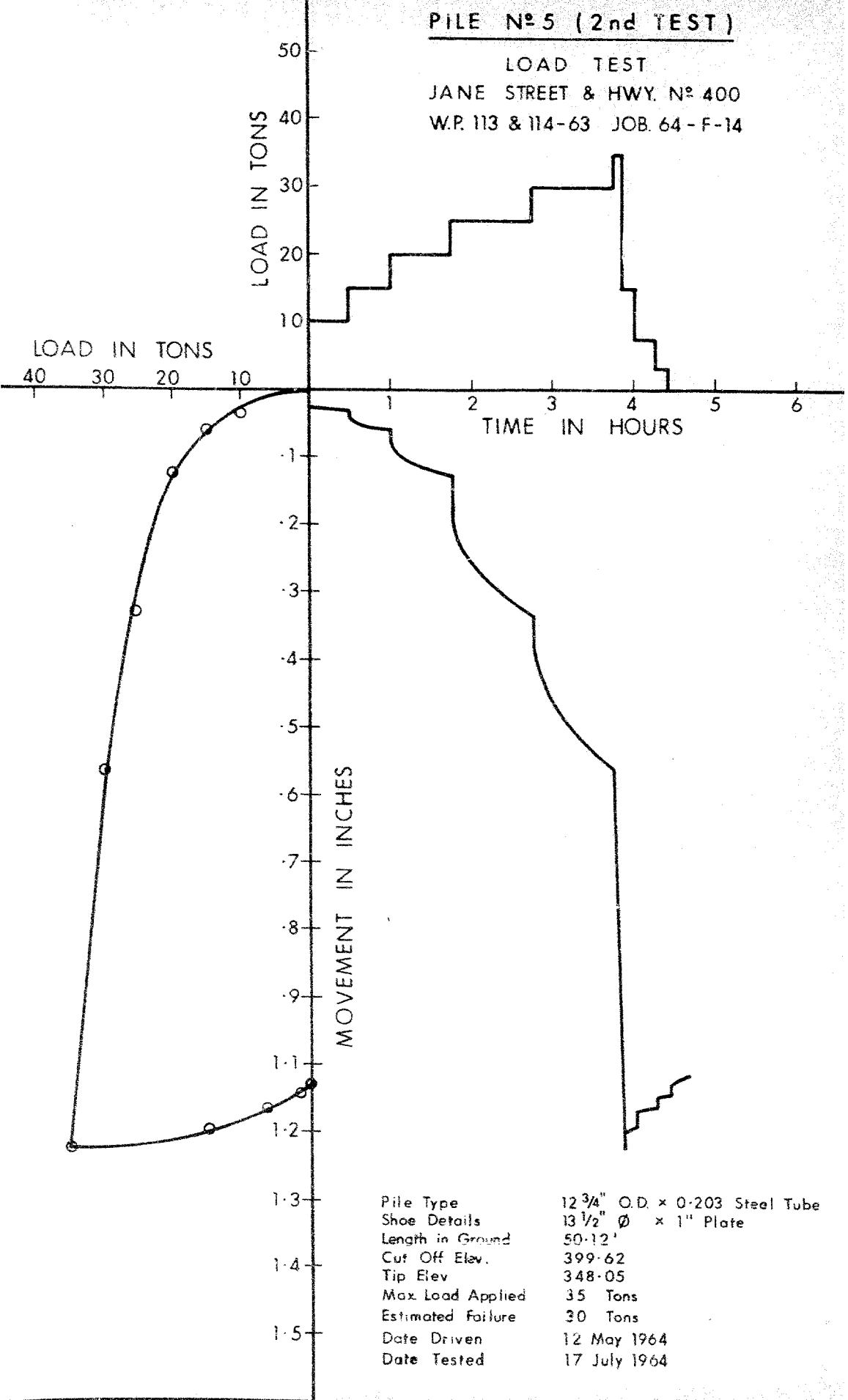
Gr1%Sa46% Si40%Cl 13%


LOAD IN TONS
30
20
10
1
2
3
4
5
6
7
TIME IN HOURS
Pile Type 12 3/4" O.D. x 0·203 Steel Tube
Shoe Details 13 1/2" Ø x 1" Plate
Length in Ground 50·21'
Cut Off Elev. 399·58
Tip Elev. 347·46
Max. Load Applied 31·25 Tons
Estimated Failure 26·0 Tons
Max. Pull Applied 27·5 Tons
Estimated Failure(Pull) 25·0 Tons
Date Driven 12 May 1964
Date of Load Test 1 June 1964
Date of Extraction Test 5 June 1964
MOVEMENT IN INCHES
·1
·2
·3
·4
·5
·6
·7
·8
·9
1·0
1·1
1·2
1·3
1·4
1·5
1·6
1·7
1·8
2·0
PILE Nº 3
LOAD & EXTRACTION TESTS
JANE STREET & H.W.Y. Nº 400
W.P. 113 & 114-63 JOB 64-F-14
LOAD TEST
EXTRACTION TEST

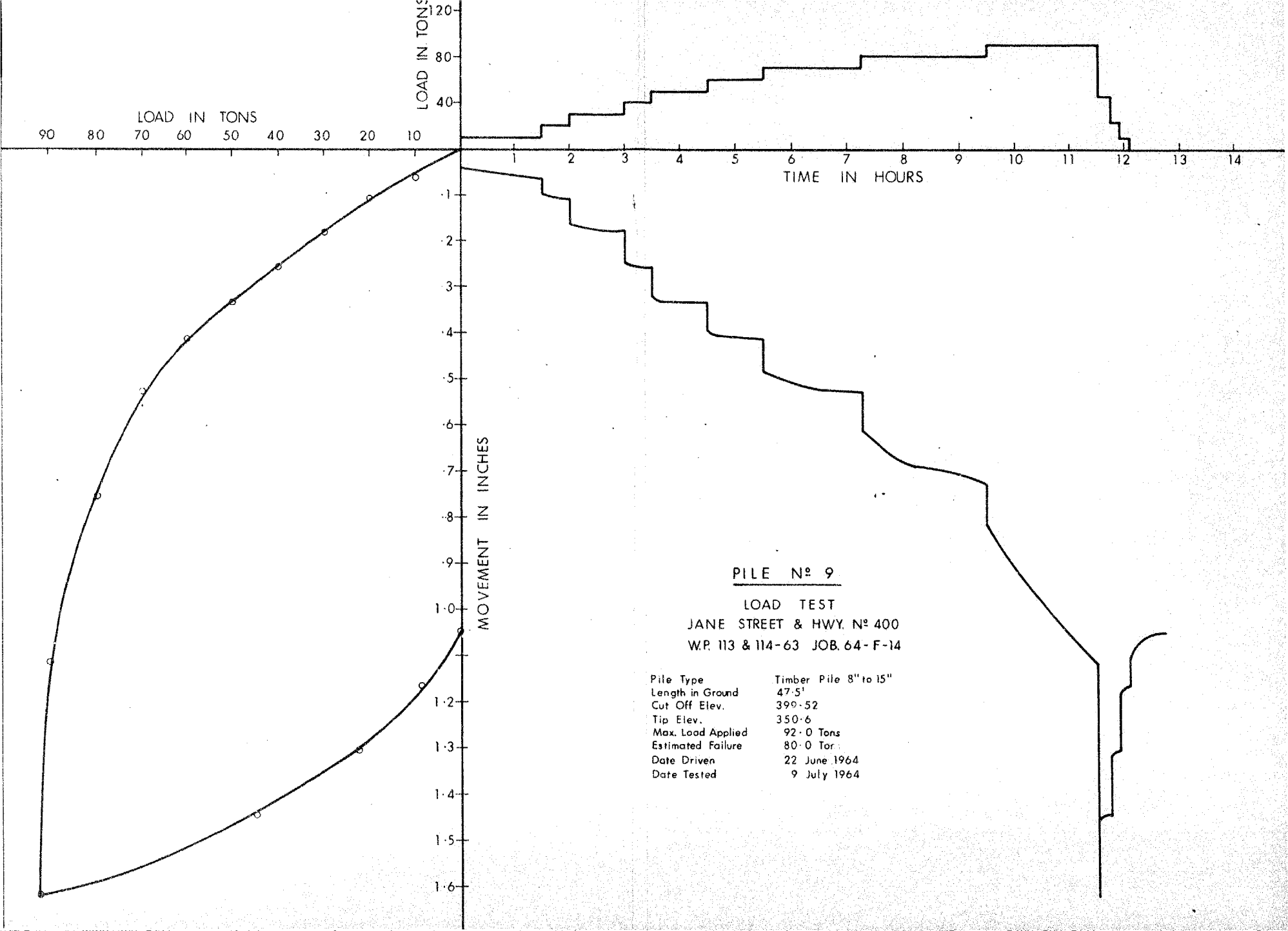

Pile Type 12¾" O.D. × 0·203 Steel Tube
Shoe Details 12¾" Ø × 1" Plate
Length in Ground 50-12'
Cut Off Elev. 399·62
Tip Elev. 348·05
Max. Load Applied 37·5 Tons
Estimated Failure 32·0 Tons
Max. Pull Applied 27·5 Tons
Estimated Failure(Pull) 25·0 Tons
Date Driven 12 May 1964
Date of Load Test 29 May 1964
Date of Extraction Test 4 June 1964
LOAD IN TONS
70
60
50
40
30
20
10
LOAD IN TONS
40 30 20 10
1 2 3 4 5 6
TIME IN HOURS
·2
·4
·6
·8
1·0
1·2
1·4
1·6
1·8
2·0
2·2
2·4
2·6
2·8
3·0
3·2
3·4
3·8
4·0
MOVEMENT IN INCHES
LOAD TEST
EXTRACTION TEST
PILE Nº 5 (1st. TEST)
LOAD & EXTRACTION TESTS
JANE STREET & HWY. Nº 400
W.P. 113 & 114-63 JOB. 64-F-14

PILE Nº 5 (2nd TEST)

LOAD TEST
JANE STREET & HWY. Nº 400
W.P. 113 & 114-63 JOB. 64-F-14



Pile Type	12 3/4" O.D. × 0·203 Steel Tube
Shoe Details	13 1/2" Ø × 1" Plate
Length in Ground	50·12'
Cut Off Elev.	399·62
Tip Elev	348·05
Max Load Applied	35 Tons
Estimated Failure	30 Tons
Date Driven	12 May 1964
Date Tested	17 July 1964



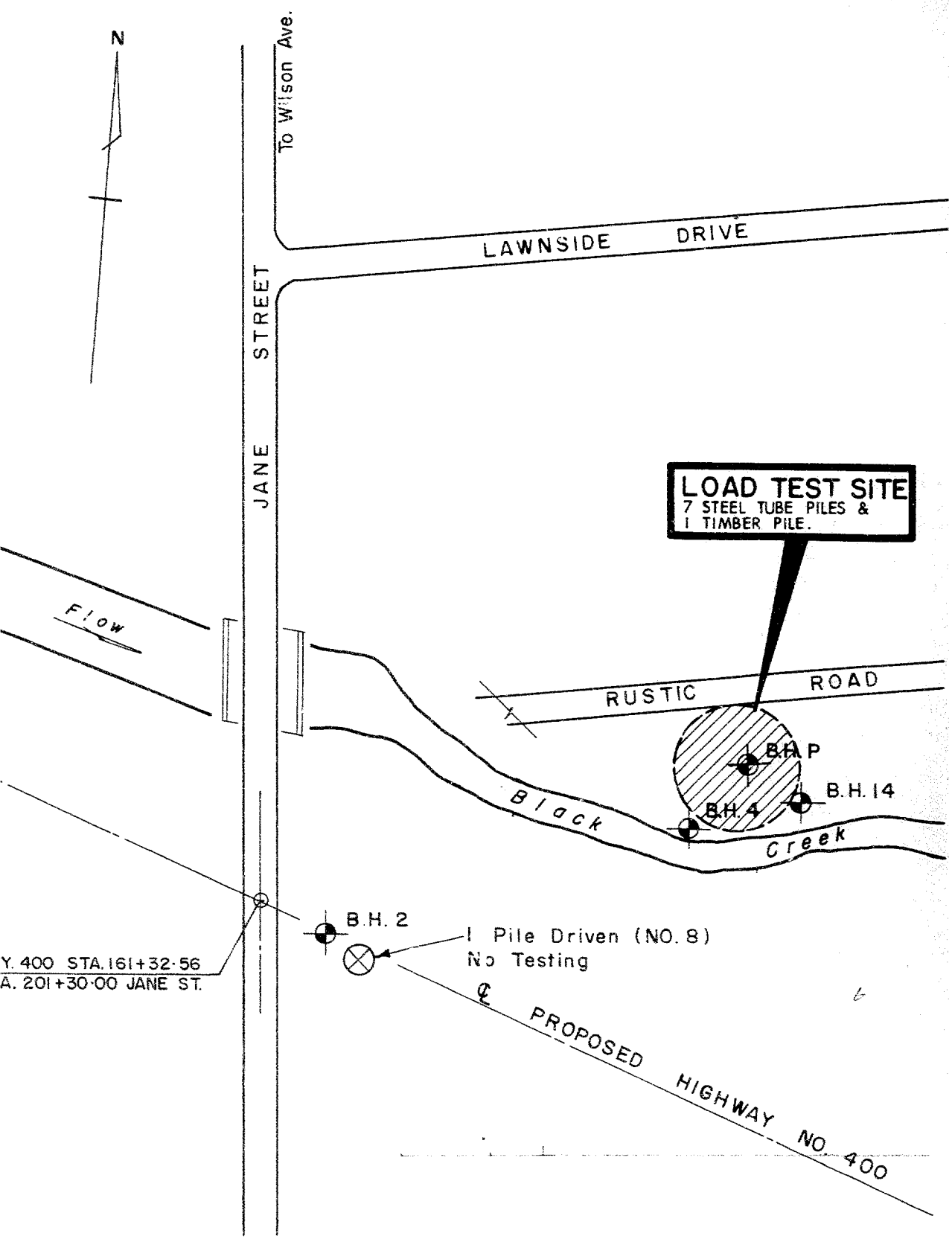
PILE Nº 9

LOAD TEST

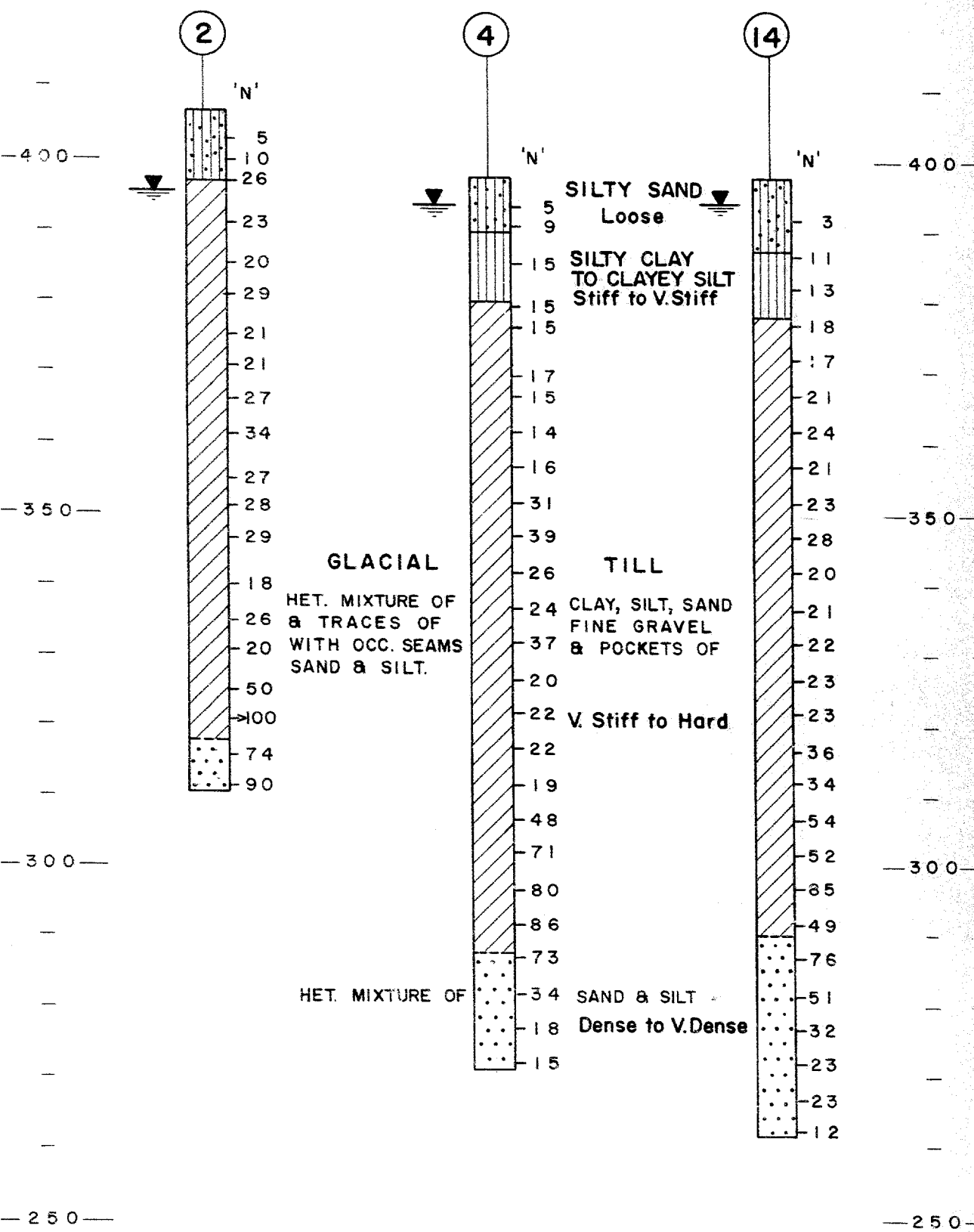
JANE STREET & HWY. Nº 400

W.P. 113 & 114-63 JOB. 64-F-14

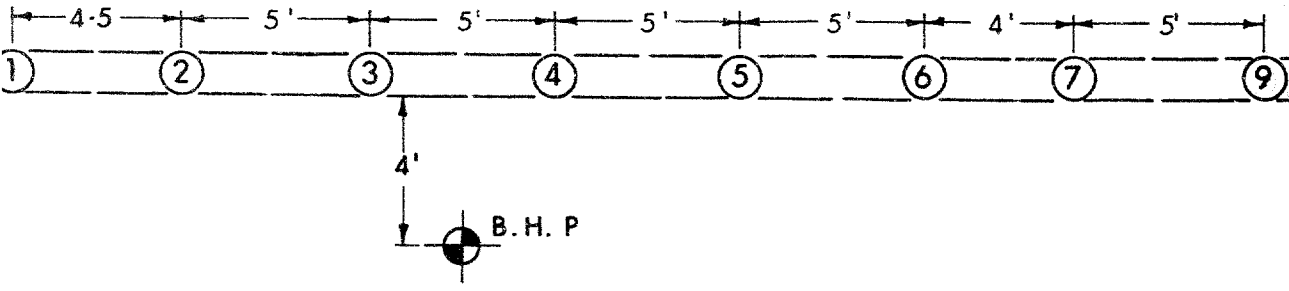
Pile Type	Timber Pile 8" to 15"
Length in Ground	47·5'
Cut Off Elev.	399·52
Tip Elev.	350·6
Max. Load Applied	92·0 Tons
Estimated Failure	80·0 Tons
Date Driven	22 June 1964
Date Tested	9 July 1964



IGINATED K. G. S.	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE 1 in. = 100 ft.
AWN H. D. R.	MATERIALS & RESEARCH SECTION	W. P. NO. 113 & 114-63
ECKED	JANE STREET & HWY. 400	JOB NO. 64 - F - 14
PROVED	PILE TEST LOCATION	DWG. NO. 64-F-14A
TE 5 MAR. 1964		



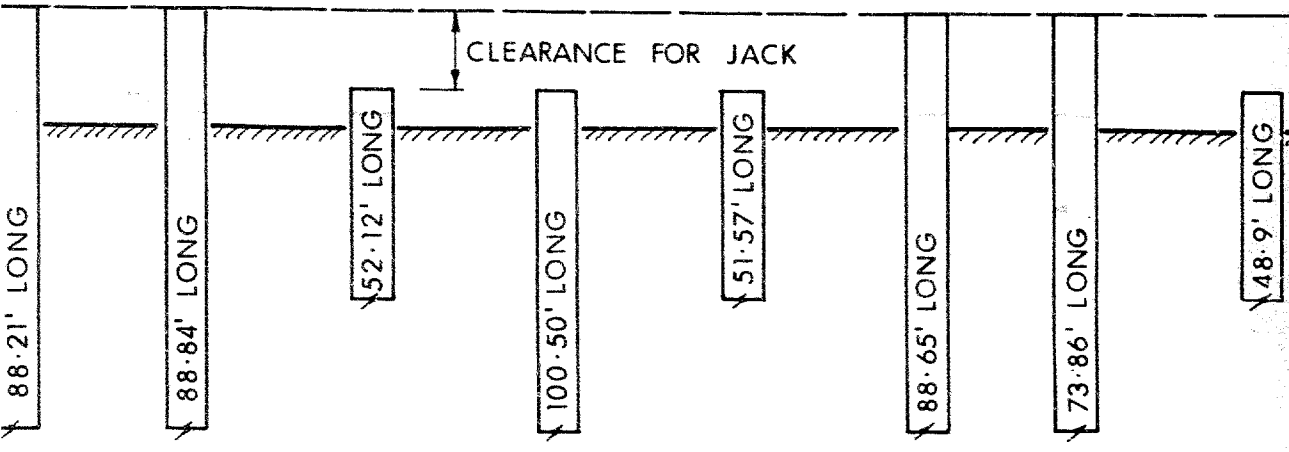
ORIGINATED K. G. S.	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE 1 in = 20 ft. Ver
DRAWN H. D. R.	MATERIALS & RESEARCH SECTION	W. P. NO. 113 & 114 - 63
CHECKED	JANE STREET & HWY. 400	JOB NO. 64 - F - 14
APPROVED	SUB-SOIL STRATIGRAPHY AT BOREHOLES	DWG. NO. 64 - F - 14 B
DATE 5 MAR. 1964		



PLAN

SCALE: 1 in. = 5 ft.

REACTION BEAM



SECTION

NOTE: Nº 4 & 8 - $12\frac{3}{4}$" × 0·25" TUBULAR STEEL PILES
Nº 1, 2, 3, 5, 6, & 7 - $12\frac{3}{4}$" × 0·203" TUBULAR STEEL PILES
Nº 9 - UNTREATED TIMBER PILE

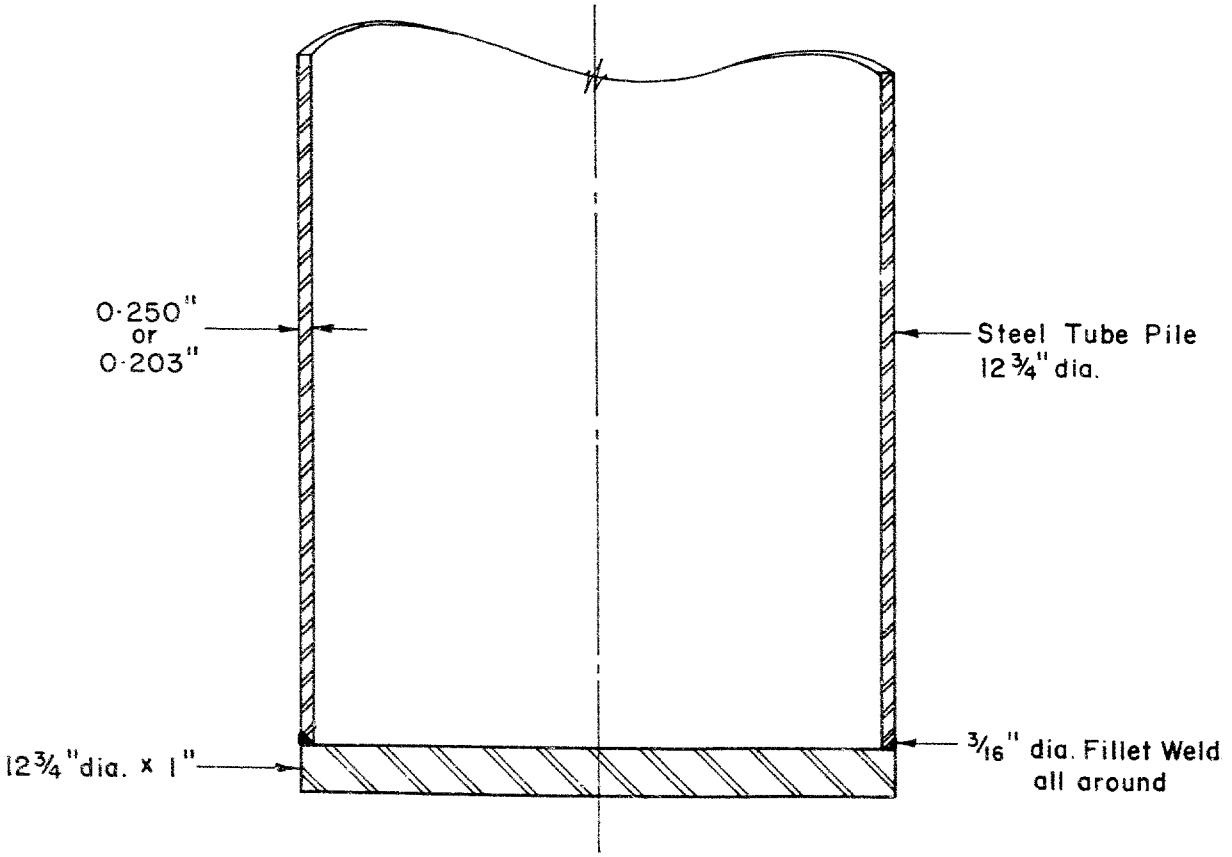
LOCATION OF PILES (HWY. Nº 400 STATIONS)

PILE Nº	1	STA. 158+58	248' RT.
" "	2	" 158+53·6	247·5' "
" "	3	" 158+48·7	246·5' "
" "	4	" 158+43·8	245·8' "
" "	5	" 158+38·8	245' "
"	6	" 158+33·8	244·3' "
"	7	" 158+30	243·7 "
" "	8	" 160+40	10' LT.
	9	158+25	243' RT.

DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

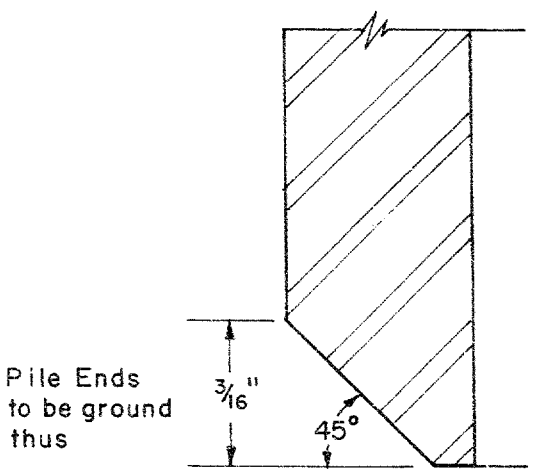
JANE STREET & HIGHWAY Nº 400
ARRANGEMENT OF TEST PILES ANCHOR PILES & REACTION BEAM

DATE APRIL 12, 1965 | APPROVED [signature] | DRAWING NO. 64 - F - 14 C



PILE SHOE

Scale – 3 inches = 1 foot

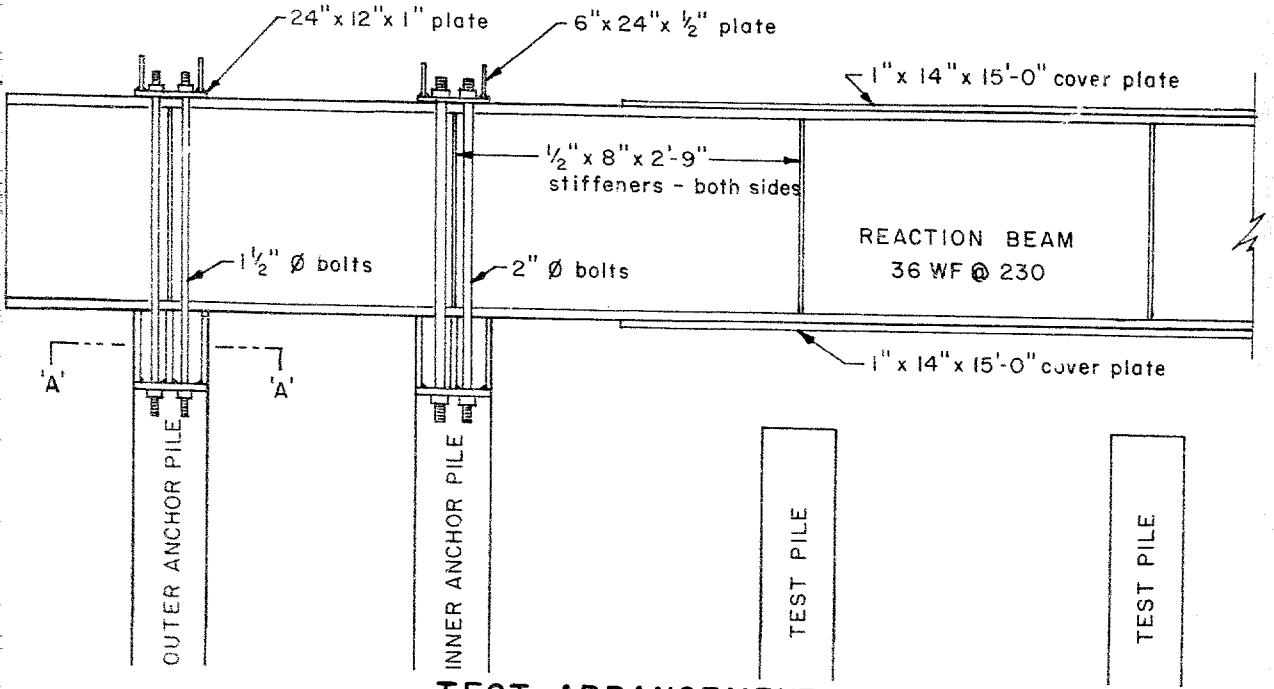


NOTE – For Piles 4, 5 & 8 refer to Bridge Design Standards 4.5.2.1. Sept. 63

PILE END PREPARATION

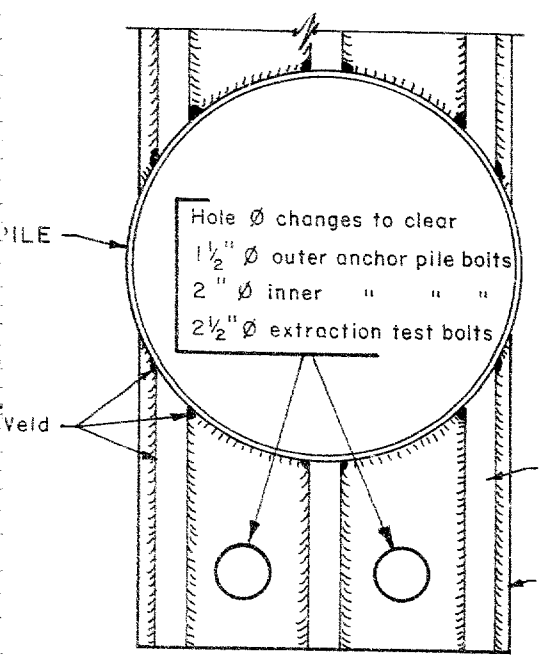
Enlarged 4 times actual size

ORIGINATED	K. Selby	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE As Shown
DRAWN	H. Reed	MATERIALS & RESEARCH SECTION	W. P. NO. 113 & 114 - 63
CHECKED		DETAILS OF PILE SHOES	JOB NO. 64-F-14
APPROVED		FOR PILES 1, 2, 3, 6 & 7	DWG. NO. 64-F-14D
DATE	25 March 1964		



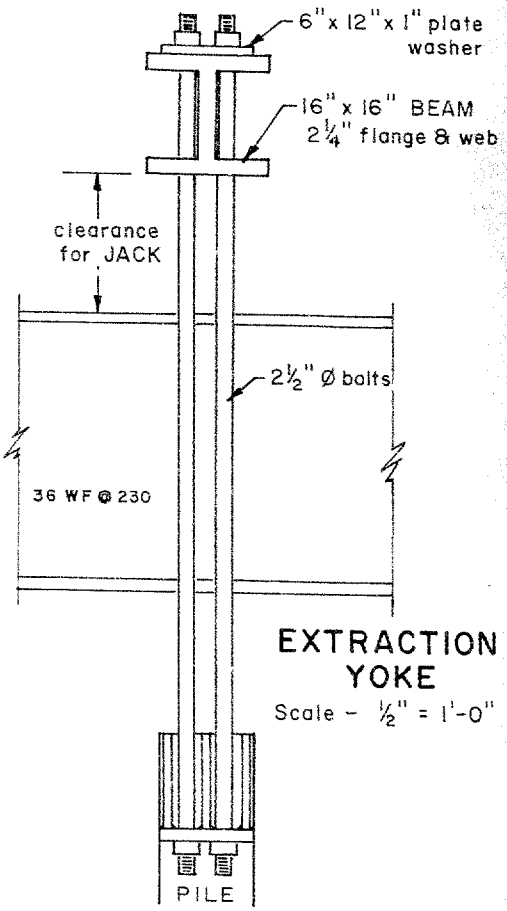
TEST ARRANGEMENT

Scale - ⅜" = 1'-0"



A - A

Scale - 1" = 6"

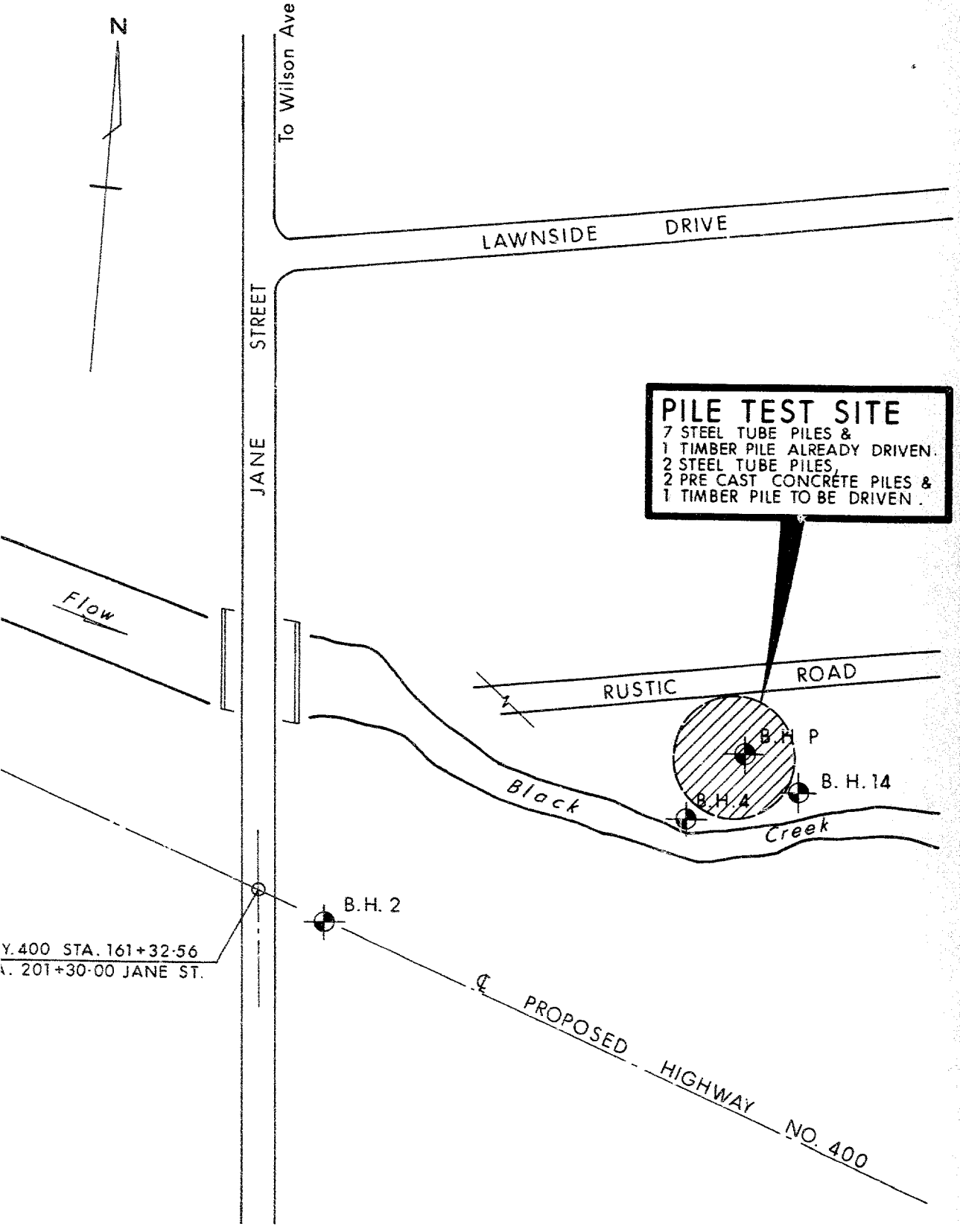


EXTRACTION YOKE

Scale - ½" = 1'-0"

se some system for attachment to test piles for extraction tests)

GINATED K. Selby	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE As Shown
WN H. Reed	MATERIALS & RESEARCH SECTION	W. P. NO. 113 & 114-63
CKED K. S.	JANE STREET & HWY. NO. 400	JOB NO. 64-F-14
ROVED H. A. Reed	PILE TEST DETAILS	DWG. NO. 64-F-14E
E 3 April 1964	TEST PILES, ANCHOR PILES & REACT'N. BEAM	



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ITARIO

JANE STREET & HWY. 400

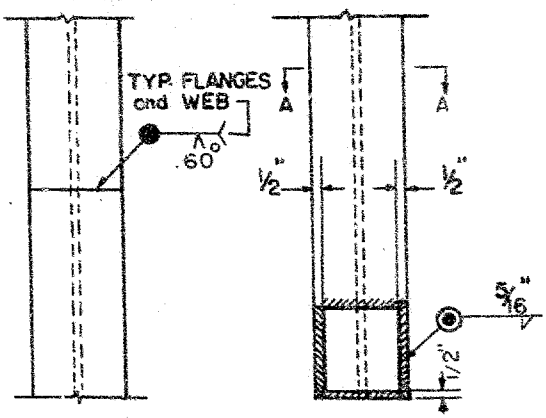
PILE TEST LOCATION

W.P. 113 & 114 - 63

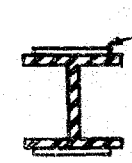
E 23 JUNE 1965 | APPROVED | DRAWING NO. 64 - F - 14 G

PILE SPLICES AND SHOES

STEEL H PILES



SPLICE SHOE PLATE

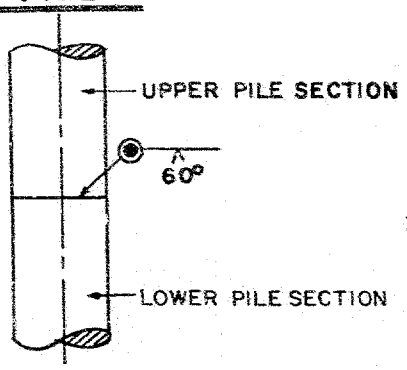


SECTION A-A

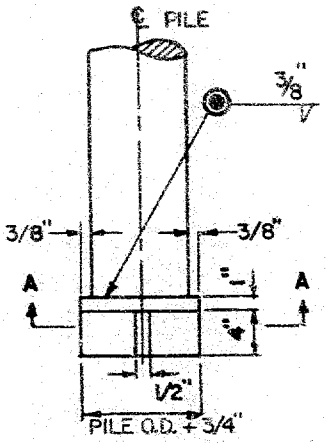
NOTE:
FOR PLATE SIZES SEE TABLE BELOW.

PILE	10 B.P. 42	12 B.P. 53	14 B.P. 73
FLANGE PLATES	9"X 1/2"X 12"	11"X 1/2"X 12"	13"X 1/2"X 12"

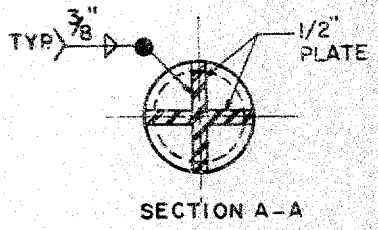
TUBE PILE



SPLICE



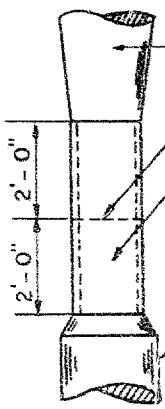
SHOE



SECTION A-A

THIS SHOE FOR ANY DIAMETER TUBE PILE.

TIMBER PILES



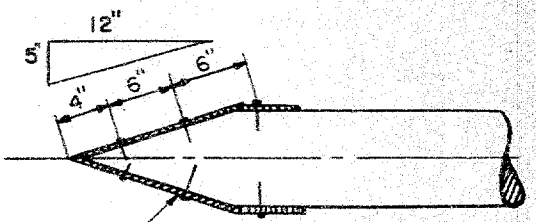
UPPER PILE SECTION: CUT TIP TO FIT SNUGLY INTO PIPE.

PILE END MUST BEAR ON SQUARE ENDS.

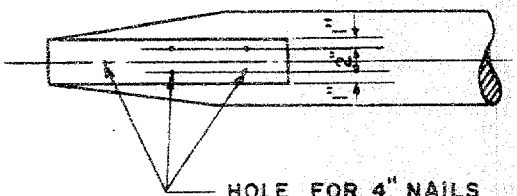
PIPE – 8" ϕ FOR SIZE 12 PILES.
10" ϕ FOR SIZE 14 PILES.

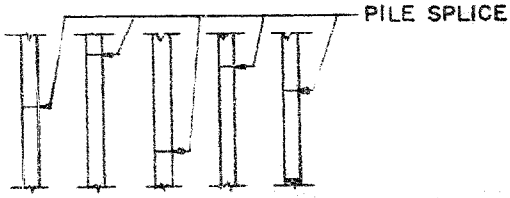
PIPE TO BE BLACK IRON WITH 0.279" WALL THICKNESS OR STEEL WITH 0.188" WALL THICKNESS.

CUT BUTT TO FIT SNUGLY INTO PIPE.



1/4" X 4" X 34" STEEL PLATE BENT TO SUIT.





DIAGRAMATIC SKETCH SHOWING SPLICE STAGGERING.

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 :-

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

TYPE OF SAMPLE

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

SOIL TESTS

Q_u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q_{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q_d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

Re: pile loading
Jane St & #400

Mr. A. E. McKim,
Bridge Contract Engineer,
Bridge Division.

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

Attn: Mr. Ken Howe,
Bridge Mat'ls. Control
Officer.

March 9, 1964

Piles for Proposed Pile Loading and Extraction Tests at Jane Street & Hwy. #400, District #6, Toronto.

WP 113-63 & 114-63.

As discussed with you by 'phone March 6, we are requesting you to requisition the following materials for use in the above project:

Steel Tube Piles -

12¾" O.D. x 0.25" wall - 4 pieces at 46'

12¾" O.D. x 0.203" wall - 10 pieces at 45'

It is intended to start the work on April 1, 1964. As yet, no Work Order has been issued, but this should be expedited shortly after we received quotations from the Contractors.

The Work Project numbers for the future structures involved in the tests are W.P. 113-63 and W.P. 114-63. Ninety-two (92) feet of 12¾" O.D. x 0.25" wall steel tube should be charged to W.P. 113-63 and the remainder to W.P. 114-63.

Please indicate where and when the piling will be made available to the Contractor.

K. G. Selby

KGS/MdeF

K. G. Selby,
SENIOR FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Foundations Office
Gen. Files

Q2

re: file leading at
June St. & 400

Materials and Research Division

March 9, 1964

Bermingham Construction Ltd.,
General Contractors,
42 Main Street West,
Hamilton, Ontario.

W.P. 113-63
114-63.

Attention: Mr. Wm. Bermingham.

Dear Sirs:

Please supply us with a firm quotation for carrying out the work outlined on the attached sheets.

It is understood that the work described will be carried out under the supervision of and to the satisfaction of the D.H.O. Foundation Section and will be subject to the conditions contained herein and to the current relevant D.H.O. specifications.

The prices quoted should be exclusive of Federal Sales Tax, but should include Ontario Provincial Sales Tax.

It is intended that the work be commenced on or about April 1, 1964.

Please include your proposed time schedule.

Yours very truly,

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

KGS/MdeF

cc: Foundations Office
Gen. Files

This letter sent also to:

Franki of Canada Ltd.

Leeds Richardson Co. Ltd.

Report filed in W.P. 113-63

PROPOSED PILE LOADING & EXTRACTION TESTS AT
JANE STREET & HWY. #400 - TORONTO, ONTARIO.

W.P. 113 & 114-63 W.J. 64-F-14

GENERAL DESCRIPTION OF WORK

The work consists of the following:

(1) The driving of eight 12¾" O.D. steel tube piles as directed by the D.H.O. to depths ranging from 50' to 90' below ground level - estimated total length 580'.

(2) Placing concrete in seven of the above piles - (3000 p.s.i. at 28 days) - estimated quantity 15 cu.yd.

(3) Splicing tube piles where necessary - estimated quantity 8.

(4) Welding driving shoes to steel tube piles - estimated quantity 8.

(5) Supplying and fixing a steel reaction beam to four anchor piles initially, and after completion of load test No. 1 attaching it also to pile #4. The beam must be capable of withstanding a load of 200 tons at the centre.

(6) Carrying out three load tests as directed by the D.H.O. on piles #4, #3 and #5 in that order, up to a maximum load of 200 tons on each pile.

(7) Supplying and installing a suitable yoke to be used in conjunction with a 200 tons jack for the purpose of extraction tests on piles #3, #4 and #5, as directed by the D.H.O. The yoke must have a capacity of 150 tons. It will not be necessary to extract each pile more than 6 inches.

(8) The installation of reference beams, gauge brackets and bearing plates for each of the three load tests and each of the three extraction tests, as directed by the D.H.O.

(9) Clearing site at completion of work.

NOTE:- If any material or equipment supplied by the Contractor proves to be inadequate or defective, it must be replaced or modified to the satisfaction of the D.H.O. at the Contractor's expense.

cont'd....2

MATERIALS:

The following materials will be supplied by the D.H.O. and made available to the Contractor at the designated points:

(1) Steel Tube Piles -

12¾" O.D. x 0.25" wall:- 4 pieces at 46'
Available at D.H.O. Yard - Winona.

12¾" O.D. x 0.203" wall:- 10 pieces at 45'
Available at D.H.O. Yard - Downsview.

(2) One 200-ton Hydraulic Jack -
Available at D.H.O. Lab. Building, Downsview.

(3) Four Deflection Gauges -
Available at D.H.O. Lab. Building, Downsview.

(4) Eight Driving Shoes (to be welded to the piles)
Available at D.H.O. Lab. Building, Downsview.

All other materials necessary for the above work must be supplied by the Contractor.

DRAWINGS:

The layout of the test piles and anchor piles is shown on the attached Drawings #64-F-14A, B & C. The sequence of operations is given on Drawing #64-F-14C. The Contractor must include with his Quotation a sketch showing details of the following:

(1) Reaction Beam

(2) Reference Beams

(3) Yoke (for extraction tests)

cont'd. 3

QUOTATION:

The Contractor should submit a quotation for carrying out the work as outlined above, such quotation to include the provision of all personnel, equipment and materials necessary except as provided for in the section headed "Materials" above. The quotation should be itemized as follows:

(1) Supply all equipment and materials for pile driving and load tests.

(2) Weld driving shoes to piles (est. quantity - 8).

(3) Splice tube piles (est. quantity - 8).

(4) Drive piles (est. quantity - 580 lin. ft.).

(5) Place concrete in piles (est. quantity - 15 cu.yd.).

(6) Carry out load tests on Piles #3, #4 & #5.

(7) Supply all equipment and materials for extraction tests.

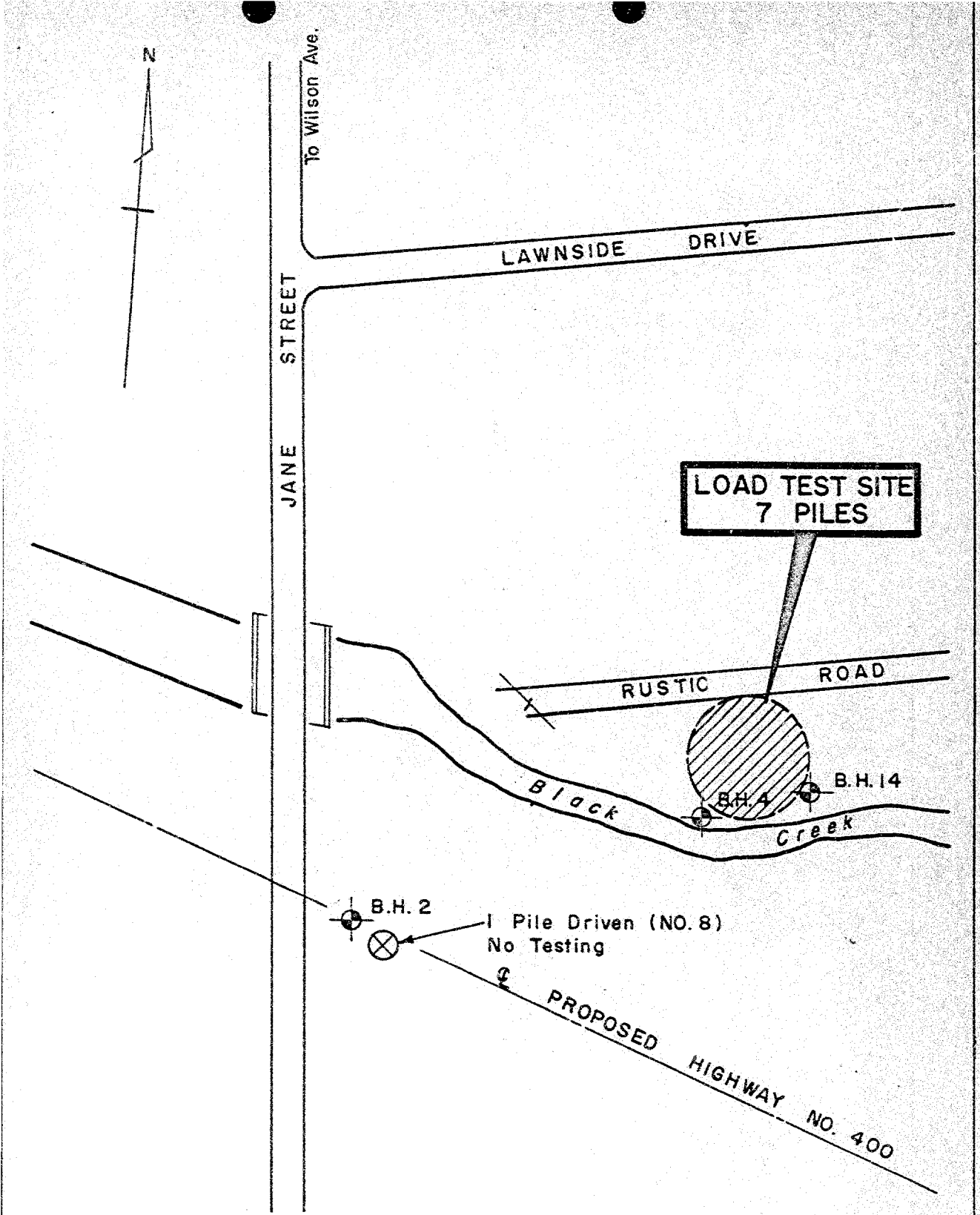
(8) Carry out extraction tests on Piles #3, #4 & #5.

SITE:

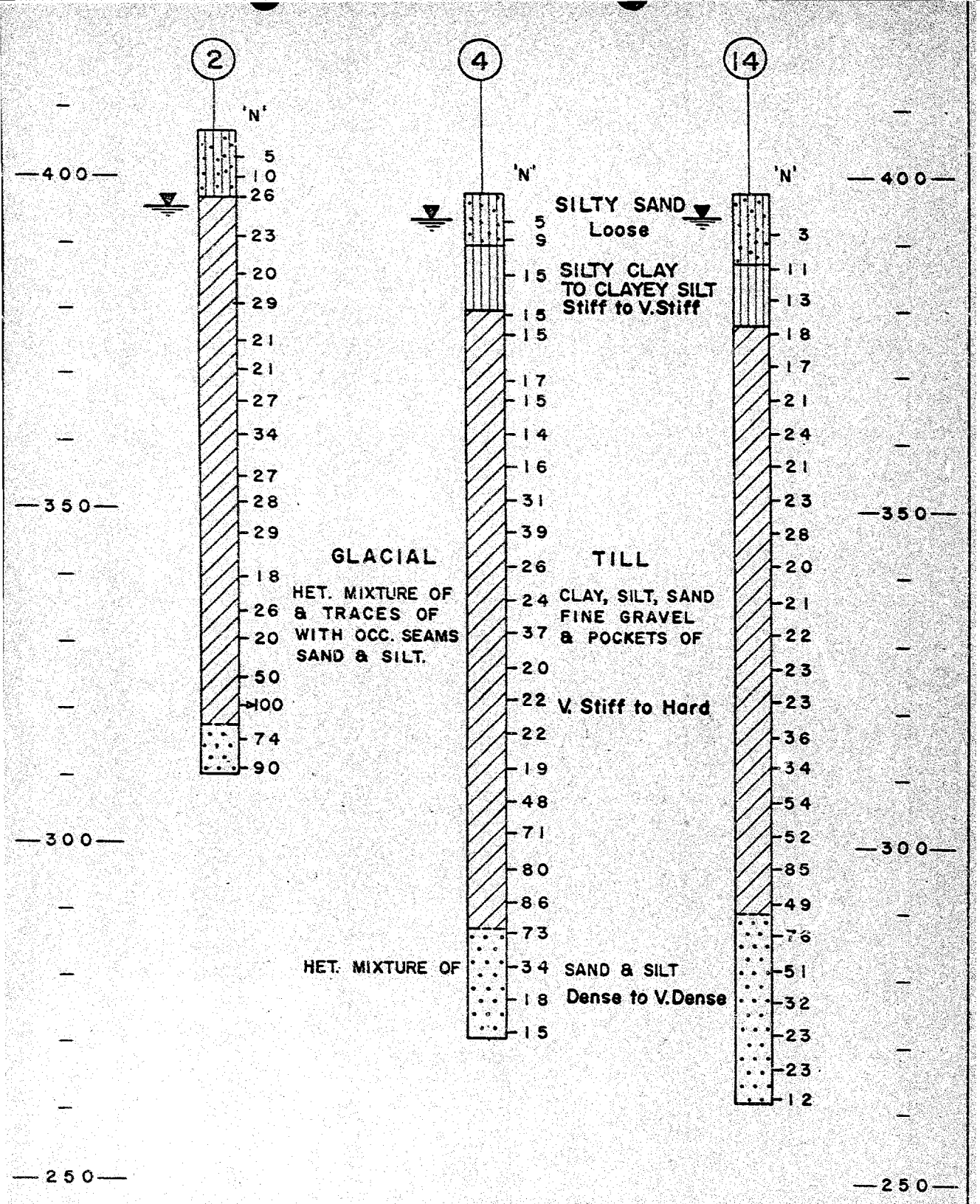
The site is located at the intersection of Jane Street and Rustic Road, Downsview. The load and extraction test area is flat and easily accessible. In order to reach the location of Pile #8, it will be necessary for the Contractor at his own expense, to arrange a temporary crossing over the 12.0' wide creek at the site.

KGS/MdeF

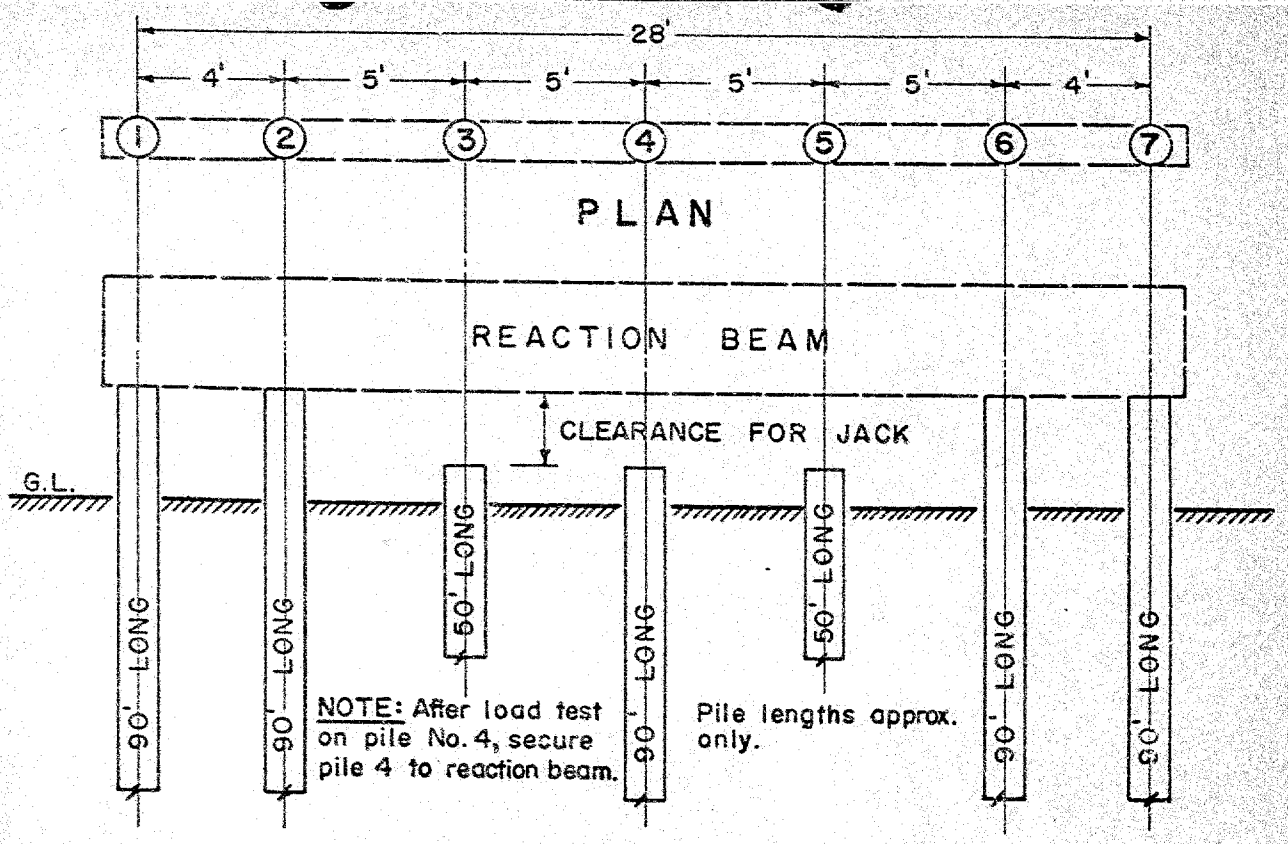
K. G. Selby,
SENIOR FOUNDATION ENGR.



ORIGINATED K. G. S.	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE 1 in. = 100 ft.
DRAWN H. D. R.	MATERIALS & RESEARCH SECTION	W. P. NO. 113 & 114-63
CHECKED HR	JANE STREET & HWY. 400	JOB NO. 64 - F - 14
APPROVED R. L. Sully	PILE TEST LOCATION	DWG. NO. 64-F-14A
DATE 5 MAR. 1964		



ORIGINATED K. G. S.	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE 1 in = 20 ft. Vert.
DRAWN H. D. R.	MATERIALS & RESEARCH SECTION	W. P. NO. 113 & 114 - 63
CHECKED	JANE STREET & HWY. 400	JOB NO. 64 - F - 14
APPROVED	SUB-SOIL STRATIGRAPHY AT BOREHOLES	DWG. NO. 64 - F - 14 B
DATE 5 MAR. 1964		



NOTE: No. 4 & 8 – 12 $\frac{3}{4}$" x 0·25" TUBULAR STEEL PILES
No. 1, 2, 3, 5, 6 & 7 – 12 $\frac{3}{4}$" x 0·203" TUBULAR STEEL PILES.

Sequence of events –

(1) Drive piles.
(2) Place concrete in piles.
(3) Attach reaction beam to anchor piles
(4) Fix reference beams and dial gauges.
(5) Load test Pile #4.
(6) Attach reaction beam to Pile #4.
(7) Load test Pile #3.
(8) Load test Pile #5.
(9) Extraction Test on Pile #3.
(10) Extraction Test on Pile #4.
(11) Extraction Test on Pile #5.
(12) Clear site to satisfaction of D.H.O.

ORIGINATED K.G. SELBY	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE 1 in. = 5 ft.
DRAWN H.D.R.	MATERIALS & RESEARCH SECTION	
CHECKED [illegible]	JANE STREET & HWY. NO. 400	W. P. NO. 113 & 114 – 63
APPROVED K. E. Selby	ARRANGEMENT OF TEST PILES	JOB NO. 64 – F – 14
DATE 9 MARCH 1964	ANCHOR PILES & REACTION BEAM	DWG. NO. 64-F-14 C

cc: Gen. Files

23-65-227

Re: Pile Loading tests
Black Creek - Hwy 400

Mr. B. R. Davis,
Bridge Design Engr.,
Bridge Division.

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

Attention: Mr. J. L. Keen

August 13, 1964

Pile Loading Tests at Black Creek and Hwy. 400
near Jane Street, Toronto, Ontario, Dist. 6.
W.P. 113 & 114-63 -- W.J. 64-F-14

Pile loading tests for timber and tubular piles have been completed at the above-mentioned location. We have reviewed the pile loading test results and submit the following recommendations:

Timber Piles:

No. 14 timber piles (treated if not completely below the water level) should provide a safe load of 30 tons if driven a distance of 45 feet into the original ground.

Tubular Piles:

12¾" Ø tubular piles driven approximately 90 feet into original ground should provide a safe capacity of 50 tons per pile.

It appears to us that the use of timber piles could provide a more economical solution. The length ratio of timber pile to steel pile is 1:2, while the safe load ratio for the respective piles is only 1:1.6. In addition to this, the cost of splicing and appreciably longer driving time of the steel pile would have to be considered.

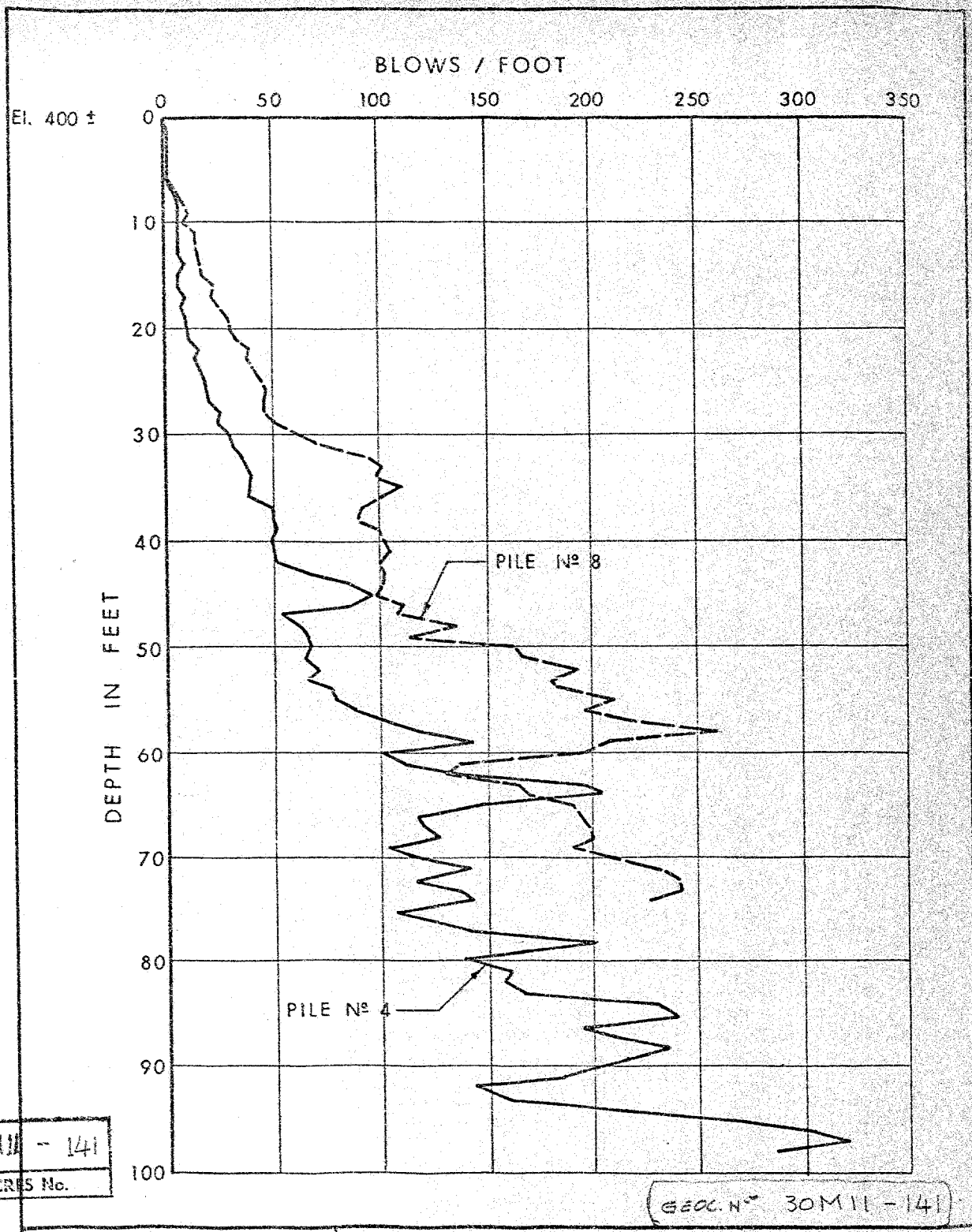
We are in the process of preparing a report giving all the pile load test and extraction test details, and will forward it to you when completed.

Should there be, in the meantime, any questions that you would like to discuss, please feel free to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF

cc: Foundations Office
Gen. Files



30M11 - 141

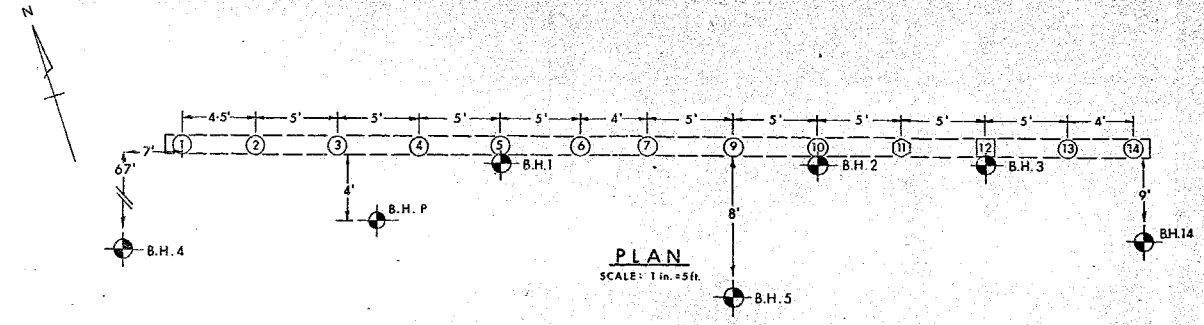
GEOCRES No.

GEOC. Nº 30M11 - 141

DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

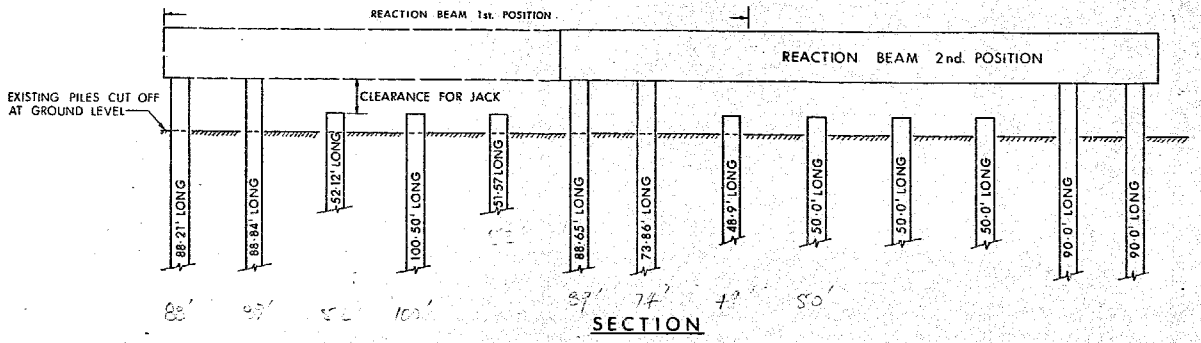
COMPARISON OF DRIVING RESISTANCE FOR PILE Nº 4 & PILE Nº 8

DATE APRIL 13, 1965 | APPROVED | DRAWING NO. 64 - F - 14 F



PLAN

SCALE: 1 in. = 5 ft.



SECTION

NOTES

PILES DRIVEN

NO. 4 – $12\frac{3}{4}$" × 0·25" TUBULAR STEEL PILE

NO. 1, 2, 3, 5, 6 & 7 – $12\frac{3}{4}$" × 0·203" TUBULAR STEEL PILES

NO. 9 – UNTREATED TIMBER PILE (CLASS 'B')

PILES TO BE DRIVEN

NO. 10 – 12" CONSTANT DIAMETER UNTREATED TIMBER PILE

NO. 11 – 12" HERKULES PRECAST CONCRETE PILE

NO. 12 – $14\frac{1}{2}$–8" TAPERED SQUARE SECTION PRECAST CONCRETE PILE

NO. 13 & 14 – $12\frac{3}{4}$" × 0·203" TUBULAR STEE PILE

LOCATION OF PILES

NO. 1 – STA. 158 + 58 248' RT ℄ HWY. 400

NO. 9 – STA. 158 + 25 243' " " " "

NO. 14 – STA. 158 + 01 239' " " " "

W.P. 113 & 114-63

30M 11-141
GEOCRES No.

DEPARTMENT OF HIGHWAYS
ONTARIO
MATERIALS and TESTING DIVISION

JANE STREET & HWY. 400

ARRANGEMENT OF TEST PILES ANCHOR PILES & REACTION BEAM

DATE 24 JUNE 1965 APPROVED DRAWING NO. 64 E 1411

#64-F-14

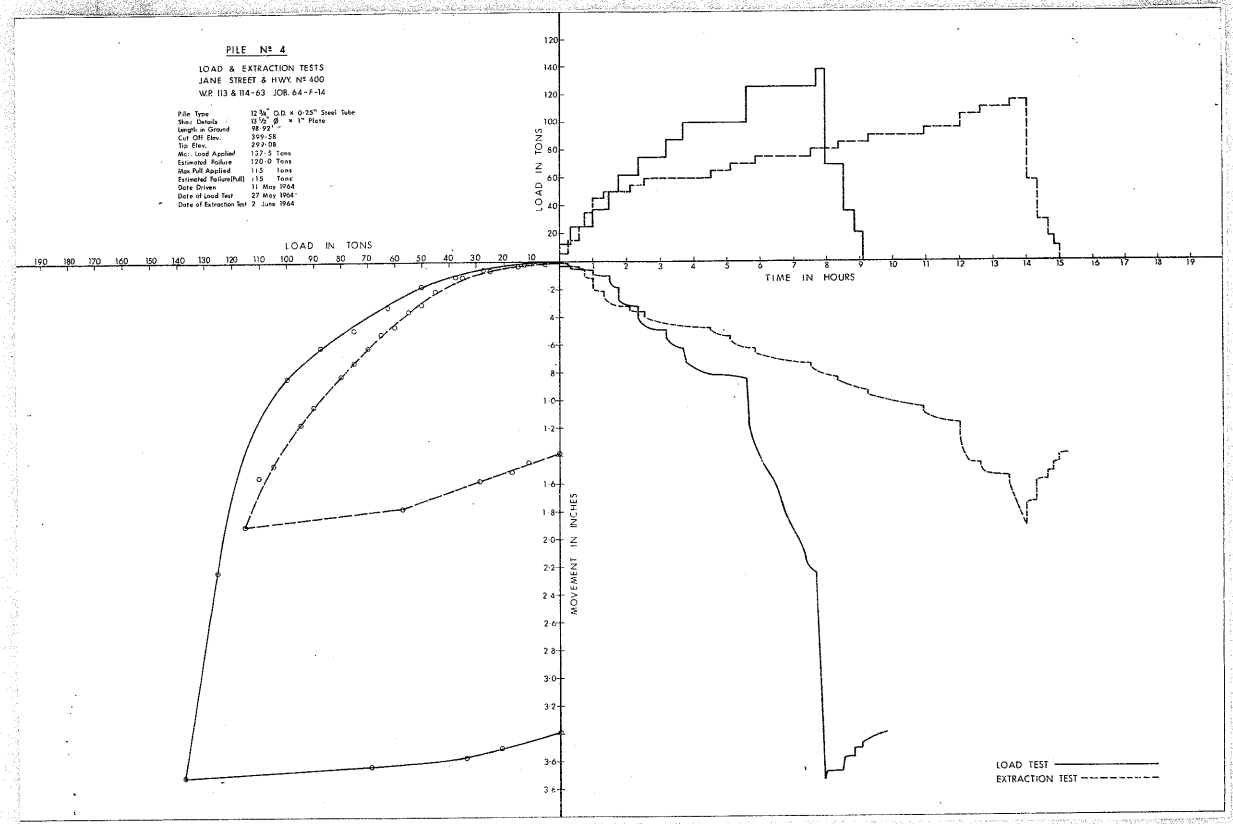
W.P. #113-63

W.P. #114-63

Hwy. #400 &

Jane St.

Interchange


PILE Nº 4
LOAD & EXTRACTION TESTS
JANE STREET & HWY. Nº 400
W.P. 113 & 114-63 JOB. 64-F-14
Pile Type 12 3/4" O.D. x 0·25" Steel Tube
Shoe Details 13 1/2" ø. x 1" Plate
Length in Ground 98·92'
Cut Off Elev. 399·58
Tip Elev. 299·08
Max. Load Applied 137·5 Tons
Estimated Failure 120·0 Tons
Max Pull Applied 115 Tons
Estimated Failure(Pull) 115 Tons
Date Driven 11 May 1964
Date of Load Test 27 May 1964
Date of Extraction Test 2 June 1964
LOAD IN TONS
MOVEMENT IN INCHES
LOAD IN TONS
TIME IN HOURS
LOAD TEST
EXTRACTION TEST