METHODS FOR PREDICTION OF THE ULTIMATE TENSION AND COMPRESSION CAPACITIES OF PRESTRESSED CONCRETE PILES DRIVEN IN FINE SANDS

ANNUAL MEETING
OF THE FLORIDA SECTION
AMERICAN SOCIETY OF CIVIL ENGINEERS
OCTOBER 1, 2 AND 3, 1987
JACKSONVILLE, FLORIDA

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ABSTRACT

METHODS FOR PREDICTION OF THE ULTIMATE TENSION AND COMPRESSION CAPACITY OF PRESTRESSED CONCRETE PILES DRIVEN INTO FINE SANDS

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Case histories of seven solid, square, prestressed, precast concrete piles driven into fine sand in Florida are presented. These piles were evaluated using two static prediction methods, (1) the Florida DOT Pile Capacity Method (FDOT Bulletin 121-A, and (2) the Federal Highway Administration Nordlund Method; and a dynamic prediction procedure (1) the Pile Driving Analyzer with the CAPWAPC wave equation computer model. Both axial tension and compression capacities were evaluated by the presented methods and compared to static pile load tests carried to failure. The pile ranged in size from 12 to 20 inches square. These piles were driven into very loose to very dense fine sands, clayey fine sands and silty fine sands. The prediction methods which correlated favorably with the static load test results are presented and discussed.

The piles evaluated and tested consisted of the following sizes:

SQUARE PRECAST CONCRETE PILE SIZE (INCHES)	PILE LENGTH (FEET)	ULTIMATE CAPACITIES FROM STATIC LOAD TESTS	
		COMPRESSION (TONS)	TENSION (TONS)
12	30	65	-
14	60	172	75
20	45 - 100	180 - 310	60 - 100

Recommendations are presented for the use and implementation of the above prediction methods in determining axial tension and compression capacities.

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METHODS FOR PREDICTION OF THE ULTIMATE TENSION AND COMPRESSION CAPACITIES OF PRESTRESSED CONCRETE PILES DRIVEN INTO FINE SANDS

INTRODUCTION

This study compares the results of two accepted analytical pile capacity analysis methods and the dynamic Pile Driving Analyzer and CAPWAPC methods with the results of seven static compression pile load test performed to failure on precast concrete piles driven in sands at four locations in the North Florida area. Three of these static compression load test piles were also tested in tension to determine their ultimate uplift capacities.

The two analytical pile capacity analysis methods used were:

1. Florida Department of Transportation - Schmertmann Method
2. Federal Highway Administration - Nordlund Method

These methods are briefly described in the following section and references are provided for obtaining details guidelines for using these methods.

The dynamic testing pile capacity analysis method uses the Pile Driving Analyzer (PDA) to monitor the initial installations and restrike driving of indicator piles at sites to obtain preliminary static pile compression capacities. The dynamic data recorded in the field by the PDA is used as input data in a sophisticated wave equation computer program (CAPWAPC) to determine the skin frictional and end bearing components of the pile capacities. The skin frictional component can then be used to evaluate the pile uplift ultimate capacities. This method is described in more detail below.

The static axial compression and tension load tests were performed on solid square precast prestressed concrete piles driven in sand in the North Florida area. These piles range in sizes from 12-inch to 20-inch square and had driven

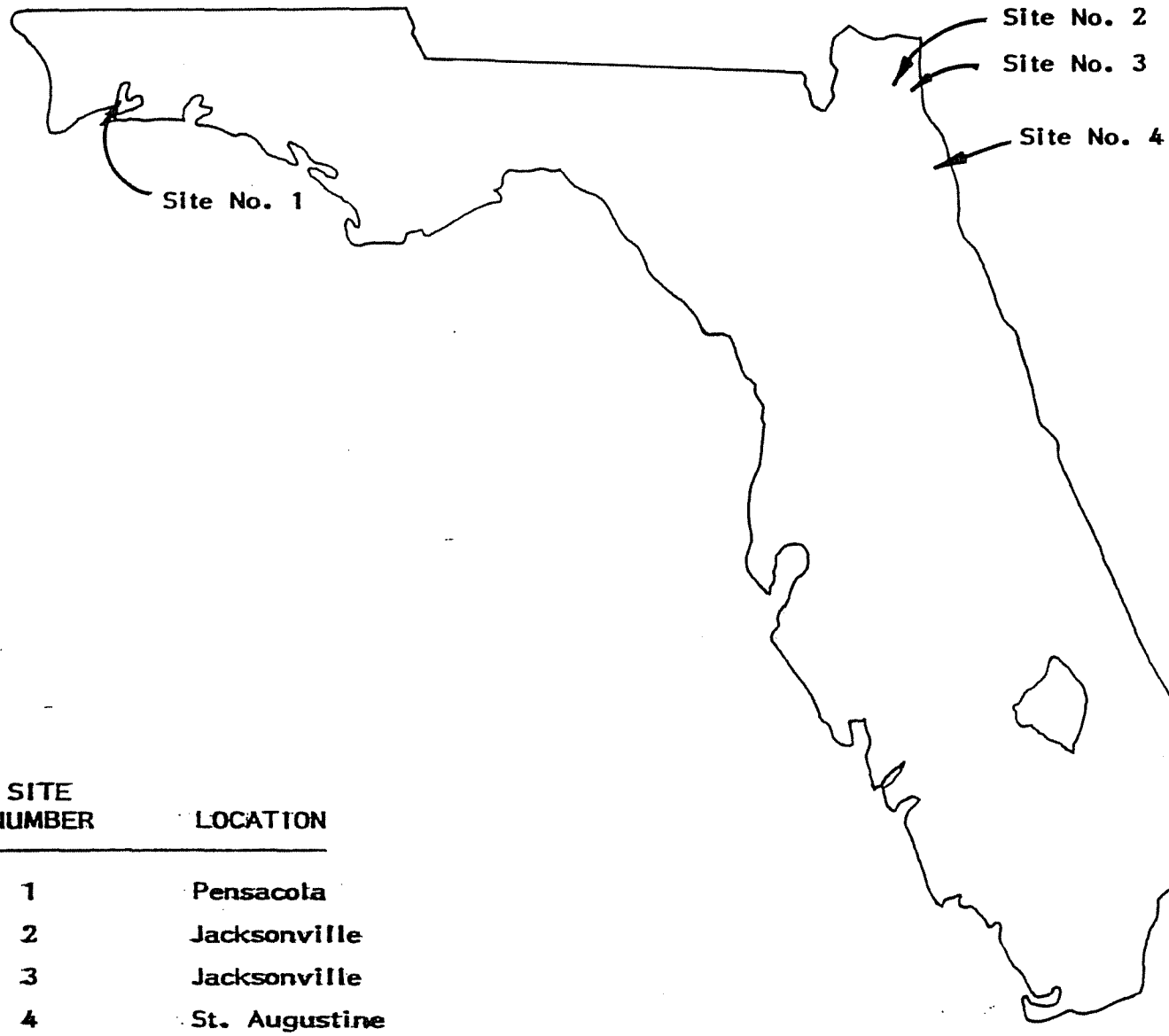
(unspliced) length ranging from 30 to 155 feet. Both single and double acting air/steam and single acting diesel pile hammers with rated energies ranging from 18,000 to 105,000 ft-lbs were used in installing the test piles. These piles were driven to pile tip depths ranging from approximately 20 to 100 feet below grade.

The static axial compression and tension pile load tests were performed in general accordance with ASTM - D1143, "Piles under Static Axial Compression Load" and ASTM D-3689, "Method for Testing Individual Piles Under Static Axial Tensile Load". The pile loadings were applied in accordance with the Standard and Quick Loading Procedures outlined in Sections 5.0 of the two procedures. The ultimate pile axial compressive capacities were determined using the Davisson criteria which is described below. The pile axial tension capacities were determined using the tangent intersection method.

The piles were installed in both marine and land environments. The piles were driven through fine sands, fine to medium sands, slightly silty to silty sands and slightly clayey to clayey fine sands of varying consistencies. The pile tips were generally driven into dense to very dense fine sands, slightly silty to silty fine sands and fine sand with shell fragments.

Site Information - Specific site information is presented individually for each test pile site in the Appendix. The sites are numbered No. 1 through No. 4 and where multiple piles are tested at each site, the piles are designated for example No. 1-A and No. 1-B (Site No. 1 - Pile A). The four site locations are shown on the following Site Plan. Each individual site project information section in the Appendix contain:

1. Project Summary Sheet
2. Subsurface Profile and Pile Installation Information
3. Soil Test Boring Record
4. Pile Driving Record
5. Static Pile Load Test - Load vs. Deflection Curve
6. CAPWAPC - Computer Pile Dynamic Analysis Results.



SITE NUMBER	LOCATION
1	Pensacola
2	Jacksonville
3	Jacksonville
4	St. Augustine

SITE LOCATION PLAN

DRAWN: WRW	DATE: 9/30/87	SCALE:
CHECKED: GTM	JOB NO: ASCE	

ANALYTICAL PILE CAPACITY ANALYSIS METHODS

Nordlund Method- This semi-emperical method of pile capacity analysis for individual driven piles is recommended by the Federal Highway Administration for use by the State Department of Transportation for piles driven into cohesionless soils (sands). This method utilizes correlations with the corrected Standard Penetration Test (SPT) N values, soil property and pile geometry to obtain various factor to be used in a general Nordlund equation. These factors account for the differences in tapered and non-tapered piles, displacement (concrete piles, closed end pipes) and non-displacement piles (H-piles,open ended pipes). This method uses the vertical effective overburden soil pressure at the mid-point of each soil layer and at the pile tip with the various correlation factors to calculate the soil skin frictional resistance and pile tip bearing capacity. The Nordlund method does not include the critical depth concept in calculating the effective overburden pressure of the various soil layers.

These Nordlund correlation factors were determined semi-emperically from pile load test programs performed on timber, H-piles, concrete, pipe, monotube and Raymond step taper. An ultimate pile capacity is calculated which is the sum of end bearing and skin frictional components. A factor of safety of FS=3 is recommended for use with this method to obtain design allowable pile capacity.

The Nordlund Method is presented in detail with correlation charts and example problems in the Federal Highway Administration "Manual on Design and Construction of Driven Pile Foundations", Report No. FHWA-DP-66-1, Revision 1, dated April, 1986. This document is available through the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

Schmertmann - Florida Department of Transportation Method - This emperical analytical method of pile capacity analysis was developed by Dr. John H. Schmertmann of the University of Florida under contract to the Florida Department of Transportation. This method uses the Standard Penetration Test (SPT) N-values directly to obtain allowable design skin frictional values and allowable pile end bearing capacities for the soil layers penetrated for individual driven, non-tapered, displacement piles (precast concrete and closed end pipe piles). Charts and tables are provided which allow design skin friction and end bearing values for various soil types and weak limestones to be selected versus SPT N-values.

This design method includes a recommended factor of safety of FS=2 for soil skin frictional capacity and FS=3 for the end bearing component of the pile capacity. A depth of embedment correction is required for the skin friction end bearing calculations in the soil layer at the pile tip. Effective overburden soil pressure calculations are not required in this method.

The Schmertmann Florida Department of Transportation method is presented in the Florida Department of Transportation Research Bulletin No. 121-A, "Guidelines for Use in Soil Investigations and Design of Foundations for Bridge Structures in the State of Florida", dated September 14, 1967. This procedure was developed from a series of static axial compression pile load test programs performed in Florida and therefore may not be appropriate for soils in other geographical areas.

DYNAMIC PILE CAPACITY EVALUATION

Dynamic Pile Testings - Dynamic pile testing was performed to evaluate the pile installation procedures, pile driving resistance, pile capacities, pile hammer performance and pile driving tension and compressive stresses. The dynamic testing methods are described below.

Pile Driving Analyzers - Six of the seven static load test piles (except for No. 4-A) were dynamically monitored using a Model GB Pile Driving Analyzer (PDA). This monitoring method utilizes reusable force and acceleration transducers attached near the pile top during driving. At each hammer blow, signals from the transducers are processed by the Pile driving Analyzer (PDA), a small field computer. The pile force and velocity signals from the transducers are displayed for each hammer blow on an oscilloscope connected to the PDA. The following figure presents a general schematic of the PDA equipment.

For each hammer blow, a readout is presented of numerous measured and calculated pile driving parameters. Some of the more commonly displayed output parameters include the following:

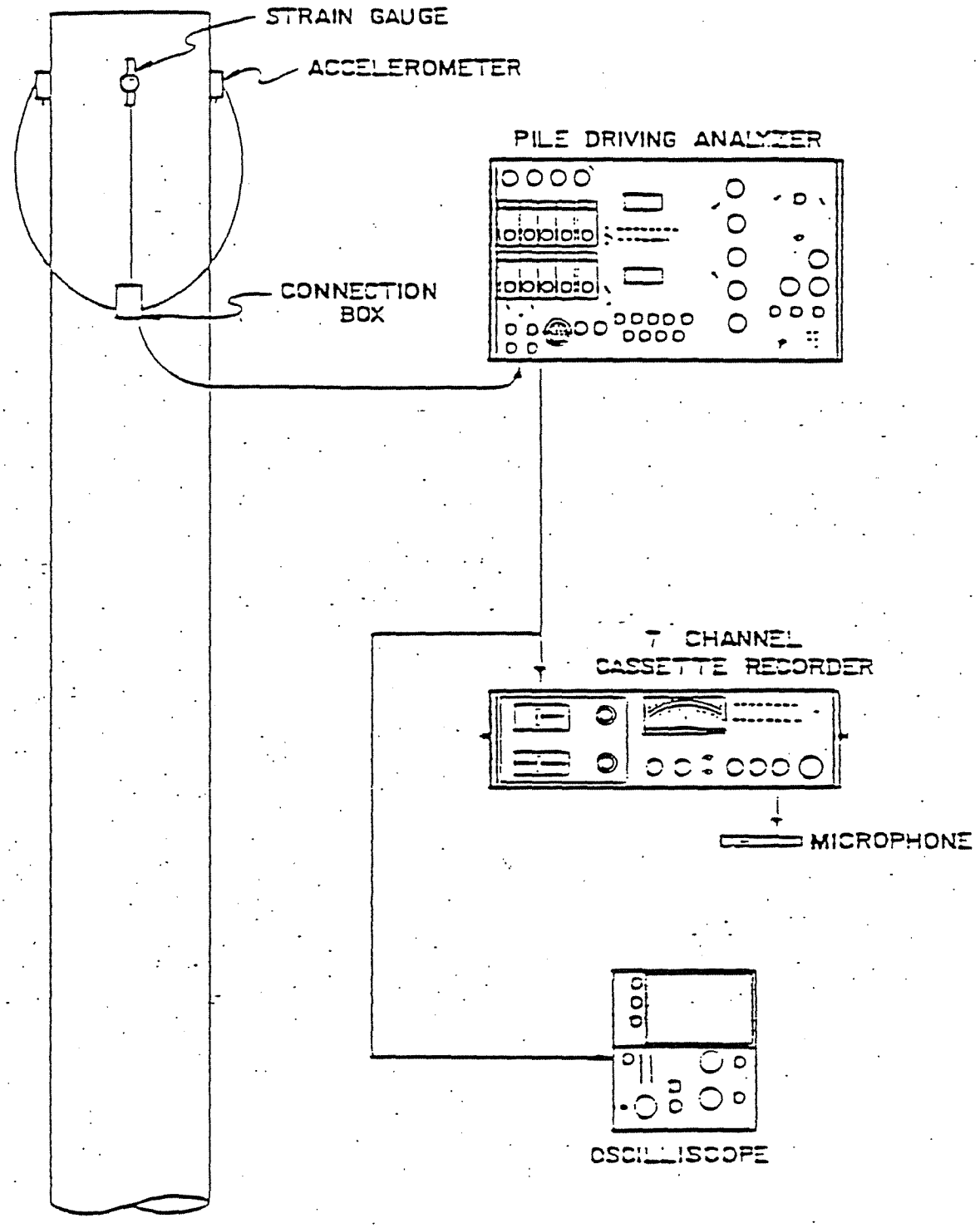
(1) Predicted ultimate static bearing capacity
(2) Energy transferred to pile by hammer
(3) Maximum compressive force (stress) in pile
(4) Maximum tension force (stress) in pile
(5) Calculated skin friction capacity
(6) Estimates of pile tip quake
(7) Pile integrity Values

During pile driving, the pile driving data displayed on the PDA was monitored to determine pile hammer and pile performance. The calculated static pile capacities were used to assist in determining when piles had been driven to the required bearing capacities. By restriking the pile after a significant period time has elapsed, any increased pile capacity due to soil set-up could also be measured.

Additional information such as hammer blows per minute, total number of blows recorded, pile top velocity and acceleration, and an index of possible pile damage was also displayed. Up to five selected output parameters can be printed on a paper tape for each hammer blow to provide a continuous permanent record of the pile driving. The field data (force and acceleration transducer measurements) are stored on a magnetic tape and can be processed later in the

PILE DRIVING ANALYZER

EQUIPMENT SCHEMATIC



office with a computer program named CAPWAPC to provide a simulated load deflection curve (predicted static load test curve), dynamic soil properties and a soil resistance distribution along the pile.

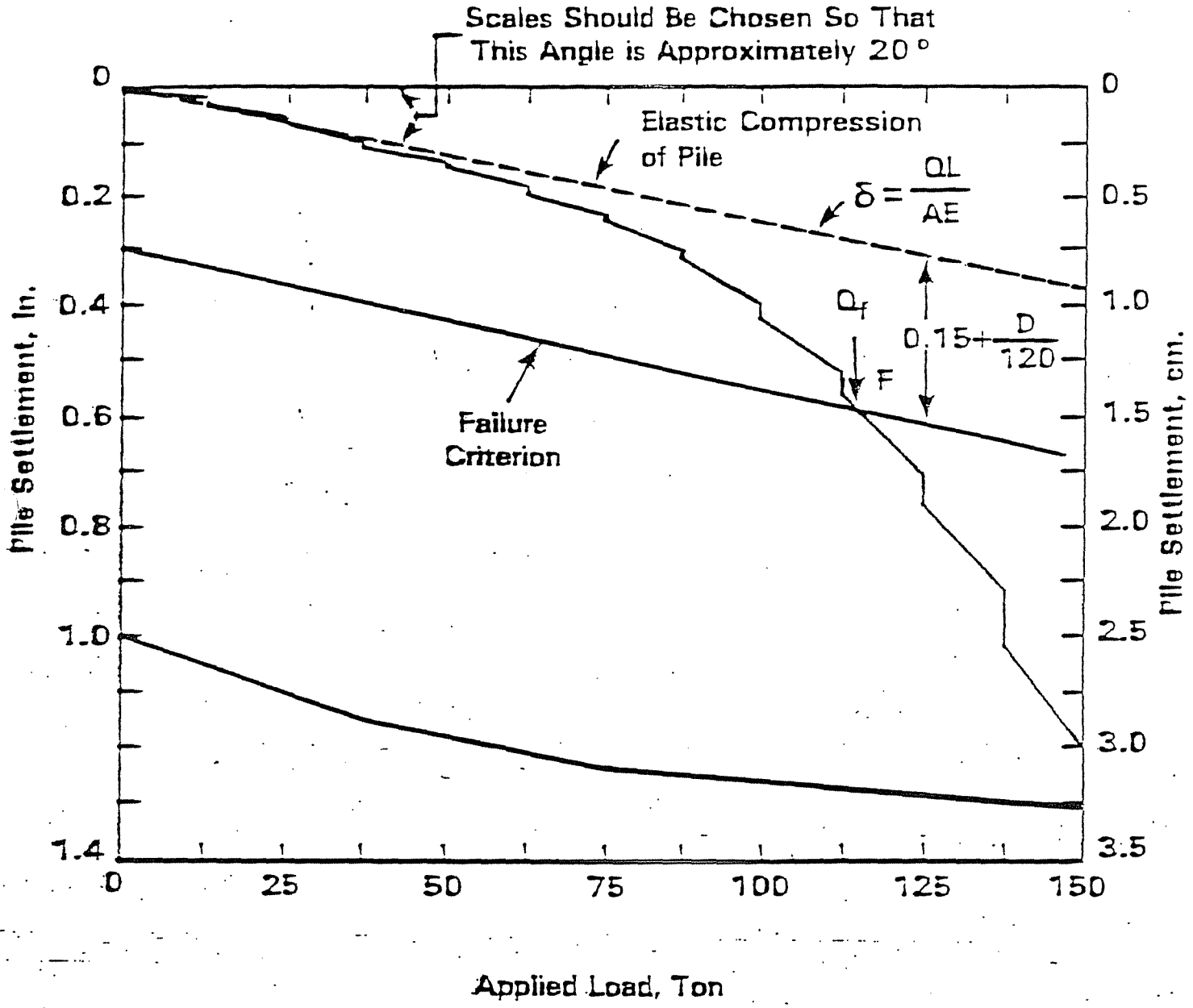
CAPWAPC Computer Modeling - Six of the seven static load test piles were analyzed using the CAPWAPC program. This computer program is essentially a wave equation calculation which uses actual measured pile top velocities instead of a pile hammer model as input into the program. The soil resistance (skin friction and end bearing) are modeled based on known geotechnical data. The computer calculates pile top forces using the actual measured pile top velocities as input and estimate soil resistance. The calculated pile top forces are compared with the measured pile top forces and the soil resistance values are adjusted and the program is rerun. This process is repeated until a realistic soil model is obtained which will produce calculated pile top forces measured during actual pile driving. The program can also be run using the pile top forces as input and compare the calculated pile top velocities with the measured pile top velocities. Using this procedure, a realistic soil resistance distribution can be determined. The results of this analysis generally agrees within $\pm$ 10 to 15 percent of a static load test carried to failure. Portions of the CAPWAPC results for six of the load test piles are presented in the Appendix.

Load Test Failure Criterion

The ultimate axial static compression capacities of the static load test piles were determined using the Davisson failure criteria. This criteria is defined by the intersection of the pile load - deflection curve and the load-elastic pile compression line (PL/AE) which has been offset from the origin by a calculated amount. The elastic pile compression line is offset from the origin, along the deflection axis, by the amount 0.15 inches plus the pile diameter divided by 120. The Davisson failure criteria line has been plotted on the

load-deflection curves for the static compression load test for each of the four project areas. The following figure, Recommended Davisson's Failure Criterion, illustrates the use of this procedure.

The failure criteria for the tension load test was somewhat more subjective. The failure load was determined using the tangent intersection method which generally determines the loading where the plotted load-deflection line began to significantly depart from the initial straight portion of the curve.



RECOMMENDED DAVISSON'S FAILURE CRITERION
(AFTER CANADIAN GEOTECHNICAL SOCIETY, 1978)

EVALUATION AND RECOMMENDATIONS

Design Axial Compression Capacity

Seven static axial compression load test piles were evaluated using two accepted analytical pile capacity analysis methods. Both of these methods, the FHWA-Nordlund Method and the FLDOT-Schmertmann Method required subsurface soil information as input. The subsurface information available for the test piles came from soil test borings generally within 50 to 100 feet of the piles, however, in some cases the nearest boring was up to 400 feet away.

The two analytical methods were evaluated using the actual pile tip elevation and with the assumption that the soil conditions at the pile locations were similar to the nearest soil boring. The pile driving records indicated in some cases that the depths into the bearing strata varied somewhat from the soil borings. The analyses were carried out using the published analytical procedures, the soil conditions at the nearest soil boring and the pile actual installation depths. The ultimate capacity calculated was divided by the recommended factor of safety of FS=3 for the Nordlund Method. The Schmertmann Method provides built-in factors of safety of FS=2 for skin friction and FS=3 for end bearing. The results of the analysis for each site is presented on the site summary sheets in the Appendix.

Dynamic pile monitoring was performed using a Pile Driving Analyzer (PDA) during a brief restrike driving of six of the seven test piles several days before the static load tests. The restrike driving generally occurred at least 24 hours after the initial driving of the test piles. The data recorded by the PDA during restrike driving was used in the CAPWAPC computer program to estimate the skin friction and end bearing components of the ultimate pile capacity. The ultimate capacity results were divided by the recommended Factor of Safety of FS=2 to

obtain design pile capacities. These design pile capacities are also presented for each site on the Site Summary sheets in the Appendix.

The following table, Summary of Pile Capacity Analysis Methods, compares the calculated design axial compression capacities with the results of the design capacities determined by static pile load testing.

SUMMARY OF PILE CAPACITY ANALYSIS METHODS

	ALLOWABLE STATIC AXIAL PILE COMPRESSION CAPACITY			
SITE NUMBER	STATIC PILE LOAD TEST FS=2* (TONS)	NORDLUND METHOD FS=3* (TONS)	SCHMERTMANN METHOD FS=2 TO 3** (TONS)	CAPWAPC METHOD FS=2* (TONS)
1-A	155	273	70	153
1-B	145	159	154	146
2-A	33	24	32	35
3-A	90	112	100	90
3-B	144	203	220	118
3-C	86	99	69	117
4-A	33	26	44	NO TEST

* - Recommended Factors of Safety
** - Schmertmann: FS=2 for Skin Friction;
FS=3 for End Bearing

For each site the design allowable pile static compression capacities were determined by applying a Factor of Safety of FS=2 to the results of the ultimate static pile compression capacity. The results of each method is graphically compared with the static load test results in the following section. Each method is discussed below and comments and recommendations for their use are presented.

Static Pile Load Test

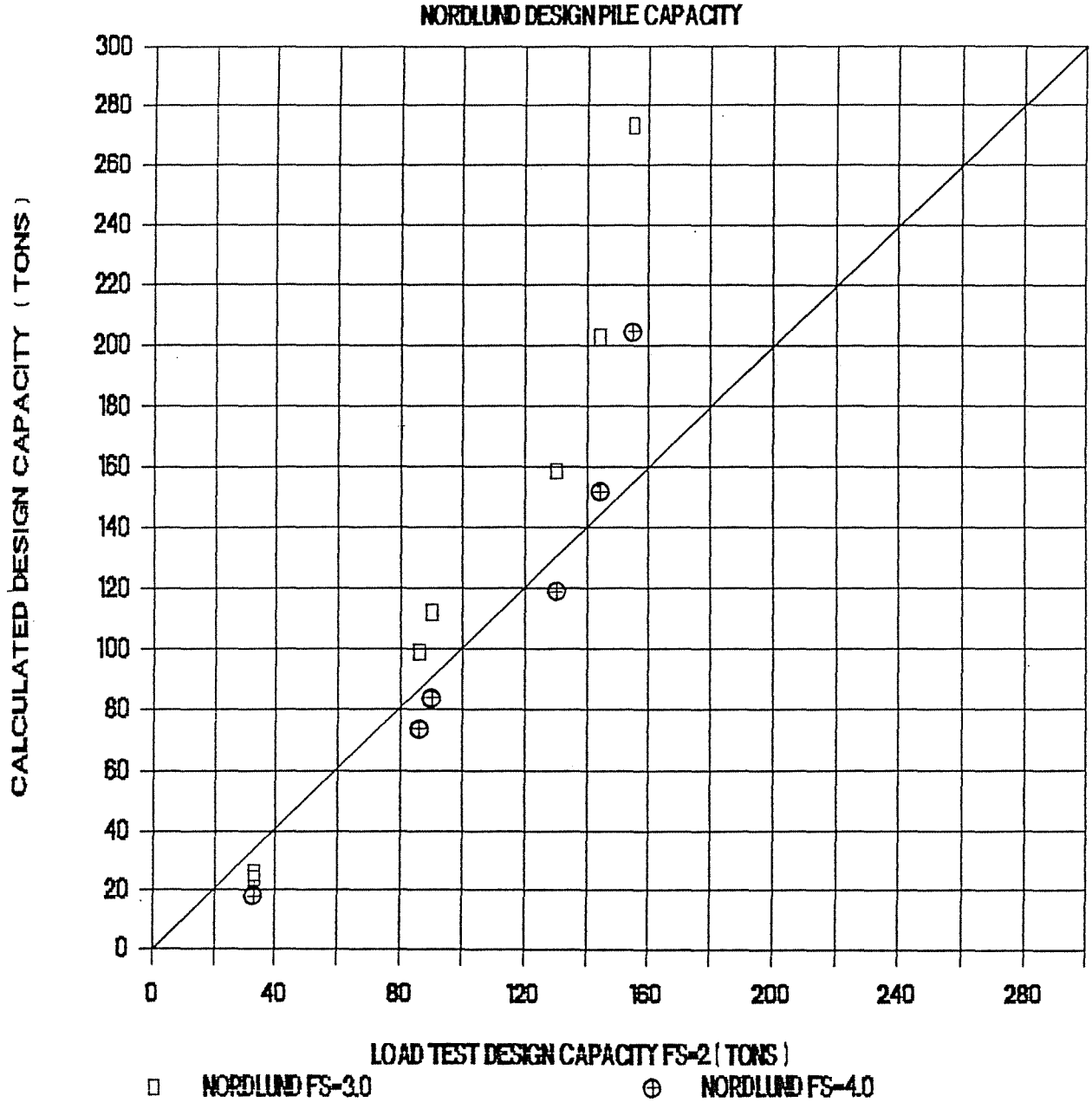
As discussed in the introduction, the static axial compression pile load tests were performed in accordance with ASTM procedures and the ultimate pile compression capacity was determined using the Davisson Method. This method generally indicates a slightly lower, therefore, more conservative ultimate pile capacity than some other methods. The procedure is straight forward and is not subject to the interpretation of the evaluation. The results obtained, are thus reproducible by different evaluators.

FHWA - NORDLUND Method

The seven test piles were evaluated using the Nordlund Method and a recommended Factor of Safety of FS=3 as outlined in the above referenced FHWA Manual. As shown on the following Figure Calculated Capacity versus Load Test for the Nordlund Method, there was considerable scatter of data when using the recommended Factor of Safety of FS=3. Five of the data points, generally for the larger diameter piles, were above the 1 to 1 comparison line. This indicates that the Nordlund Method overpredicted the design allowable capacities when compared with the design computer determined from a static load test with a Factor of Safety of FS=2.

We reevaluated the seven piles using a Factor of Safety of FS=4 with the Nordlund Method. These data points are also indicated on the following Figure. It can be seen that the FS=4 points more closely correspond with the load test design capacities and generally fall close to or below the 1 to 1 correspondence line. It appears that for larger pile sizes, say larger than 14-inch square, that an increased factor of safety of FS=4 appears to be more appropriate. For small size piles, 14-inch square and smaller, the recommended Factor of Safety of FS=3 is appropriate.

CALCULATED CAPACITY - VS - LOAD TEST



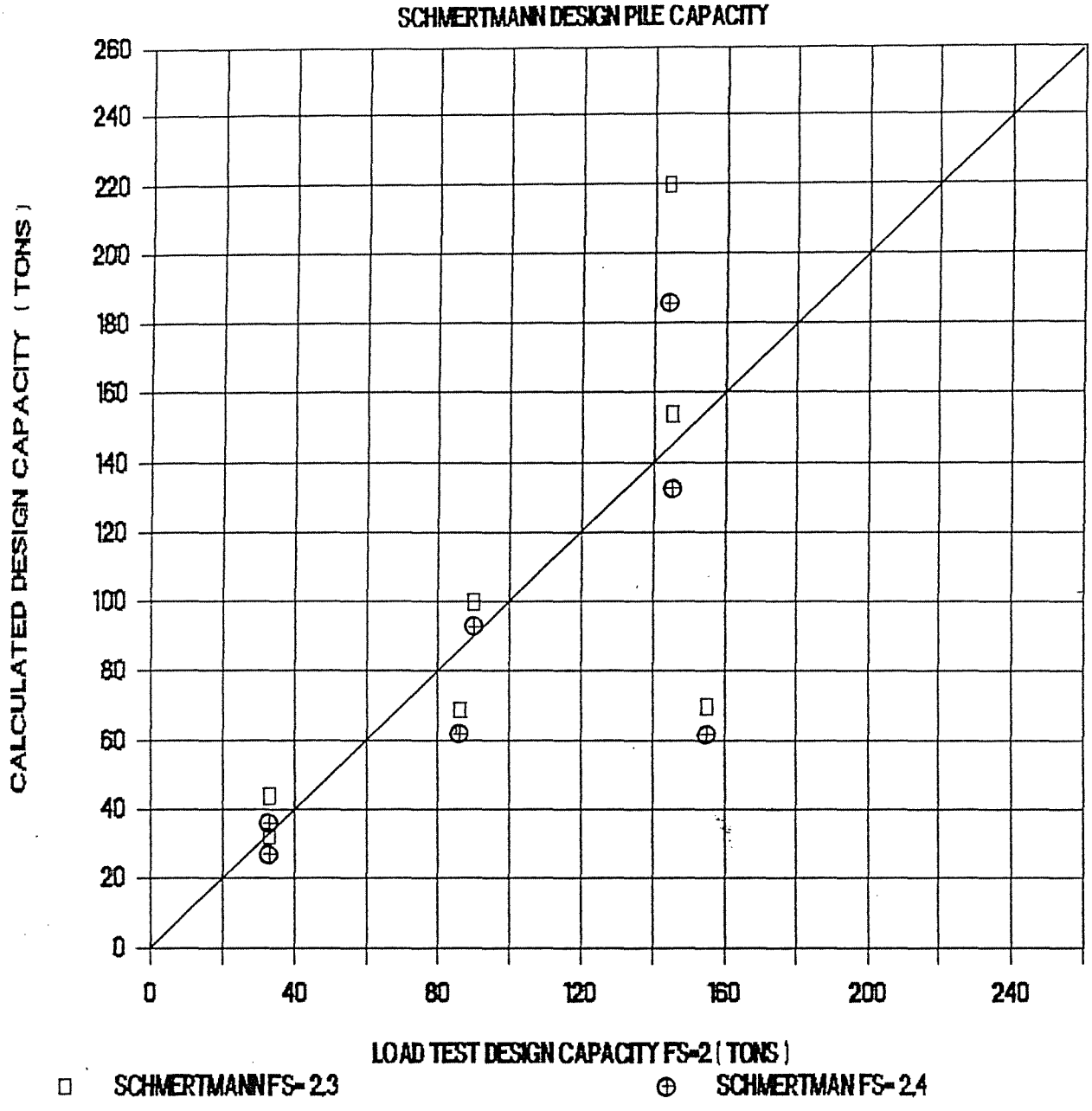
The Nordlund Method design allowable pile capacities with Factor of Safety of FS=3 for small piles and FS=4 for larger piles are generally within 10 to 15 percent of the static load test allowable design capacities (FS=2). In general, the Nordlund Method appears to underpredict the design capacity of small diameter, short piles and overpredicts the capacity of large diameter, long piles. It should be noted also that the Nordlund chart which takes into account the diameter of prestressed concrete piles does not extend to piles larger than 16 inches square.

Florida Department of Transportation - Schmertmann Method

The seven load test piles were evaluated by the Schmertmann Method as described in the above referenced technical bulletin and using the nearby soil borings. The design allowable compression capacity results of the Schmertmann Method are presented graphically versus the static load test allowable design capacities on the following Figure, Calculated Capacity Versus Load Test for the Schmertmann Method. The Schmertmann Method has a built-in Factor of Safety of FS=2 on skin frictional component and Factor of Safety of FS=3 for the end bearing component of the pile allowable design capacity.

This figure indicates there is considerable scatter in the calculated allowable design capacities using the recommended built-in factors of safety when compared with the static load test capacities. The data indicates that in general the procedure slightly overpredicts and occasionally seriously overpredicts the design capacities. In order to try to establish a better more conservative correlation, we reevaluated the design allowable capacities using an increased Factor of Safety of FS=4 instead of FS=3 for the end bearing component of the capacity and retained the Factor of Safety FS=2 for skin friction. These data points are presented on the following Figure and provide closer agreement with the

CALCULATED CAPACITY - VS - LOAD TEST



load test design capacities. Pile size did not appear to be related to the selection of the increased Factor of Safety.

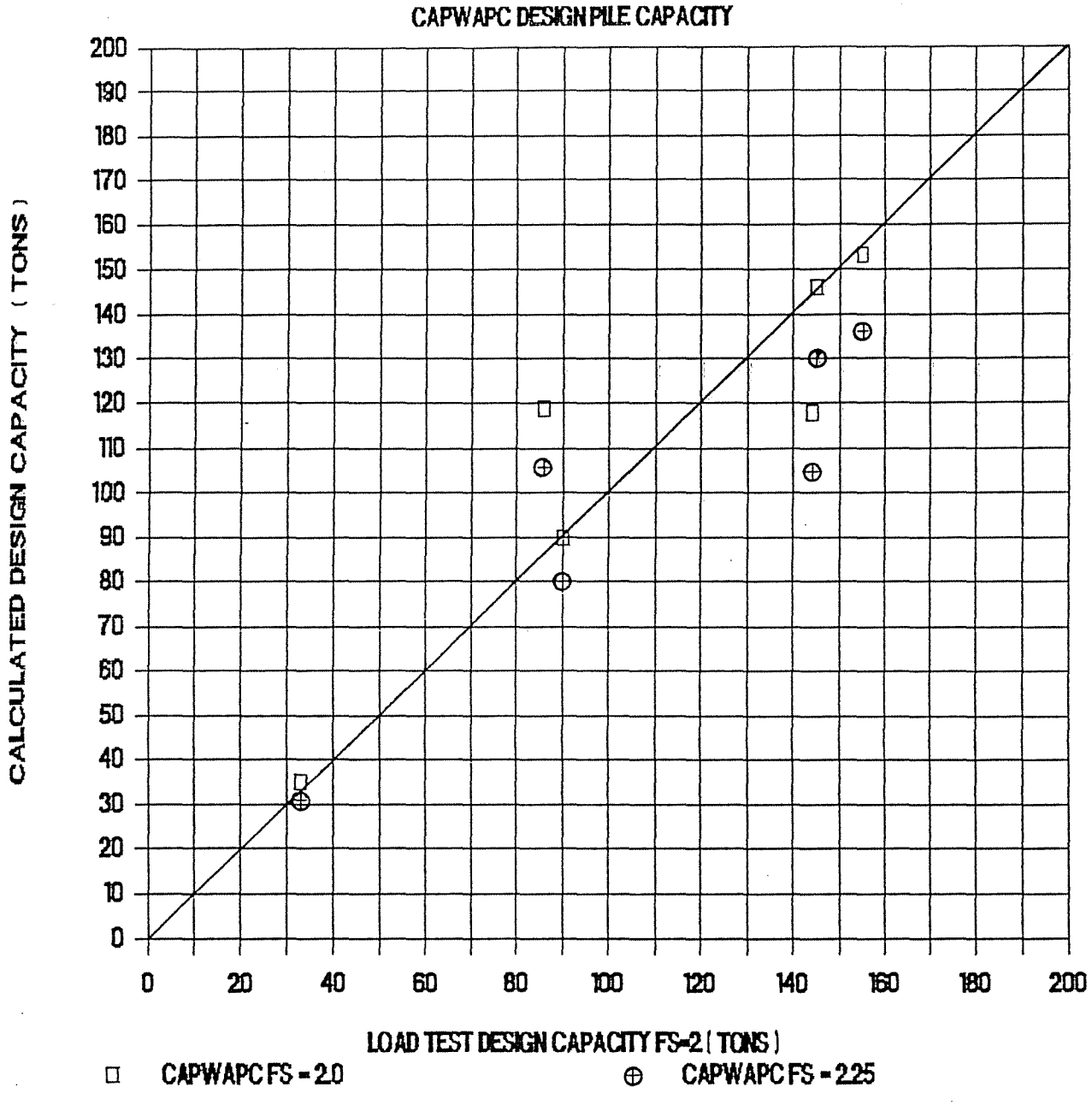
The Schmertmann procedure is an empirical method and requires more judgement from the evaluation. The depth of embedment correction into the bearing stratum used in the calculation is very sensitive and caused some serious over and under prediction of end bearing capacity when the actual pile tip depth were evaluated against the nearby soil boring (generally within 50 to 400 feet). It is possible that due to soil stratigraphy variation from the boring locations to the actual pile locations that greater or lesser embedments into the bearing layer were actually achieved than that used in the analysis.

Dynamic CAPWAPC Method

Six of the seven load test piles were monitored with the Pile Driving Analyzer (PDA) during restrike driving prior to the static pile load tests. CAPWAPC computer analyses were performed on the six cases. A design allowable compression capacities were calculated using a Factor of Safety FS=2. The results of our evaluations are presented graphically on the following Figure Calculated Capacity Versus Load Test for the CAPWAPC Method.

For the allowable design capacities calculated using a Factor of Safety of FS=2, there was also some scatter of data when plotted versus the static load test design capacities. In general, the CAPWAPC Method slightly underpredicts the design capacities or is within 10 percent of the load test values. Only one case was overpredicted by more than 10 percent. In order to provide a more conservative correlation, the Factor of Safety was increased to FS=2.25 which brought the single high data point to within 20 percent of the static load test results and increased the conservatism of the other results. In general, a Factor of Safety of FS=2 has been shown on numerous other projects to be appropriate.

CALCULATED CAPACITY - VS - LOAD TEST



Design Axial Tension Capacity

Three of the compression load test piles were also tested in tension to determine their ultimate pull out capacity. It is known that the upward acting skin friction for piles in granular soils is lower than the downward acting skin friction. It was anticipated that the pullout skin friction would be less than the calculated downward acting skin friction computed for the axial pile compression capacity.

For the two analytical methods and the CAPWAPC dynamic method, the calculated skin friction capacities were compared with the design tension pile capacities determined by dividing the ultimate pull out capacity by a Factor of Safety of FS=2. An attempt was made to determine a Factor of Safety to be used with each analysis method which would produce reasonable agreement with the load test design tension capacities.

The following table compares the results of the calculated skin friction capacities and design tension capacities with the appropriate Factors of Safety for the three piles with the load test design values.

SUMMARY OF TENSION PILE CAPACITY ANALYSIS

SITE NUMBER	STATIC PILE LOAD TEST FS=2 TONS	NORDLUND METHOD CALC. TONS	NORDLUND METHOD FS=8 TONS	SCHMERTMANN METHOD CALC. TONS	SCHMERTMANN METHOD FS=4 TONS	CAPWAPC METHOD CALC. TONS	CAPWAPC METHOD FS=4 TONS
3A	30	265	33	145	37	110	28
3B	53	345	49	167	42	152	38
3C	37	215	27	80	20	214	53

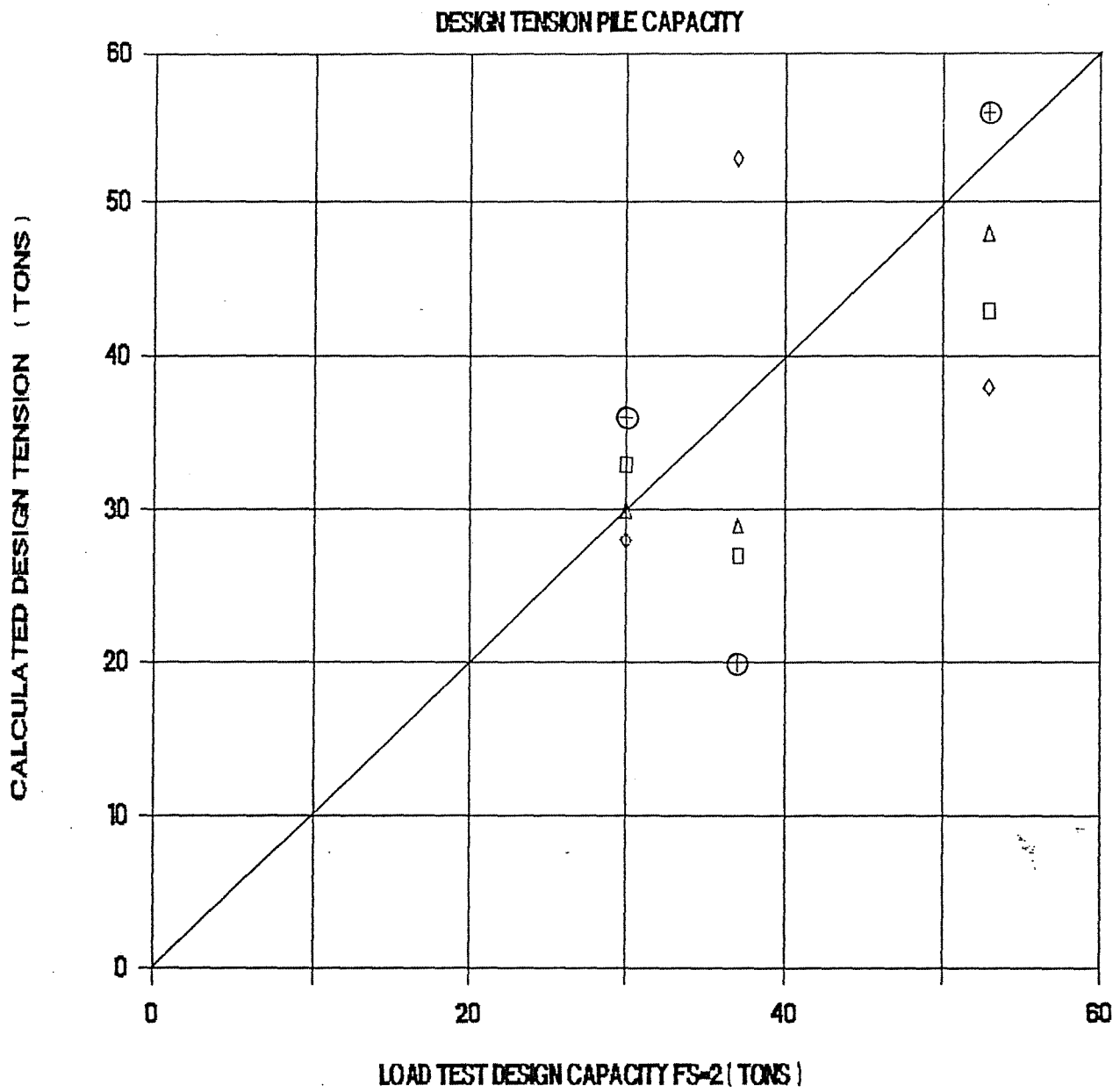
These results are presented graphically on the following Figure Calculated Capacity Versus Load Test for Design Tension Pile Capacity. This Figure compares each of the design tension capacities calculated by the three methods using the presented Factors of Safety with the design allowable pile tension capacity determined using the pull out capacity divided by a Factor of Safety of FS=2. As can be seen there in a much greater scatter than for the compression test results. With the exception of one data point, the calculated results are within 20-25 percent of the load test design values.

It is interesting to observe that the design tension capacity ranges from 33 to 40 percent of the design compression capacity. On the following Figure the design tension capacity calculated as 33 percent of the design compression capacity is also plotted. For these limited cases, it appears that this method provides an easy and consistently conservatively method for determining allowable tension capacities for piles which have a significantly embedment and a considerable portion of their total capacity by skin friction. It should be cautioned that for predominantly end bearing piles, this method might prove to be unconservative. We suggest that design pile tension capacities may be preliminarily evaluated using 1/4 to 1/3 of the load test design compression capacities for piles with significant skin frictional capacities.

General Comments

It is apparent that no single analysis procedure works for all cases every time. We have pointed out above some modifications to the recommended Factors of Safety to assist in calculating more consistently conservative results which reduce the possibility of overpredicting pile ultimate capacity which produce allowable design pile capacities with undesirable low Factors of Safety.

CALCULATED CAPACITY - VS - LOAD TEST



□ Nordlund FS=8.0

⊕ Schmertmann FS=4.0

◇ CAPWAPC FS=4.8

△ Tension = 1/3 Compression

We recommend that more than one analytical pile capacity analysis method be used possibly with dynamic testing to evaluate pile tension and compression capacities. For the cases where the various analysis methods tend to agree, then one will be more confident in the accuracy of the capacity evaluation. On the contrary, where the various methods give widely conflicting estimated capacities, then additional evaluation and possibly dynamic testing may be required.

SITE NO. 1

PILE 'A'

SITE NO.: 1

PILE NO.: A

LOCATION: (BRIEF DESCRIPTION) Pensacola, Florida -- Bridge Site. Marine environment, over-water pile installations. The generalized subsurface profile described below is located approximately 70 feet from Pile No. 1-A.

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 10	WATER
10 - 40	VERY SOFT silty CLAYS
40 - 66	VERY LOOSE to FIRM fine SANDS
66 - 78	VERY LOOSE clayey SANDS and SOFT sandy CLAYS
78 - 88	VERY DENSE slightly silty fine SAND
88 - 100	DENSE silty fine SAND

PILE DRIVING HAMMER INFORMATION

MAKE: Delmag

MODEL: D46-23

TYPE: Diesel

STROKE: 10 Ft.

RAM WEIGHT: 10,100 lbs.

RATED ENERGY: 105,000 ft-lbs

ACTION: Single

HAMMER CUSHION: Al-Micarta

PILE CUSHION: 6" Oak

PILE INFORMATION

SIZE: 20-inch square

LENGTH: 87.9 Feet

TYPE: Prestressed Concrete

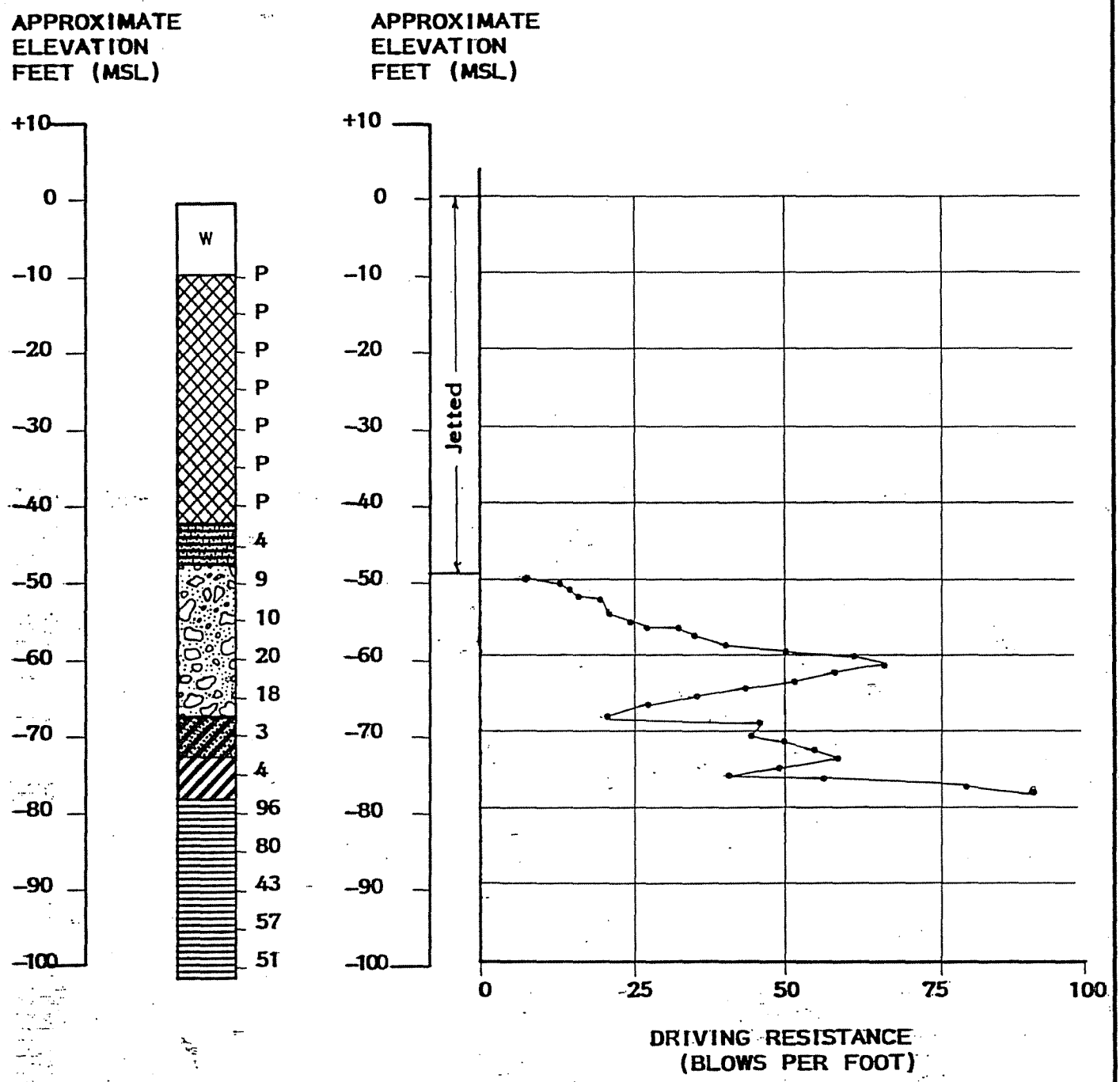
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	N/P	310	165	654	819	78	92	170	121	185	305
DESIGN CAPACITY (TONS)	N/A	155	55	218	273	39	31	70	60	93	153

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

Refer to the following page.

GENERALIZED SUBSURFACE PROFILE
AND DRIVING RESISTANCE

– Site No. 1 Pile 'A' –

DRAWN: W. WEEKS	DATE: 9/29/87	SCALE:
CHECKED: KFK	JOB NO: ASCE	As Noted

LEGEND

Water


Bay bottom SILTS


SAND with gravel


Slightly silty to silty SAND


Slightly clayey to clayey SAND


Sandy CLAY to CLAY


Clayey to sandy SILT

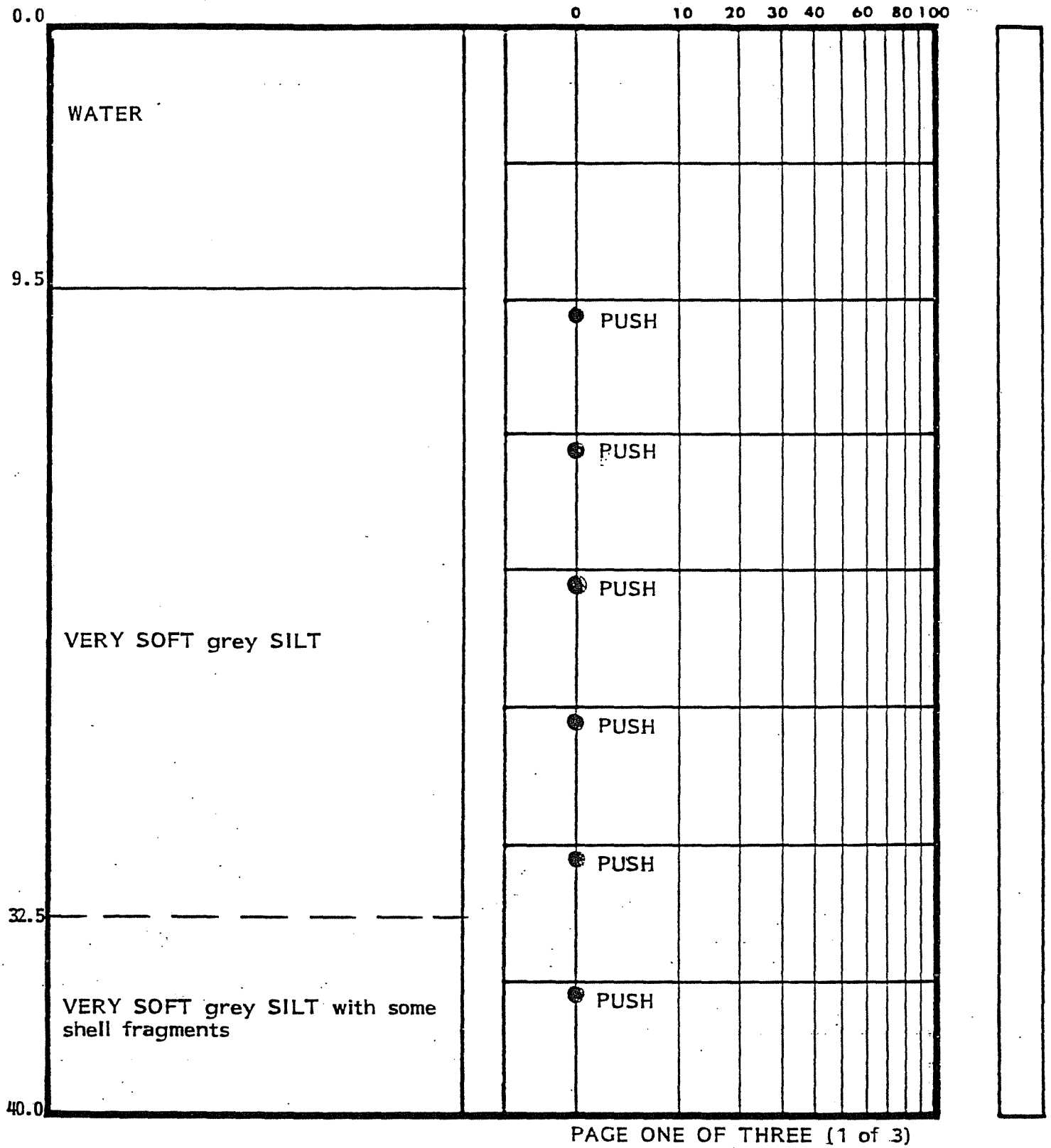
Groundwater Level (Time of Drilling)

Loss of Drilling Fluid

Standard Penetration Resistance, Blows/Foot

B.T. Boring Terminated

P Sampler Advanced Manually



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

100 % ROCK CORE RECOVERY

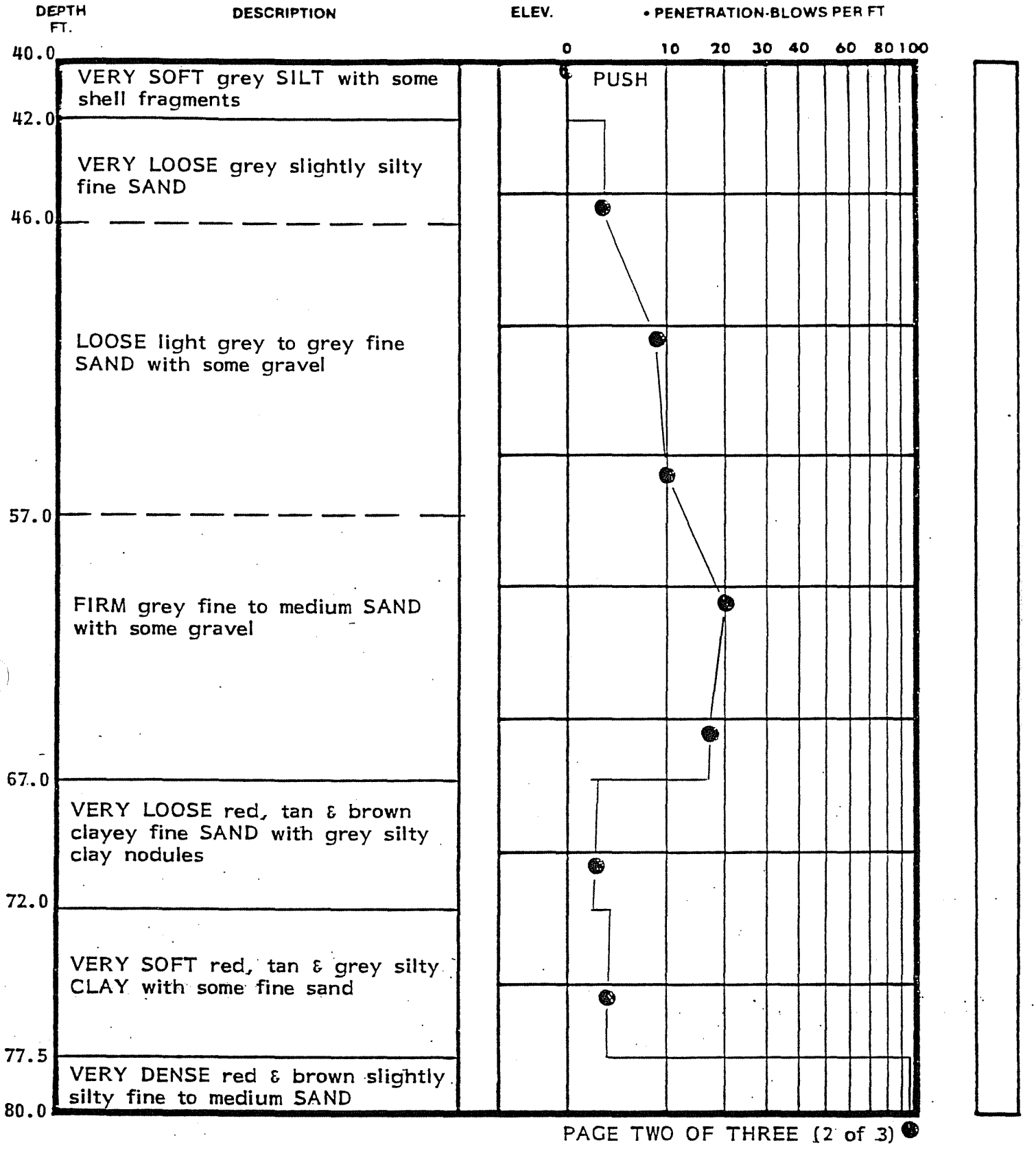
WATER TABLE, 24 HR.

WATER TABLE AT TIME OF DRILLING

LOSS OF DRILLING WATER

Site No. 1

Pile 'A'



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

60 % ROCK CORE RECOVERY

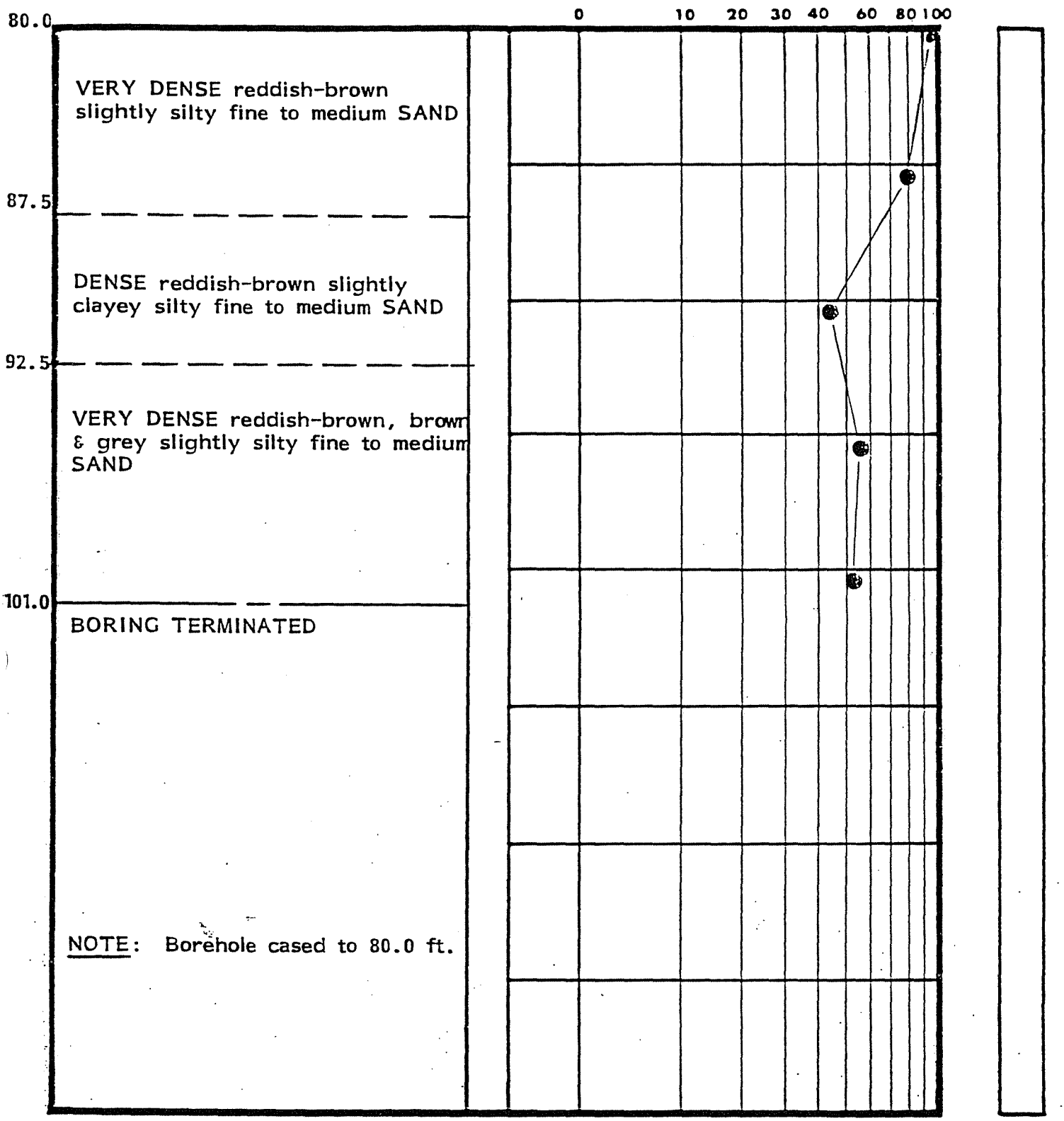
WATER TABLE, 24 HR.

WATER TABLE AT TIME OF DRILLING

LOSS OF DRILLING WATER

Site No. 1

Pile 'A'



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE AT TIME OF DRILLING

LOSS OF DRILLING WATER

Site No. 1
Pile 'A'

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: Site No. 1
Location: Pensacola, Florida

-- TEST PILE --

PILE DATA

Pile Number	A
Orig. Length	115 Ft.
Date Driven	9/27/85
Jetting Depth	0
Surface Elev.	+8.41 Ft.
Driving Time	29 Minutes
Cut-Off Elev.	N/A
Tip Elevation	-78.1 Ft.
Cut-Off Length	N/A

Specified Capacity: 200 Tons Compression
Required Blows: N/A

Pile Type: Prestressed Concrete
Pile Size: 20-inch square

HAMMER DATA

Make: DELMAG

Model: D-46-23

Stroke: 10.4 FT.

Ram Weight: 10,100 LBS.

Rated Energy: 105,000

Type: DIESEL

Action: SINGLE

Hammer Cushion AL. AND MIC.

Pile Top Cushion: 6" OAK

PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft
1	WOP	20		39		58	8	77	46		
2		21		40		59	13	78	N/R		
3		22		41		60	15	79	45		
4		23		42		61	16	80	50		
5		24		43		62	19	81	55		
6		25		44		63	21	82	58		
7		26		45		64	25	83	49		
8		27		46		65	28	84	42		
9		28		47		66	36	85	56		
10		29		48		67	41	86	66=10"		
11		30		49		68	50	87			
12		31		50		69	63				
13		32		51		70	66				
14		33		52		71	58				
15		34		53		72	52				
16		35		54		73	44				
17		36		55		74	36				
18		37		56		75	28				
19	"	38	"	57	"	76	26				

RESTRIKE*

DATE/TIME: 10/11/85

1"=11
2"=8
3"=8
4"=8
5"=7
6"=5
7"=6
8"=7

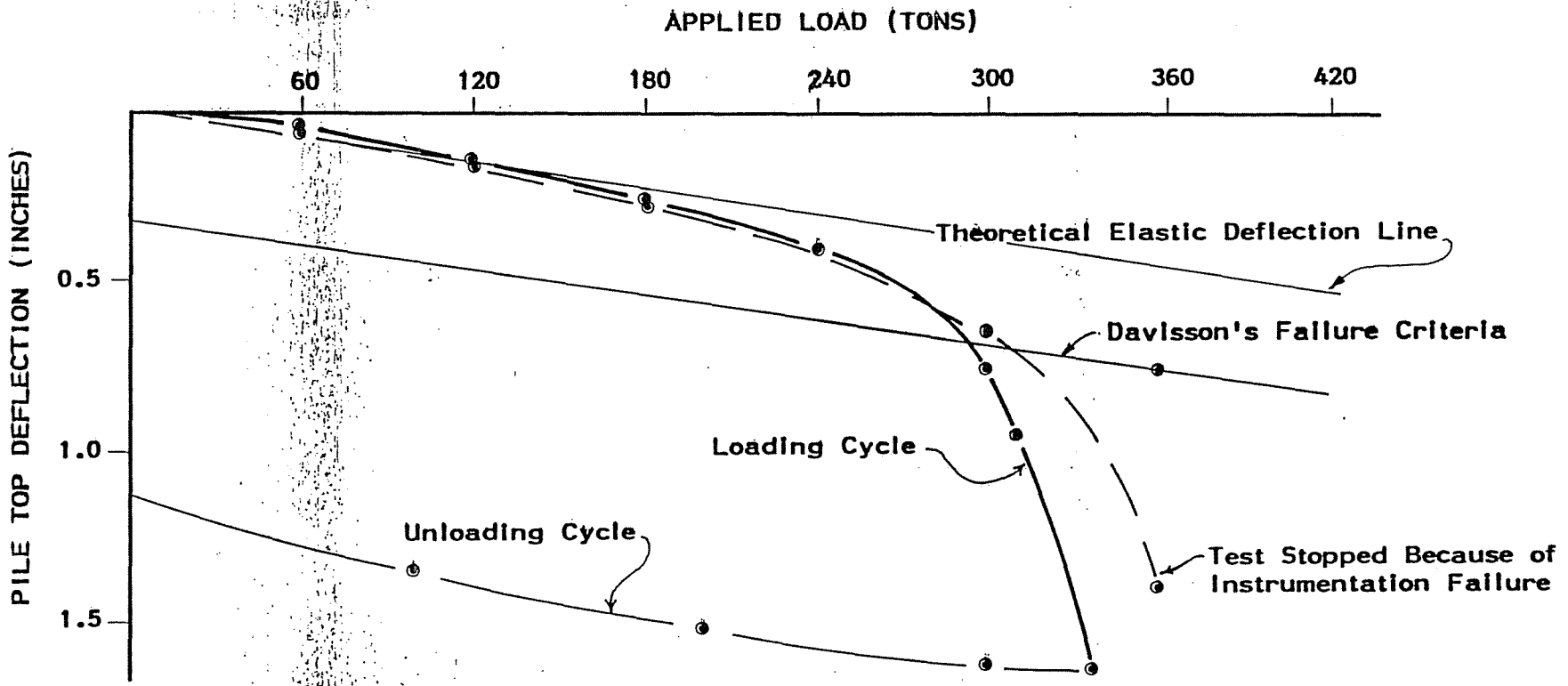
* REDROVE ON MAXIMUM ENERGY SETTING (105,000 FT-LBS)

REMARKS

WOP: WEIGHT OF PILE

PILE MONITORED WITH PDA.

NOTE: INITIALLY DROVE PILE USING ENERGY SETTING NO. 3 (RATED ENERGY 90,300 FT-LBS.)



Pile Information:

Type: Prestressed Concrete

Length: 87.9 Feet

Size: 20-Inch Square (Solid)

Pile Tip Elevation: -77.9 Feet (MSL)

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

- Site No. 1 Pile 'A' -

DRAWN: W·WEEKS	DATE: 9/29/87	SCALE: As Noted.
CHECKED: KFK	JOB NO: ASCE	

IS	DEPTH FT	QUAKE IN	RES KIPS	SUM RES KIPS	VISC. J KIPS/F/S	IMPDNCE KIPS/F/S	T-SLACK IN	C-SLACK IN	IP
0	3.4	.000	.0	611.5	.0	161.9	.0000	.0000	1
1	50.5	.250	24.1	587.3	3.3	161.9	.0000	.0000	15
2	57.2	.250	24.1	563.2	3.3	161.9	.0000	.0000	17
3	63.9	.250	24.1	539.1	3.3	161.9	.0000	.0000	19
4	70.6	.250	24.1	514.9	3.3	161.9	.0000	.0000	21
5	77.4	.250	24.1	490.8	3.3	161.9	.0000	.0000	23
6	84.1	.250	24.1	466.6	3.3	161.9	.0000	.0000	25
7	90.8	.250	24.1	442.5	3.3	161.9	.0000	.0000	27
8	97.5	.250	24.1	418.3	3.3	161.9	.0000	.0000	29
9	104.3	.250	24.1	394.2	3.3	161.9	.0000	.0000	31
10	111.0	.250	24.3	369.9	3.3	161.9	.0000	.0000	33
PILE	TOE	.350	369.9		69.6	GAP	.0000		

RESISTANCE			CASE DAMPING		SMITH DAMPING		QUAKES	
SKIN KIPS	TOE KIPS	TOTAL KIPS	SKIN	TOE	SKIN 1/FT/S	TOE 1/FT/S	SKIN IN	TOE IN
241.6	369.9	611.5	.204	.430	.137	.192	.250	.350

UNLOADING QUAKES IN PERCENT: 100 100
RELOADING LEVELS IN PERCENT: 0 0

SKIN FRICTION UNLOADING TO -20% OF R ULT, SOIL MASS .000 KIPS

ENERGY		FORCES						DISPLACEMENTS	
MAX FT-KIPS	FIN FT-KIPS	MAX KIPS	I	TMAX MS	MIN KIPS	I	TMIN MS	TOP IN	TOE IN
39.4	34.3	1437	15	26.	-39	14	59.	.666	.406

TIME INCR (MS)= .267; INT. PILE DAMPING (%)= .5; NO. OF TRIALS= 3

CAPWAPC RESULTS

- Site No. 1 Pile 'A' -

DRAWN: WRW	DATE: 9/29/87	SCALE:

SITE NO. 1

PILE 'B'

SITE NO.: 1

PILE NO.: B

LOCATION: (BRIEF DESCRIPTION) Pensacola, Florida -- Bridge Site. Marine environment, over-water pile installations. The generalized subsurface profile described below is located approximately 100 feet from Pile 1-B.

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 10	WATER
10 - 40	VERY SOFT silty CLAYS
40 - 66	VERY LOOSE to FIRM fine SANDS
66 - 78	VERY LOOSE clayey SANDS and SOFT sandy CLAYS
78 - 88	VERY DENSE slightly silty fine SAND
88 - 100	DENSE silty fine SAND

PILE DRIVING HAMMER INFORMATION

MAKE: Delmag STROKE: 10 Ft. ACTION: Single

MODEL: D46-23 RAM WEIGHT: 10,100 lbs. HAMMER CUSHION: Al-Micarta

TYPE: Diesel RATED ENERGY: 105,000 ft-lbs. PILE CUSHION: 6" Oak

PILE INFORMATION

SIZE: 20-inch square

LENGTH: 100.5 Feet

TYPE: Prestressed Concrete

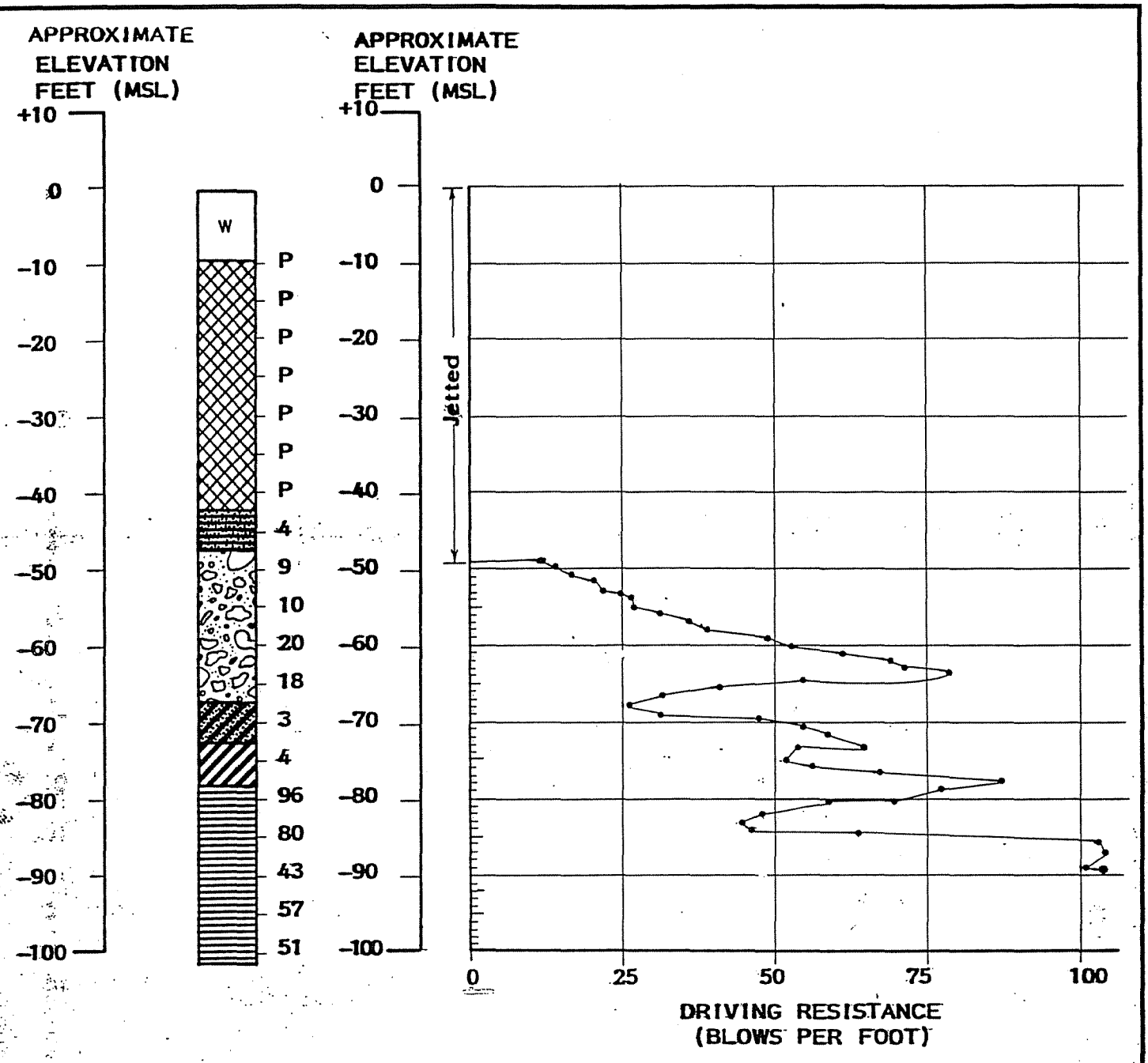
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	N/P	260	198	278	476	142	250	392	146	145	291
DESIGN CAPACITY (TONS)	N/A	130	66	93	159	71	83	154	73	73	146

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

Refer to the following page.

GENERALIZED SUBSURFACE PROFILE AND DRIVING RESISTANCE

– Site No. 1 Pile 'B' –

DRAWN: W·WEEKS	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

LEGEND

Water

Bay bottom SILT

SAND with gravel

Slightly silty to silty SAND

Slightly clayey to clayey SAND

Sandy CLAY to CLAY

Clayey to sandy SILT

Groundwater Level (Time of Drilling)

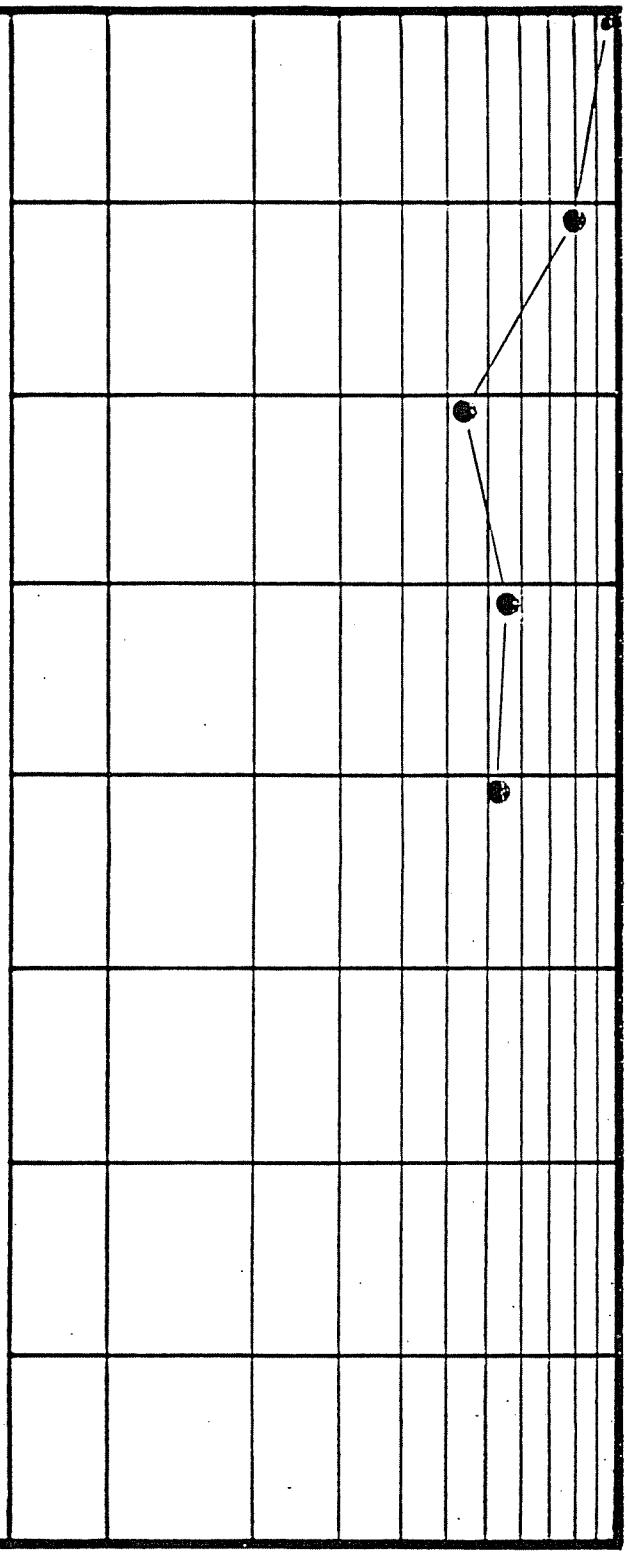
Loss of Drilling Fluid

Standard Penetration Resistance, Blows/Foot

B.T. Boring Terminated

P Sample Advanced Manually

DEPTH FT.	DESCRIPTION	ELEV.	• PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
80.0			
	VERY DENSE reddish-brown slightly silty fine to medium SAND		
87.5			
	DENSE reddish-brown slightly clayey silty fine to medium SAND		
92.5			
	VERY DENSE reddish-brown, brown & grey slightly silty fine to medium SAND		
101.0			
	BORING TERMINATED		
	NOTE: Borehole cased to 80.0 ft.		



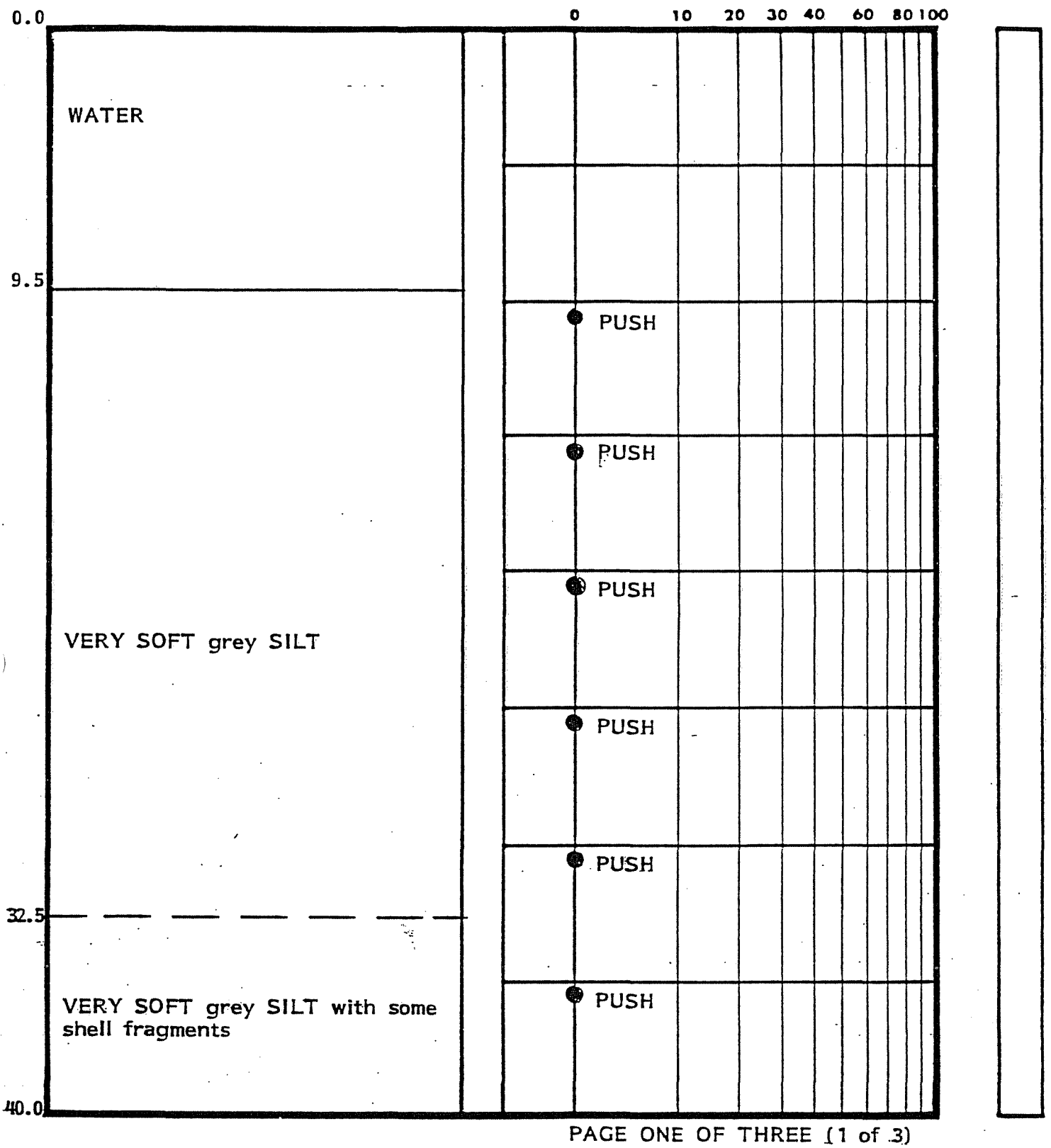
TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Site No. 1
Pile 'B'

WATER TABLE, 24 HR.
UNDISTURBED SAMPLE
WATER TABLE AT TIME OF DRILLING
|80| % ROCK CORE RECOVERY
LOSS OF DRILLING WATER



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

% ROCK CORE RECOVERY

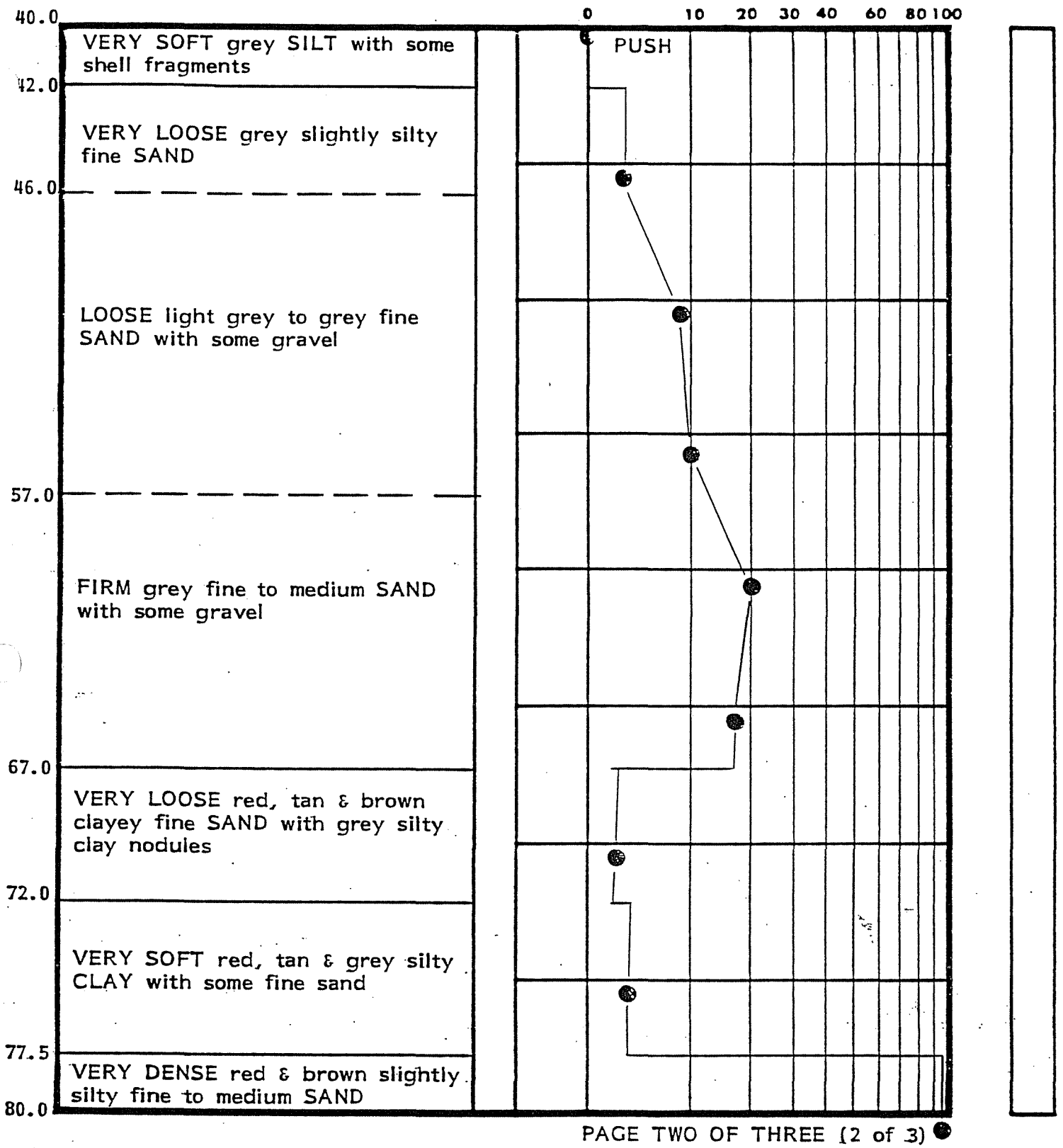
WATER TABLE, 24 HR.

WATER TABLE AT TIME OF DRILLING

LOSS OF DRILLING WATER

Site No. 1

Pile 'B'



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

60 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE AT TIME OF DRILLING

LOSS OF DRILLING WATER

Site No. 1

Pile 'B'

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: SITE NO. 1
Location: PENSACOLA, FLORIDA

-- TEST PILE --

PILE DATA

Pile Number	B
Orig. Length	155 FEET
Date Driven	10/25/85
Jetting Depth	0
Surface Elev.	+7.6 FEET (MSL)
Driving Time	44 MINUTES
Cut-Off Elev.	N/A
Tip Elevation	-89.14 FEET
Cut-Off Length	N/A

Specified Capacity: 200 TONS COMPRESSION
Required Blows: -NONE-

Pile Type: PRESTRESSED CONCRETE
Pile Size: 20-INCH SQUARE

HAMMER DATA

Make: DELMAG

Model: D-46-23

Stroke: 10.4 FT.

Ram Weight: 10,100 LBS.

Rated Energy: 105,000 FT-LBS

Type: DIESEL

Action: SINGLE

Hammer Cushion AL AND MIC.

Pile Top Cushion: 6" OAK

PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft
1	WOP	20		39		58	14	77	32	88	70
2		21		40		59	17	78	48	89	59
3		22		41		60	21	79	55	90	48
4		23		42		61	22	80	59	91	45
5		24		43		62	27	81	65	92	46
6		25		44		63	28	82	54	93	64
7		26		45		64	33	83	52	94	122
8		27		46		65	36	84	56		
9		28		47		66	39	85	68		
10		29		48		67	48	86	87		
11		30		49		68	53	87	77		
12		31		50		69	61				
13		32		51		70	68				
14		33		52		71	71				
15		34		53		72	79				
16		35		54		73	55				
17		36		55		74	41				
18		37		56	″	75	33				
19	″	38	″	57	12	76	26				

RESTRIKE*

DATE/TIME: 11/7/85

1st Ft	2nd Ft	3rd Ft
1"=15	1"=7	1"=10
2"=11	2"=8	2"=10
3"=12	3"=9	3"=11
4"=10	4"=7	4"=10
5"=11	5"=9	5"=8
6"=10	6"=7	6"=10
7"=10	7"=10	7"=8
8"=10	8"=9	8"=9
9"=11	9"=10	9"=9
10"=8	10"=11	10"=9
11"=7	11"=10	11"=9
12"=9	12"=9	12"=10

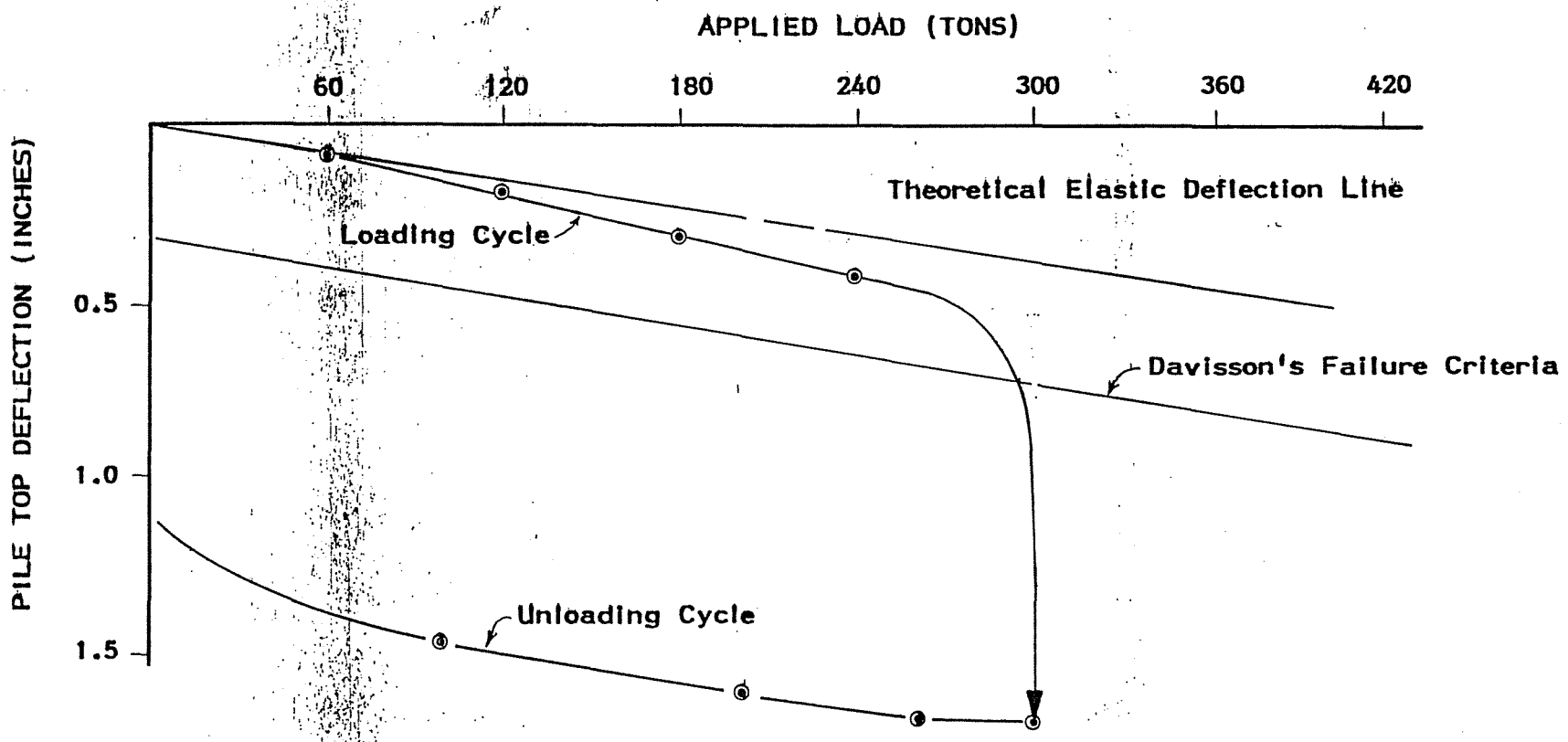
* REDROVE ON MAXIMUM ENERGY SETTING (RATED ENERGY 105,000 FT-LBS.)

REMARKS

WOP: WEIGHT OF PILE.

PILE MONITORED WITH PDA

NOTE: INITIALLY DROVE PILE USING ENERGY SETTING NO. 3 (RATED ENERGY 90,300 FT-LBS.)



Pile Information:

Type: Prestressed Concrete

Length: 100.5 Feet

Size: 20-Inch Square (Solid)

Pile Tip Elevation: -89.1 Feet (MSL)

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

- Site No. 1 Pile 'B' -

DRAWN: W. WEEKS	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

IS	DEPTH FT	QUAKE IN	RES KIPS	SUM RES KIPS	VISC. J KIPS/F/S	IMPDNCE KIPS/F/S	T-SLACK IN	C-SLACK IN	IP
0	3.3	.000	.0	581.8	.0	161.1	.0000	.0000	1
1	78.8	.120	3.3	578.5	1.1	161.1	.0000	.0000	24
2	85.3	.120	2.8	575.7	.9	161.1	.0000	.0000	26
3	91.9	.120	4.1	571.7	1.4	161.1	.0000	.0000	28
4	98.5	.120	5.1	566.6	1.7	161.1	.0000	.0000	30
5	105.0	.120	5.7	560.9	1.9	161.1	.0000	.0000	32
6	111.6	.120	5.7	555.2	1.9	161.1	.0000	.0000	34
7	118.2	.120	5.7	549.5	1.9	161.1	.0000	.0000	36
8	124.7	.120	16.6	532.9	5.6	161.1	.0000	.0000	38
9	131.3	.120	60.6	472.3	20.4	161.1	.0000	.0000	40
10	137.9	.120	67.3	405.0	22.7	161.1	.0000	.0000	42
11	144.4	.120	64.9	340.0	21.9	161.1	.0000	.0000	44
12	151.0	.120	49.1	290.9	16.5	161.1	.0000	.0000	46
PILE TOE		.220	290.9		83.3	GAP	.0000		

RESISTANCE			CASE DAMPING		SMITH DAMPING		QUAKES	
SKIN KIPS	TOE KIPS	TOTAL KIPS	SKIN	TOE	SKIN 1/FT/S	TOE 1/FT/S	SKIN IN	TOE IN
290.9	290.9	581.8	.608	.517	.337	.293	.120	.220

UNLOADING QUAKES IN PERCENT: 33 33
RELOADING LEVELS IN PERCENT: 0 0

SKIN FRICTION UNLOADING TO 0% OF R ULT, SOIL MASS .000 KIPS

ENERGY		FORCES						DISPLACEMENTS	
MAX FT-KIPS	FIN FT-KIPS	MAX KIPS	I	TMAX MS	MIN KIPS	I	TMIN MS	TOP IN	TOE IN
28.0	24.6	1087	40	33.	-127	32	72.	.579	.260

TIME INCR (MS)= .262; INT. PILE DAMPING (%)= 1.5; NO. OF TRIALS= 22

CAPWAPC RESULTS

– Site No. 1 Pile 'B' –

DRAWN: WRW	DATE: 9/29/87	SCALE: N/A

SITE NO. 2

PILE 'A'

SITE NO.: 2

PILE NO.: A

LOCATION: (BRIEF DESCRIPTION) Jacksonville, Florida. Industrial Site. Bank of St. Johns River. Riverine environment. Piles driven on land. The generalized subsurface profile described below is located approximately 50 feet from Pile 2-A.

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 2	VERY SOFT organic PEAT
2 - 4.5	LOOSE fine SAND
4.5 - 8	LOOSE slightly silty fine SAND
8 - 13.5	DENSE fine SAND
13.5 - 22	VERY FIRM fine SAND with occasional clay seams

PILE DRIVING HAMMER INFORMATION

MAKE: MKT

MODEL: DA-35B

TYPE: Diesel

STROKE: 6.4 Feet

RAM WEIGHT: 2800 lbs.

RATED ENERGY: 18,000 ft-lbs

ACTION: Double

HAMMER CUSHION: Neopreme

PILE CUSHION: 5½" Pine

PILE INFORMATION

SIZE: 12-inch square

LENGTH: 19 Feet

TYPE: Prestressed Concrete

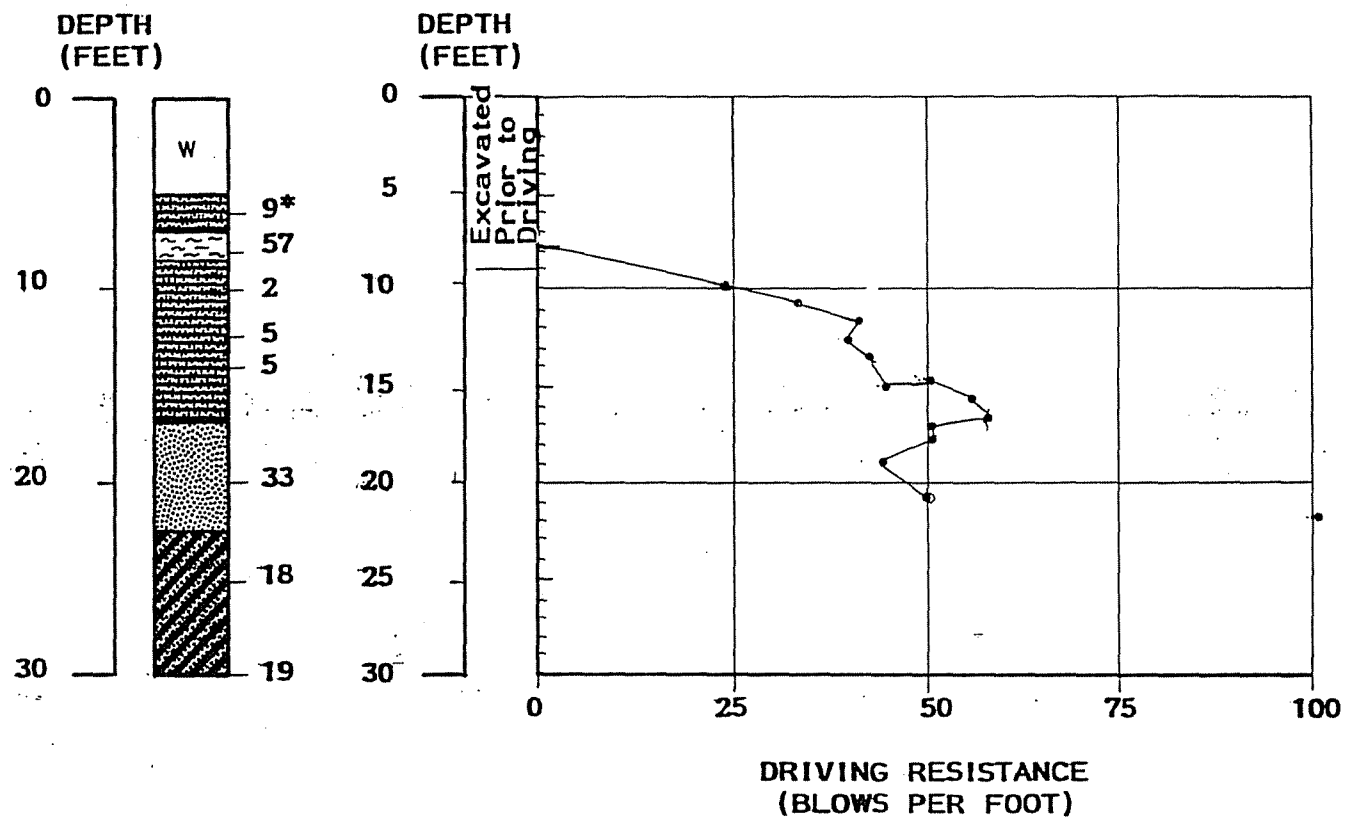
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	N/P	66	43	29	72	24	60	84	15	56	71
DESIGN CAPACITY (TONS)	N/A	33	14	10	24	12	20	32	7	28	35

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

W — Water

Slightly silty fine SAND with wood and organic peat

Fine SAND

Fine SAND with clay layers

Wood

--- Groundwater Level (Time of Drilling)

Loss of Drilling Fluid

Standard Penetration Resistance, Blows/Foot

B.T. Boring Terminated

GENERALIZED SUBSURFACE PROFILE AND DRIVING RESISTANCE

– Site No. 2 Pile 'A' –

DRAWN: W. WEEKS	DATE: 9/29/87	SCALE:
CHECKED: KFK	JOB NO: ASCE	As Noted

LOG OF BORING

Date 10/19/84 Sheet 1 of 2

Ground Water Depth Not Required Time _____ Date _____ Length of Casing Set 15'
Drill Rod Size AW Casing Size HW Drill Mud Quik-Gel Dia. Bit Size _____
Boring Begun 10/09/84 Boring Completed 10/09/84 Ground Elevation _____ Datum _____

SAMPLE NO.	DEPTH IN FEET	SOIL GRAPH	MATERIAL DESCRIPTION	STANDARD PENETRATION TEST Blows per foot on 2" O.D. Sampler with 140 lb. hammer falling 30" (0 10 20 30 40 50 60 70 80)	BLOWS/FT ON SAMPLER	BLOWS/FT ON CASING
	0					
	1		(WATER)			
	2					
	3					
	4					
	5					
	6		LOOSE Dark Gray Slightly Silty Fine SAND			
1			LOOSE Light Gray Fine SAND		9	
	7					
			Gray Fine SAND With Stringers **			
2	8		WOOD		57*	
	9		Light Gray Fine SAND With ***			
	10		VERY SOFT Dark Brown Silty Organic PEAT			
3					2	
	1					
			LOOSE Light Gray & Dark Gray Mottled Silty Slightly Organic Fine SAND			
4	2				5	
	3					
	4		LOOSE Dark Brown Slightly Silty to Silty Fine SAND			
5					5	
	15					
	6					
	7					
			COMPACT Gray Fine SAND			
	8					
	9					
6					33	
	20					

Remarks: * Drove Sample Spoon Through Wood
** of Clay

Site No. 2

LOG OF BORING

Ground Water Depth Not Required Time _____ Date _____ Length of Casing Set 15' .
Drill Rod Size AW Casing Size HW Drill Mud Quik-Gel Dia. Bit Size _____
Boring Begun 10/09/84 Boring Completed 10/09/84 Ground Elevation _____ Datum _____

SAMPLE NO.	DEPTH IN FEET	SOIL GRAPH	MATERIAL DESCRIPTION	STANDARD PENETRATION TEST Blows per foot on 2" O.D. Sampler with 140 lb. hammer falling 30" (0 10 20 30 40 50 60 70 80)	BLOWS/FT. ON SAMPLER	BLOWS/FT. ON CASING
	20					
	1					
	2					
	3		MEDIUM COMPACT Gray Fine SAND			
	4		With Layer of Clay			
7	25				18	
	6					
	7					
	8					
	9					
8	30				19	
	1		BORING TERMINATED			
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	0					

Remarks:

Site No. 2

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: SITE NO. 2
Location: JACKSONVILLE, FLORIDA

-- TEST PILE --

PILE DATA

Pile Number	A
Orig. Length	30 FT
Date Driven	2/11/87
Jetting Depth	0
Surface Elev.	+1.0 FT (MSL)
Driving Time	6 MINUTES
Cut-Off Elev.	N/A
Tip Elevation	-17.1 FT.
Cut-Off Length	N/A

Specified Capacity: 30 TON COMPRESSION
Required Blows: N/A

Pile Type: PRESTRESSED CONCRETE
Pile Size: 12-INCH SQUARE

HAMMER DATA

- **Make:** MKT
- **Model:** DA35B
- **Stroke:** N/A
- **Ram Weight:** 2800 LBS.
- **Rated Energy:** 18,000 FT-LBS
- **Type:** DIESEL
- **Action:** DOUBLE
- **Hammer Cushion** NEOPREME
- **Pile Top Cushion:** WOOD

PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft
1	WOH										
2	↓										
3	↓										
4	↓										
5	↓										
6	24										
7	29										
8	36										
9	35										
10	38										
11	51										
12	56										
13	58										
14	51										
15	45										
16	N/R										
17	51										
18	53=6"										
19											

RESTRIKE

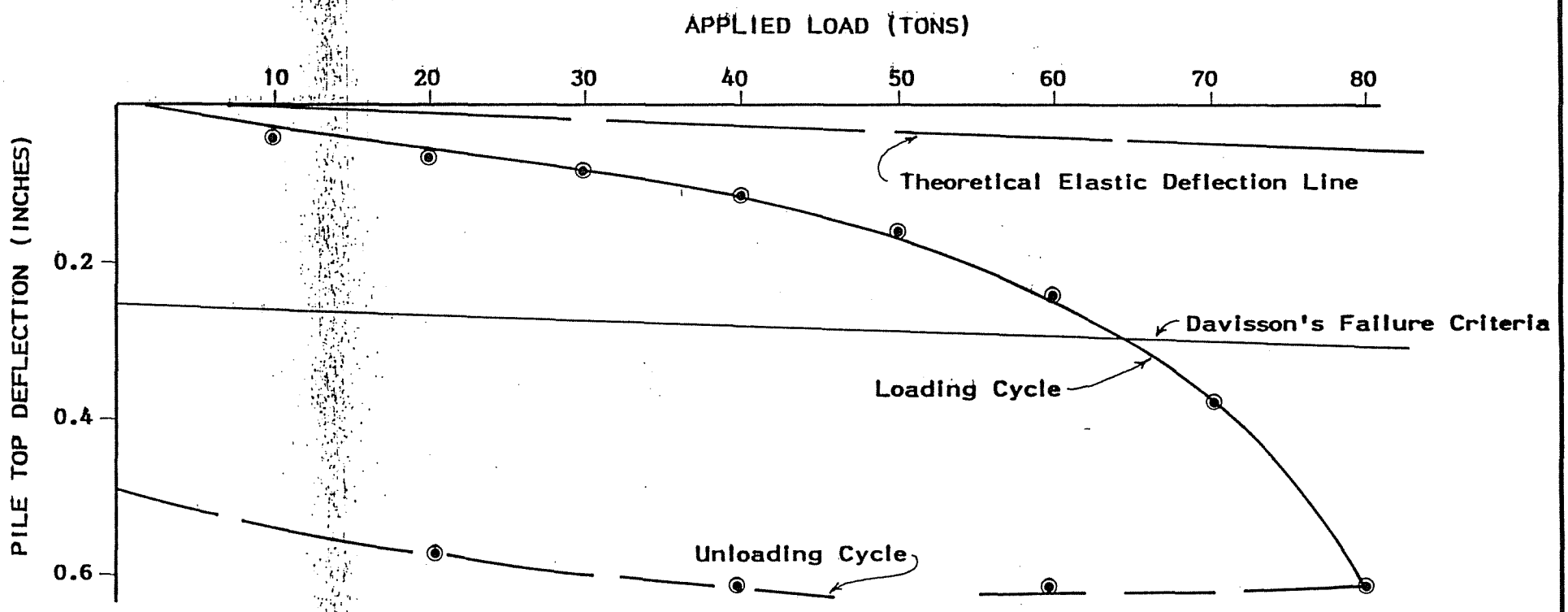
DATE/TIME: 2/12/87

32=6"

REMARKS

WOH: WEIGHT OF HAMMER

PILE MONITORED WITH PDA.



Pile Information:

Type: Prestressed Concrete

Length: 19 Feet

Size: 12-Inch Square (Solid)

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

– Site No. 2 Pile 'A' –

DRAWN: W. WEEKS	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

Final CAPWAPC Capacity: Ru 141.8, Skin 30.4, Toe 111.4 Kips

Soil Sgmnt No.	Depth Below Gages ft	Depth Below Grade ft	Quake in	Soil Damping Case Kips/ft/s	Viscs s/ft	Smith	Ru Kips	Sum of Ru Kips	Unit Skin Frctn Kips/ft2
								141.8	
1	10.5	.0	.100	.008	.4	.088	5.1	136.7	.36
2	14.0	1.0	.100	.008	.4	.088	5.1	131.7	.36
3	17.5	4.5	.100	.008	.4	.088	5.1	126.6	.36
4	21.0	8.0	.100	.008	.4	.088	5.1	121.5	.36
5	24.5	11.5	.100	.008	.4	.088	5.1	116.5	.36
6	28.0	15.0	.100	.008	.4	.088	5.1	111.4	.36
Sum				.048	2.7		30.4		
Avrge			.100			.088	5.1		.36
Toe			.140	.240	13.4	.120	111.4		111.41

Soil Model Extensions		Skin	Toe
Unloading Quake	(% of loading quake)	10	100
Unloading Level	(% of Ru)	60	
Resistance Gap	(inch)		.11

CAPWAPC RESULTS

– Site No. 2 Pile 'A' –

DRAWN: WRW	DATE: 9/29/87	SCALE:

SITE NO. 3

PILE 'A'

SITE NO.: 3

PILE NO.: A

LOCATION: (BRIEF DESCRIPTION) Jacksonville, Florida. Near the St. Johns River. The test pile is located in a power generating facility. The generalized subsurface profile described below is located approximately 400 feet from Pile No. 3-A.

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 48	LOOSE to VERY DENSE slightly silty fine SAND
48 - 50	VERY DENSE slightly cemented to cemented fine SAND

PILE DRIVING HAMMER INFORMATION

MAKE: Vulcan

MODEL: 510

TYPE: Air/Steam

STROKE: 3.25 Feet

RAM WEIGHT: 10,000 lbs.

RATED ENERGY: 32,500 ft-lbs

ACTION: Single

HAMMER CUSHION: 7½" Hammertex

PILE CUSHION: 6" Plywood

PILE INFORMATION

SIZE: 20-inch square

LENGTH: 36½ Feet

TYPE: Prestressed Concrete

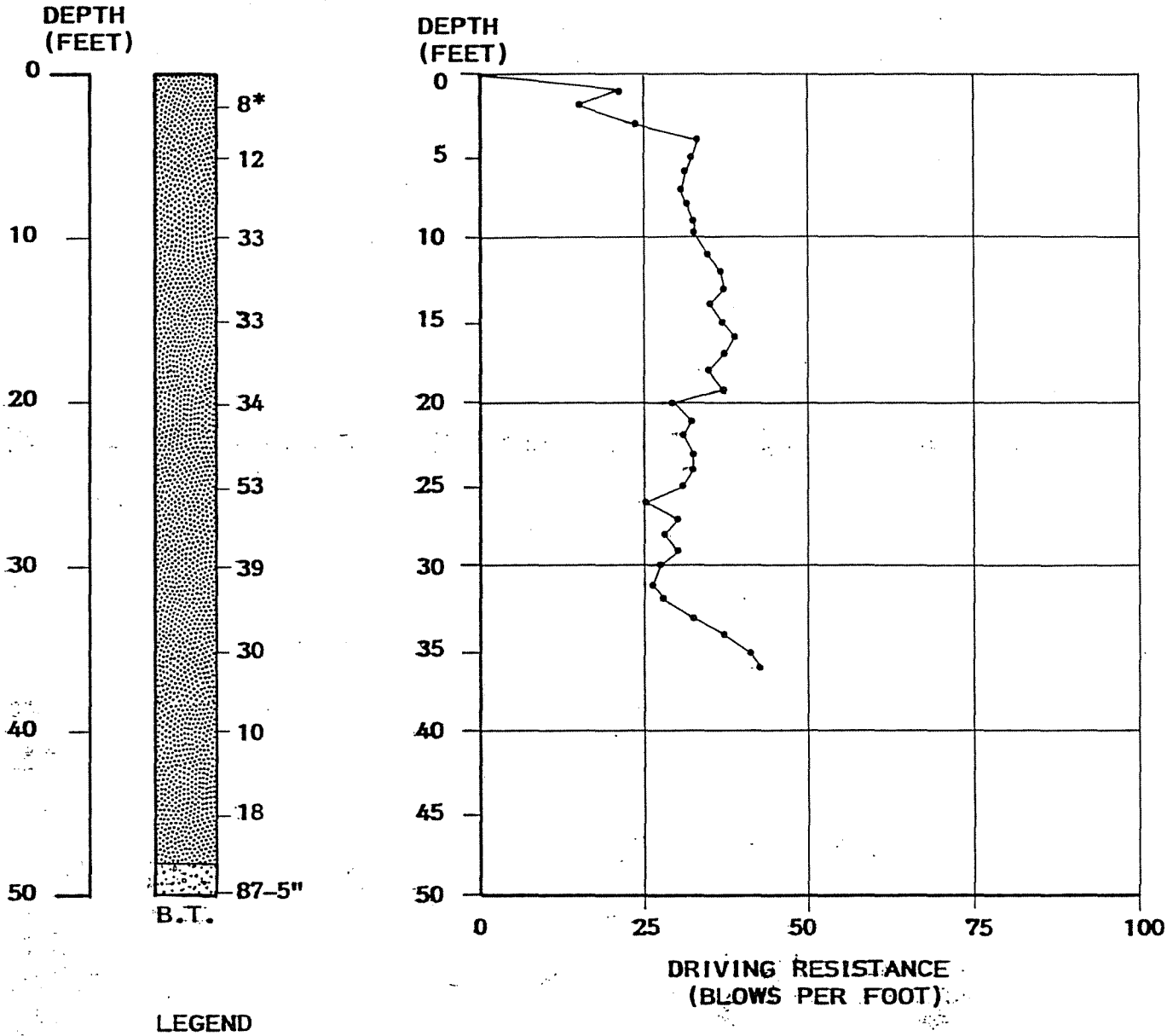
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	61	180	265	70	335	145	83	228	110	70	180
DESIGN CAPACITY (TONS)	30	90	89	23	112	72	28	100	55	35	90

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

Slightly silty fine SAND

CEMENTED fine SAND with shell fragments

Groundwater Level (Time of Drilling)

Loss of Drilling Fluid

Standard Penetration Resistance, Blows/Foot

WOR

B.T. Boring Terminated

P

GENERALIZED SUBSURFACE PROFILE AND DRIVING RESISTANCE

– Site No. 3 Pile 'A' –

DRAWN: WRW	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

LOG OF BORING

ELEVATION +10.0 GWL 0 HRS. ____

___HRS. ____

DATE START 12-20-79 DATE COMPLETE 12-20-79

Site No. 3

Pile 'A'

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	ROD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
	2 3 5	1 SS	8"					Brown	Loose fine SAND, trace silt and organic material		
	5 6 6	2 SS	10"					Tan	Medium dense fine SAND, trace silt		
	6 6 7	3 SS	11"			8.0'		White	Medium dense fine SAND, trace silt		
10	12 16 17	4 SS	12"					Light-gray	Dense fine SAND, trace silt and clay		
15	12 12 11	5 SS	12"					White	Medium dense fine SAND, trace silt and clay (lumps)		
20	8 15 19	6 SS	12"					White	Dense fine SAND, trace silt and clay (lumps)		
25	15 25 26	7 SS	12"					White	Very dense fine to medium SAND, trace silty clay pockets		
30	15 17 22	8 SS	12"					White	Dense fine SAND, trace silt and clay (lumps)		

REMARKS ____

LOG OF BORING

ELEVATION _____ GWL 0 HRS. _____
HRS. _____

DATE START 12-20-79 DATE COMPLETE 12-20-79

Site No. 3
Pile 'A'

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	RQD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
35	6 12 18	9 SS	15"					White	Dense medium to fine SAND, trace silt		
40	5 5 5	10 SS	10"					Tan	Medium dense medium to fine SAND, trace silt		
45	7 9 9	11 SS	8"					Dark-grey tan	Medium dense - coarse to fine SAND, trace silt and gravel		
						49.0'					
50	13 87=5" 12	12 SS	9"					Grey Grey	Dense coarse to fine SAND, trace silty clay pockets, trace gravel and shell Very dense partially cemented fine SAND and SHELL		

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: SITE NO. 3
Location: JACKSONVILLE, FLORIDA

-- TEST PILE --

PILE DATA

Pile Number	A
Orig. Length	40'
Date Driven	4/20-21/87
Jetting Depth	0
Surface Elev.	+13.0 FT. (MSL)
Driving Time	35 MINUTES
Cut-Off Elev.	N/A
Tip Elevation	-23.42 FT (MSL)
Cut-Off Length	N/A

Specified Capacity: 300 TONS COMPRESSION
Required Blows: NONE

Pile Type: PRESTRESSED CONCRETE (SOLID)
Pile Size: 14 INCHES SQUARE

HAMMER DATA

Make: VULCAN

Model: 510

Stroke: 3.25

Ram Weight: 10,000 LBS.

Rated Energy: 32,500 FT-LBS.

Type: AIR/STEAM

Action: SINGLE

Hammer Cushion 7½" HAMMERTEX

Pile Top Cushion: 6" PLYWOOD (PINE)

PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft
1	21	20	29								
2	15	21	32								
3	23	22	31								
4	34	23	33								
5	33	24	33								
6	32	25	31								
7	31	26	25								
8	32	27	30								
9	33	28	29								
10	33	29	30								
11	35	30	32								
12	37	31	31								
13	37	32	33								
14	35	33	37								
15	37	34	43								
16	39	35	46								
17	37	36	47								
18	35										
19	33										

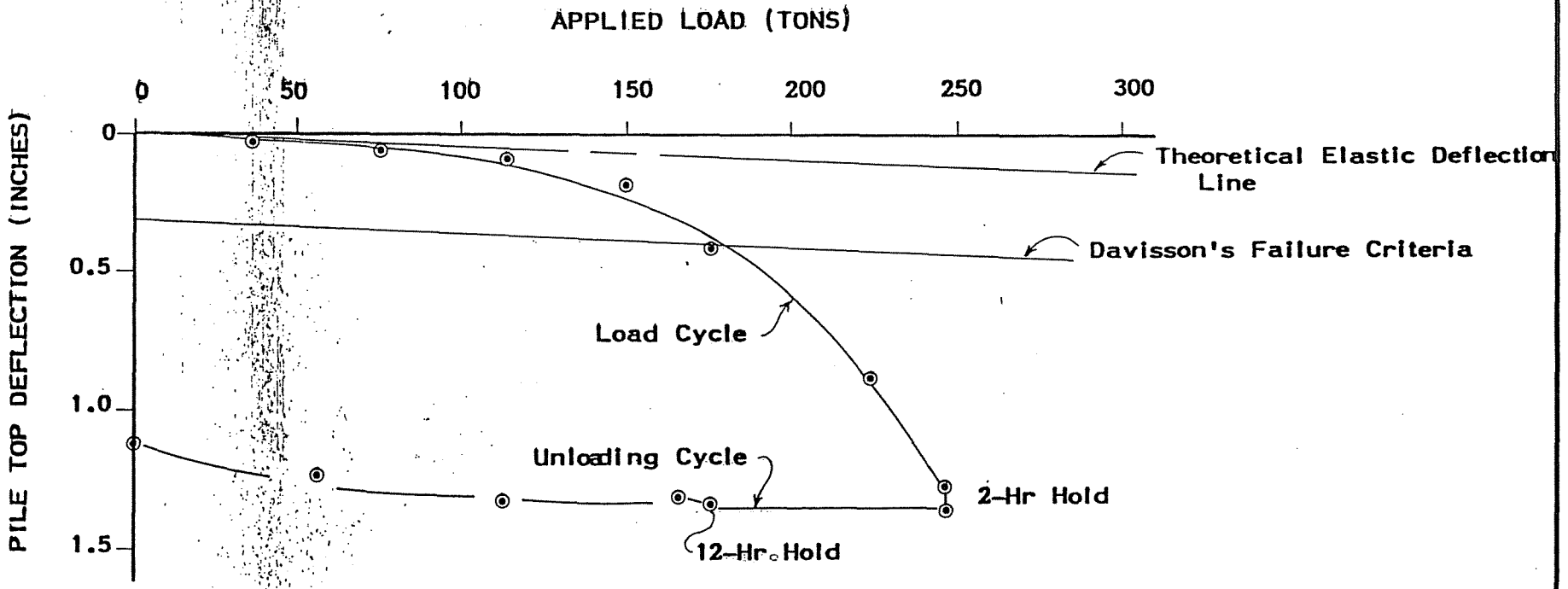
RESTRIKE

DATE/TIME: 4/21/87-1:16-1:22

1"=7
2"=5
3"=5
4"=5
5"=3@7/8"

REMARKS

PILE MONITORED WITH PDA.



Pile Information:

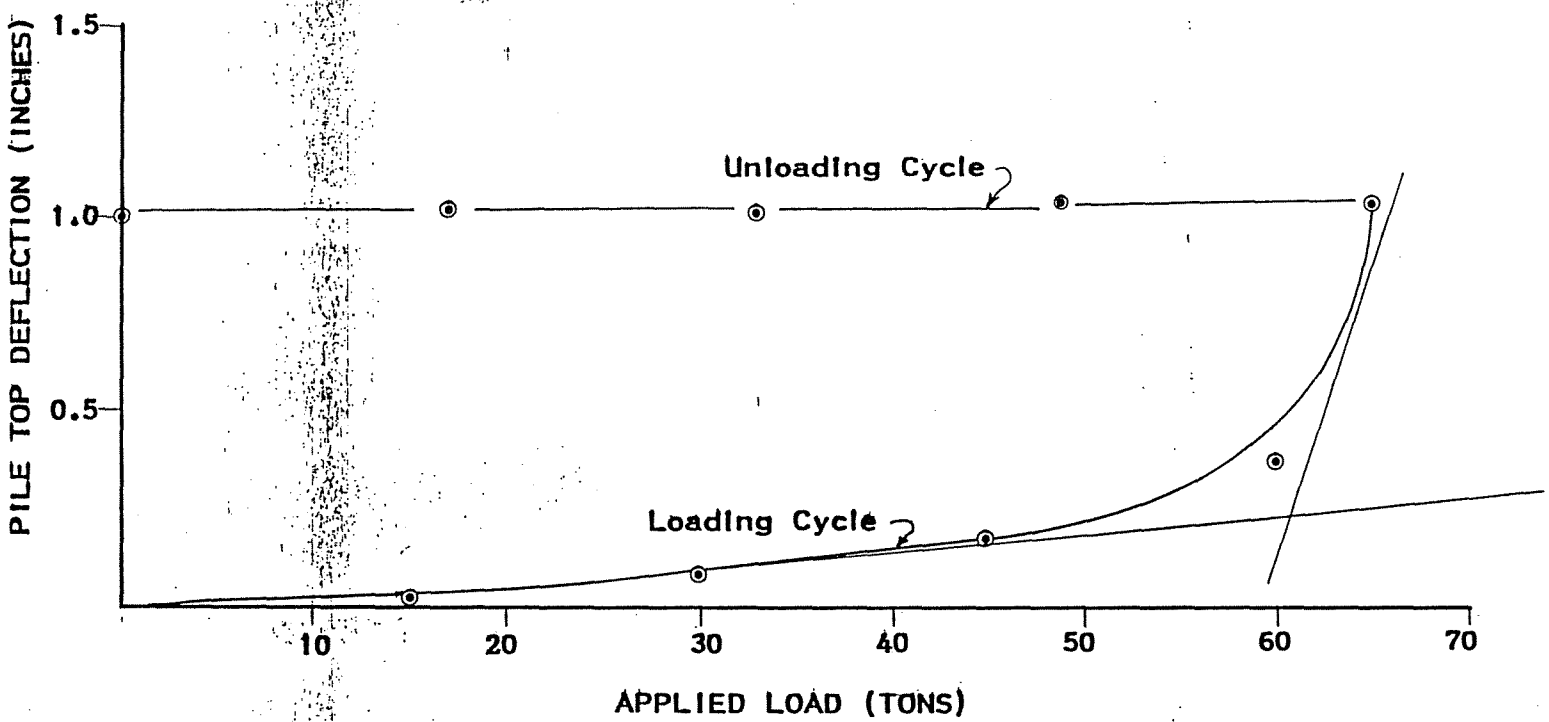
Type: Pretressed Concrete
Size: 20-Inch Square
Length: 36-1/2 Feet

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

– Site No. 3 Pile 'A' –

DRAWN: WRW	DATE: 9/29/87	SCALE:
CHECKED: KFK	JOB NO: ASCE	As Noted



Pile Information:

Type: Prestressed Concrete

Size: 20-Inch Square (Solid)

Length: 36-1/2 Feet

TENSION STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

– Site No. 3 Pile 'A' –

DRAWN: WRW	DATE: 9/29/87	SCALE:
CHECKED: KFK	JOB NO: ASCE	As Noted

Final CAPWAPC Capacity: Ru 361.4. Skin 222.6. Toe 140.5 Kips

Soil Sgmnt No.	Depth Below Gages ft	Depth Below Grade ft	Quake in	Soil Damping Case Kips/ft/s	Visco	Smith s/ft	Ru Kips	Sum of Ru Kips	Unit Skin Frctn Kips/ft2
								361.4	
1	7.2	3.6	.100	.035	5.9	.165	34.6	326.7	.72
2	14.4	10.8	.100	.059	10.1	.169	59.4	267.4	1.24
3	21.6	18.0	.100	.045	7.6	.165	45.1	222.3	.94
4	28.8	25.2	.100	.041	6.9	.159	40.9	181.4	.85
5	35.0	32.4	.100	.041	6.9	.155	40.9	140.5	.85
Sum				.221	37.4		220.6		
Avrge			.100			.159	44.2		.92
Toe			.310	.106	18.0	.128	140.5		50.73

Soil Model Extensions		Skin	Toe
Unloading Quake	(% of loading quake)	10	100
Unloading Level	(% of Ru)	30	
Resistance Gap	(inch)		.04

CAPWAPC RESULTS

– Site No. 3 Pile 'A' –

DRAWN: WRW | DATE: 9/29/87 | SCALE:

SITE NO. 3

PILE 'B'

SITE NO.: 3

PILE NO.: B

LOCATION: (BRIEF DESCRIPTION) Jacksonville, Florida. Near the St. Johns River. The test pile is located in a power generating facility. The generalized subsurface profile described below is located approximately 75 feet from Test Pile 3-B.

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 50	LOOSE to VERY DENSE slightly silty fine SAND
50 - 60	VERY DENSE slightly cemented to cemented fine SAND

PILE DRIVING HAMMER INFORMATION

MAKE: Vulcan

MODEL: 510

TYPE: Air/Steam

STROKE: 3.25 Feet

RAM WEIGHT: 10,000 lbs.

RATED ENERGY: 32,500 ft-lbs

ACTION: Single

HAMMER CUSHION: 7½" Hammertex

PILE CUSHION: 6" Plywood

PILE INFORMATION

SIZE: 20-inch square

LENGTH: 46 Feet

TYPE: Prestressed Concrete

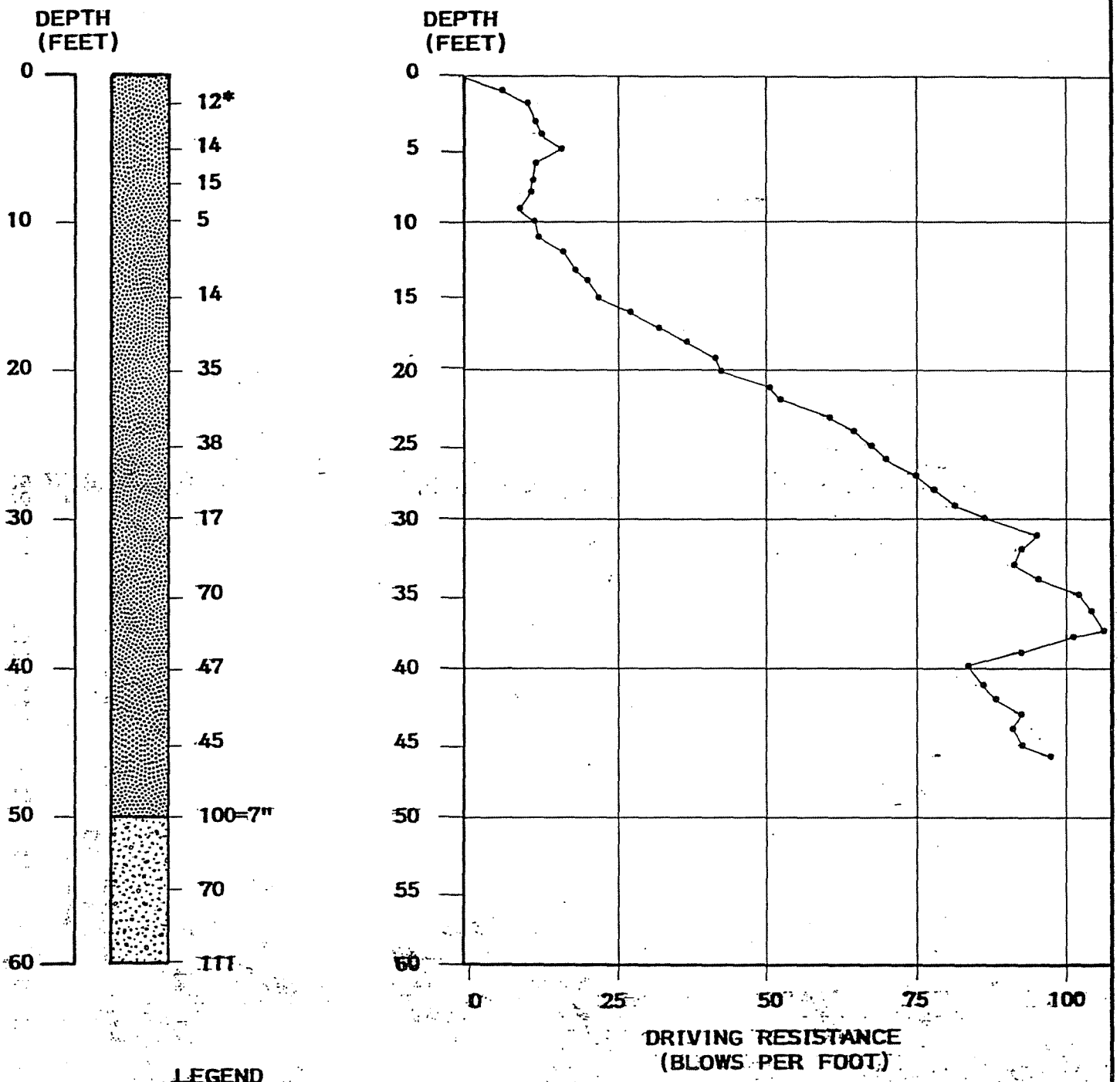
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	107	288	345	263	608	168	408	576	152	83	237
DESIGN CAPACITY (TONS)	53	144	115	88	203	84	136	220	76	42	118

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

Slightly silty fine SAND

CEMENTED fine SAND with shell fragments

Groundwater Level (Time of Drilling)

Loss of Drilling Fluid

B.T. Boring Terminated

GENERALIZED SUBSURFACE PROFILE AND DRIVING RESISTANCE

- Site No. 3 Pile 'B' -

DRAWN: W. WEEKS	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

LOG OF BORING

ELEVATION +7.5 GWL 0 HRS. 6.0' N 2909.4
HRS. W 6492.0
DATE START 10/2/79 DATE COMPLETE 10/4/79

Site No. 3
Pile 'B'

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	RQD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
	5							Tan-Gray	Medium dense fine SAND, some		
2.5	5 7	1 SS	18"						silt, trace organics		
						4.0'					
5	4 5	2 SS	18"			6.0'		Dark-Grav	Medium dense fine SAND, some silt, trace organics		
	9										
	7										
7.5	7 6	3 SS	18"			9.0'		Tan-Grav	Medium dense fine SAND, some silt		
10	2 2	4 SS	6"					Tan-Grav	loose fine SAND, some silt		
	3										
15	5 6	5 SS	6"					Tan	Medium dense fine SAND,		
	9										
						18.0'					
19											
20	10 15	6 SS	12"					White-Tan	Dense fine SAND, some silt		
20.5	20										
25	10 10	7 SS	12"					Light-Grav	Dense coarse to fine SAND		
	10										
30	5 6 8	8 SS	0"					Light-Grav	Medium dense medium to fine SAND, some silt		

LOG OF BORING

Site No. 3
Pile 'B'

ELEVATION _____ GWL 0 HRS. ___ _____
___ HRS. _____

DATE START 10/2/79 DATE COMPLETE 10/4/79

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	RQD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
						33.0'					
35	17 34 36	9 SS	12"					Light-Gray	Very dense fine to coarse SAND		
						37.0'					
40	12 23 24	10 SS	14"					Light-Grav	Dense fine SAND, some silt		
						44.0'					
45	21 22 23	11 SS	14"					Tan-Grav	Dense medium to Fine SAND		
						48.5					
50	100=7"	12 SS	7"					Gray	Very dense medium to fine SAND and LIMESTONE fragments, trace shell, partially cemented		
						54.0'					
55	8 10 60	13 SS	18"					Tan Dark-Grav	Very dense fine SAND some silt LIMESTONE fragments and medium to fine SAND		
						58.5					
60	7 30 81	14 SS	18"					Green-Gray	Very hard CLAY and SILT, some fine sand		

REMARKS _____

LOG OF BORING

ELEVATION _____ GWL 0 HRS. _____
_____ HRS. _____

DATE START 10/2/79 DATE COMPLETE 10/4/79

Site No. 3
Pile 'B'

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	RQD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
						63.0'					
65	4 3 3	15 SS	14"					Tan-Gray	Loose medium to fine SAND, some silt		
						67.5					
70	100	16 SS	6"					Tan-Gray	Very dense fine SAND, partially cemented		
75	70 30=3"	17 SS	8"					Tan-Gray	Very dense fine SAND, partially cemented		
80	60 40=3"	18 SS	8"					White-Gray	Very dense fine SAND, some clay and silt, slightly cemented		Cased to 80.0'
						83.0'					
85	16 16 17	19 SS	18"					Light-Gray	Dense fine SAND and LIMESTONE fragments, some shell		
90	21 20 36	20 SS	18"					Light-Green Gray	Very dense fine SAND, some silt and clay, trace phosphate partially cemented		

REMARKS _____

LOG OF BORING

ELEVATION _____ GWL 0 HRS. _____
_____ HRS. _____

DATE START 10/2/79 DATE COMPLETE 10/4/79

Site No. 3
Pile 'B'

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	ROD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
						92.5"					
95	7 12 14	21 SS	18"					Light-Green Gray	Dense fine SAND, some silt and clay		
100	14 10 10	22 SS	18"					Dark-Green Gray	Very stiff CLAY, some silt and shell trace fine sand		
						104.0"					
105	5 8 15	23 SS	18"					Dark Green Gray	Very stiff CLAY, some silt shell and phosphate gravel, trace fine sand, medium dense medium sand, some clay and silt		
110	5 8 13	24 SS	18"					Green-Gray	Medium dense medium to fine SAND, some silt, pockets of silty clay		
						112.0"					
115	5 7 8	25 SS	14"					Green-Gray	Medium dense medium to fine SAND, some silt and clay		
						118.0'					Presumed Hawthorne Formation
120	23 27 21	26 SS	16"					Green-Gray	Dense fine SAND, some clay and silt, trace phosphate gravel		

REMARKS _____

LOG OF BORING

ELEVATION _____ GWL 0 HRS. _____
HRS. _____

DATE START 10/2/79 DATE COMPLETE 10/4/79

Site No. 3
Pile 'B'

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO. AND TYPE	% ROCK RECOVERY	RQD	DESCRIPTION: PROFILE	SOIL OR ROCK STRATA DEPTH	ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BROKENNESS	REMARKS
A	B	C	D	E	F	G	H	I	J	K	L
125	7 7 9	27 SS	18"					Green-Gray	Medium dense fine SAND, some silt and clay		
						128.0'					
130	5 9 16	28 SS	18"					Green-Gray	Medium dense fine SAND, some silt and clay		
						133.5'					
135	9 11 20	29 SS	18"					Green-Gray	Dense SILT, some fine sand, clay and shell, partially cemented?		
						138.0'					
140	10 12 16	30 SS	18"					Green-Gray	Medium dense SILT, some clay and fine to coarse sand, trace phosphate		
						143.0'					
145	7 13 22	31 SS	18"					Light-Green Gray	Dense SILT, some clay, fine sand and phosphate gravel		
150	6 16 21	32 SS	18"					Green-Gray	Dense fine SAND, some silt and clay, trace phosphate gravel		

REMARKS _____

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: SITE NO. 3
Location: JACKSONVILLE, FLORIDA

-- TEST PILE --

PILE DATA

Pile Number	B
Orig. Length	55 FT
Date Driven	4/22-23/87
Jetting Depth	0
Surface Elev.	+6.0 FT (MSL)
Driving Time	60 MINUTES
Cut-Off Elev.	N/A
Tip Elevation	-40.17 FT (MSL)
Cut-Off Length	N/A

Specified Capacity: 300 TONS COMPRESSION
Required Blows: NONE

Pile Type: PRESTRESSED CONCRETE (SOLID)
Pile Size: 20-INCHES SQUARE

HAMMER DATA

Make: VULCAN

Model: 510

Stroke: 3.25

Ram Weight: 10,000 LBS.

Rated Energy: 32,500 FT-LBS.

Type: AIR/STEAM

Action: SINGLE

Hammer Cushion 7½" HAMMERTEX

Pile Top Cushion: 6" PLYWOOD (PINE)

PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft
1	6	20	43	39	93						
2	10	21	51	40	84						
3	12	22	53	41	86						
4	13	23	61	42	88						
5	16	24	65	43	92						
6	12	25	68	44	86						
7	11	26	70	45	92						
8	11	27	75	46	72=9"						
9	9	28	78								
10	11	29	81								
11	12	30	86								
12	16	31	95								
13	18	32	93								
14	20	33	91								
15	22	34	95								
16	28	35	106								
17	33	36	112								
18	37	37*	127								
19	42	38	103								

RESTRIKE

DATE/TIME: 4/23/87--1:15-1:23

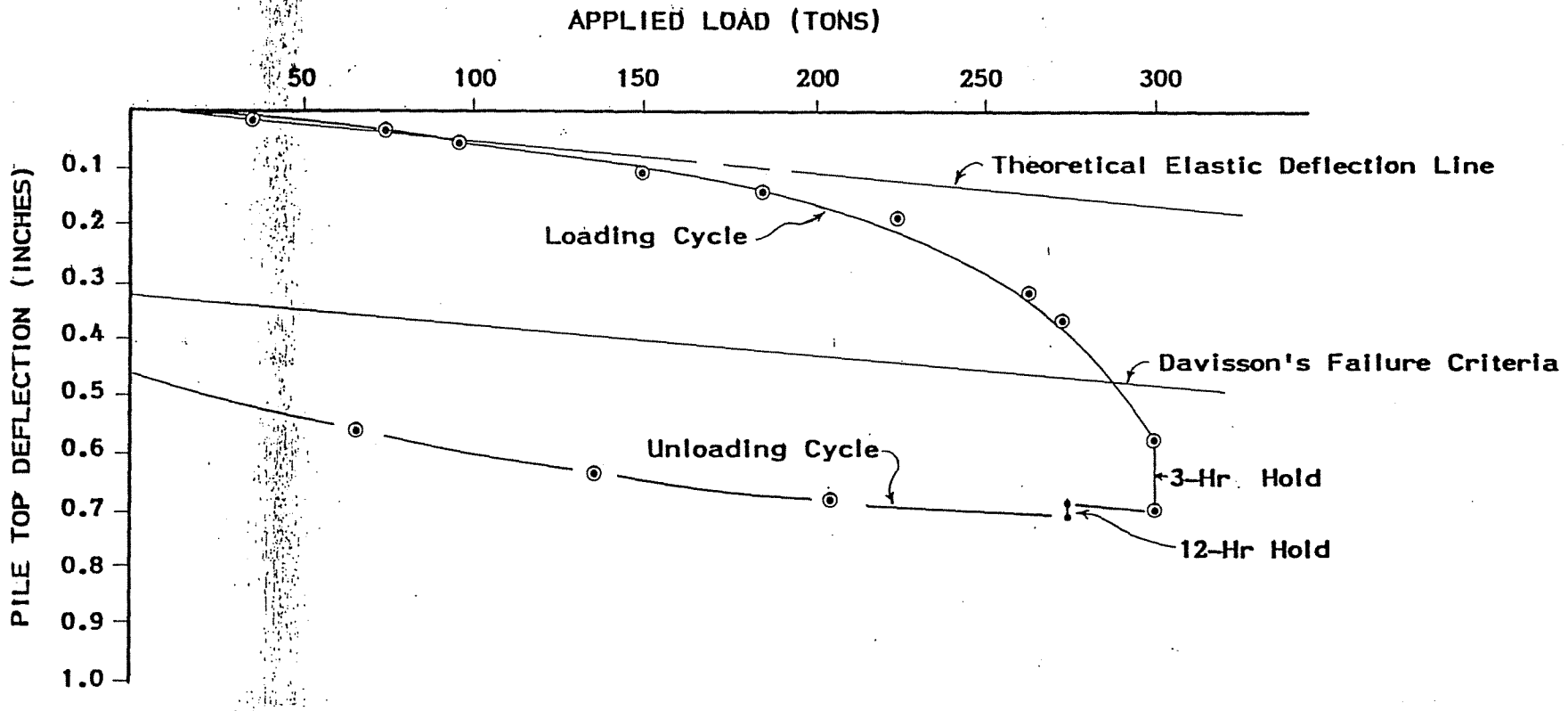
1"=13

2"=5@9/16"

REMARKS

PILE MONITORED WITH PDA.

* PILE TOP CUSHION CHANGED.



Pile Information:

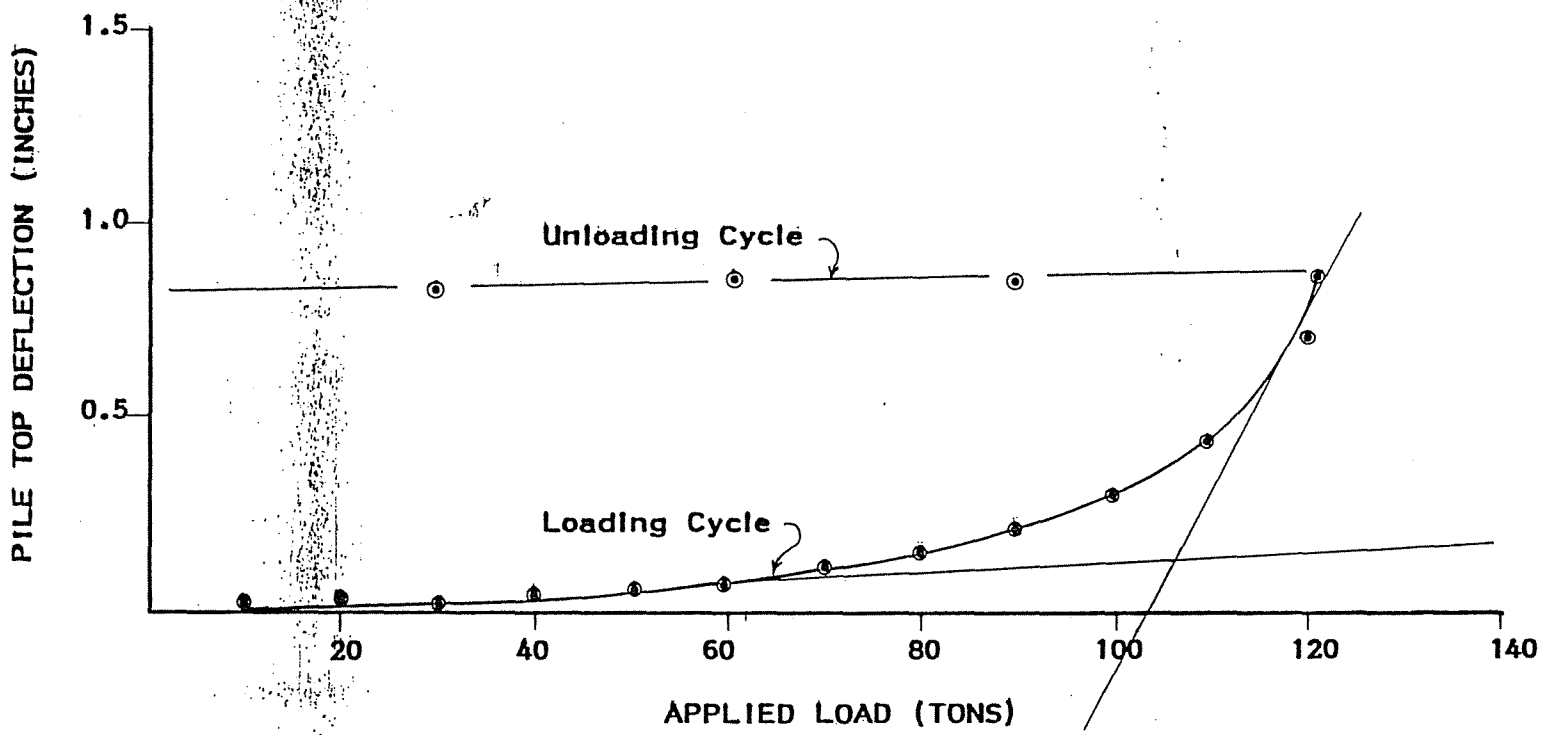
Type: Prestressed Concrete
Size: 20-Inch Square
Length: 46 Feet

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

– Site No. 3 Pile 'B' –

DRAWN: WRW	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	



Pile Information:

Type: Prestressed Concrete
Size: 20-Inch Square (Solid)
Length: 46 Feet

TENSION STATIC LOAD TEST RESULTS
LOAD VERSUS PILE TOP DEFLECTION

– Site No. 3 Pile 'B' –

DRAWN: WRW	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

Final Drivability Capacity: Ru = 473.7 Skin = 303.2 Toe = 170.5 Kips

Soil Sgmnt No.	Depth Below Gages ft	Depth Below Grade ft	Quake in	Soil Damping Case Viscs Kips/ft/s	Smith s/ft	Ru Kips	Sum of Ru Kips	Unit Skin Frctn Kips/ft2
							473.7	
1	10.2	2.8	.120	.036	5.9	.211	27.9	445.8	.62
2	17.0	9.5	.120	.033	5.3	.211	25.3	420.5	.55
3	23.8	16.4	.120	.044	7.1	.211	33.5	387.0	.74
4	30.6	23.2	.120	.046	7.4	.211	35.2	351.8	.78
5	37.4	30.0	.120	.056	9.1	.211	43.4	308.4	.96
6	44.2	36.8	.120	.077	12.5	.211	59.5	249.0	1.31
7	51.0	43.6	.120	.102	16.5	.211	78.4	170.5	1.73
Sum				.395	63.8		303.2		
Avrge			.120			.211	43.3		.95
Toe			.230	.222	35.9	.211	170.5		61.55

Soil Model Extensions		Skin	Toe
Unloading Quake	(% of loading quake)	45	100
Unloading Level	(% of Ru)	40	

CAPWAPC RESULTS

– Site No. 3 Pile 'B' –

DRAWN: WRW	DATE: 9/29/87	SCALE:

SITE NO. 3

PILE 'C'

SITE NO.: 3

PILE NO.: C

LOCATION: (BRIEF DESCRIPTION) Jacksonville, Florida. Near the St. Johns River. The test pile is located in a power generating facility. The generalized subsurface profile described below is located approximately 100 feet from Test Pile 3-C

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 5	LOOSE slightly silty fine SAND
5 - 13	VERY SOFT to SOFT silt
13 - 50	VERY LOOSE to DENSE slightly silty fine SAND
50 - 70	VERY FIRM to VERY DENSE slightly cemented to cemented fine SAND

PILE DRIVING HAMMER INFORMATION

MAKE: Vulcan

MODEL: 80C

TYPE: Air/Steam

STROKE: N/A

RAM WEIGHT: 8000 lbs.

RATED ENERGY: 24,450 ft-lbs

ACTION: Double

HAMMER CUSHION: 7½" Hammertex

PILE CUSHION: 6" Plywood

PILE INFORMATION

SIZE: 14-inch square

LENGTH: 60 Feet

TYPE: Prestressed Concrete

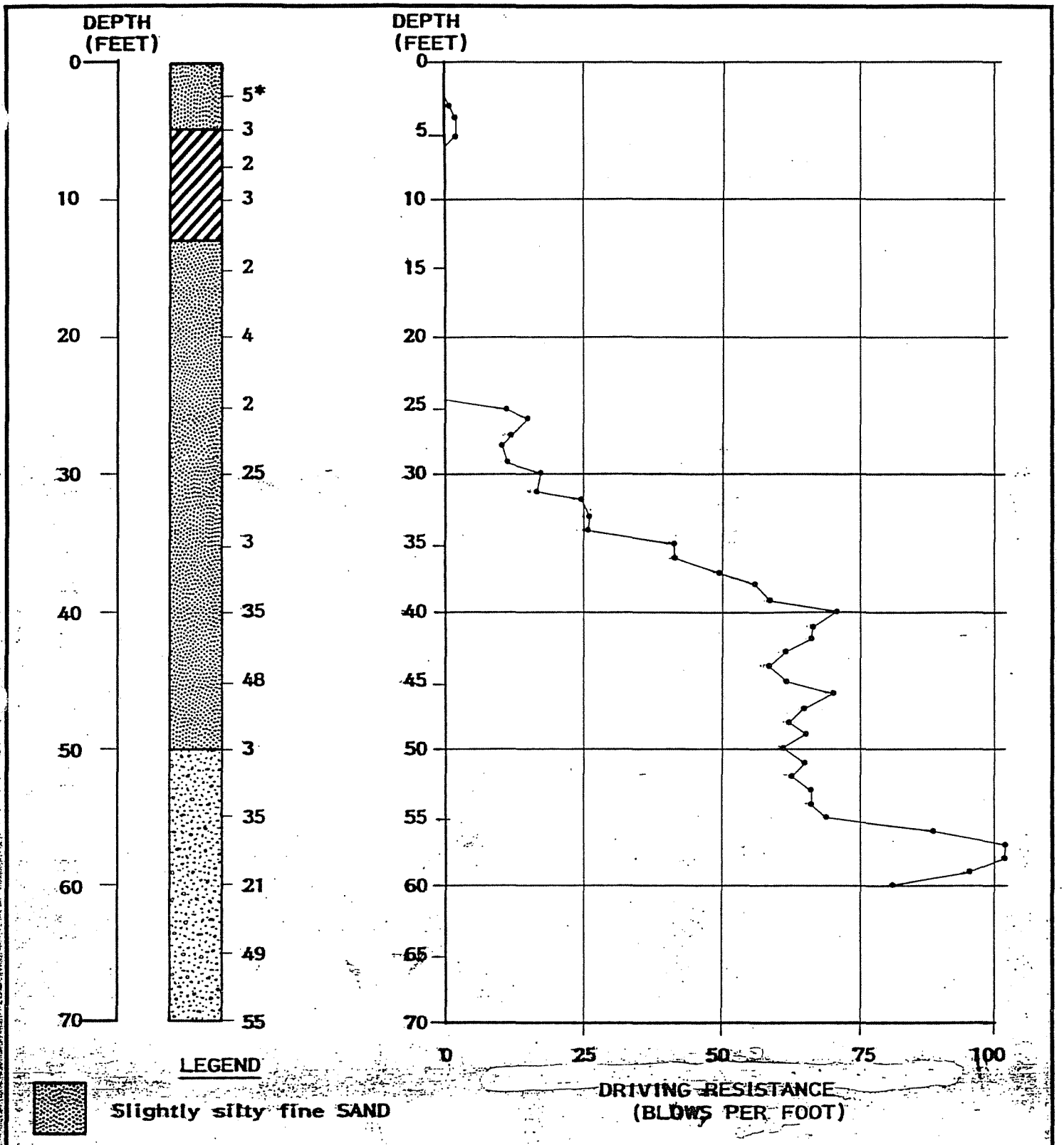
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	74	172	215	82	297	80	87	167	214	20	234
DESIGN CAPACITY (TONS)	37	86	72	27	99	40	29	69	107	10	117

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

Slightly silty fine SAND

SILT

CEMENTED fine SAND with shell fragments

Groundwater Level (Time of Drilling)

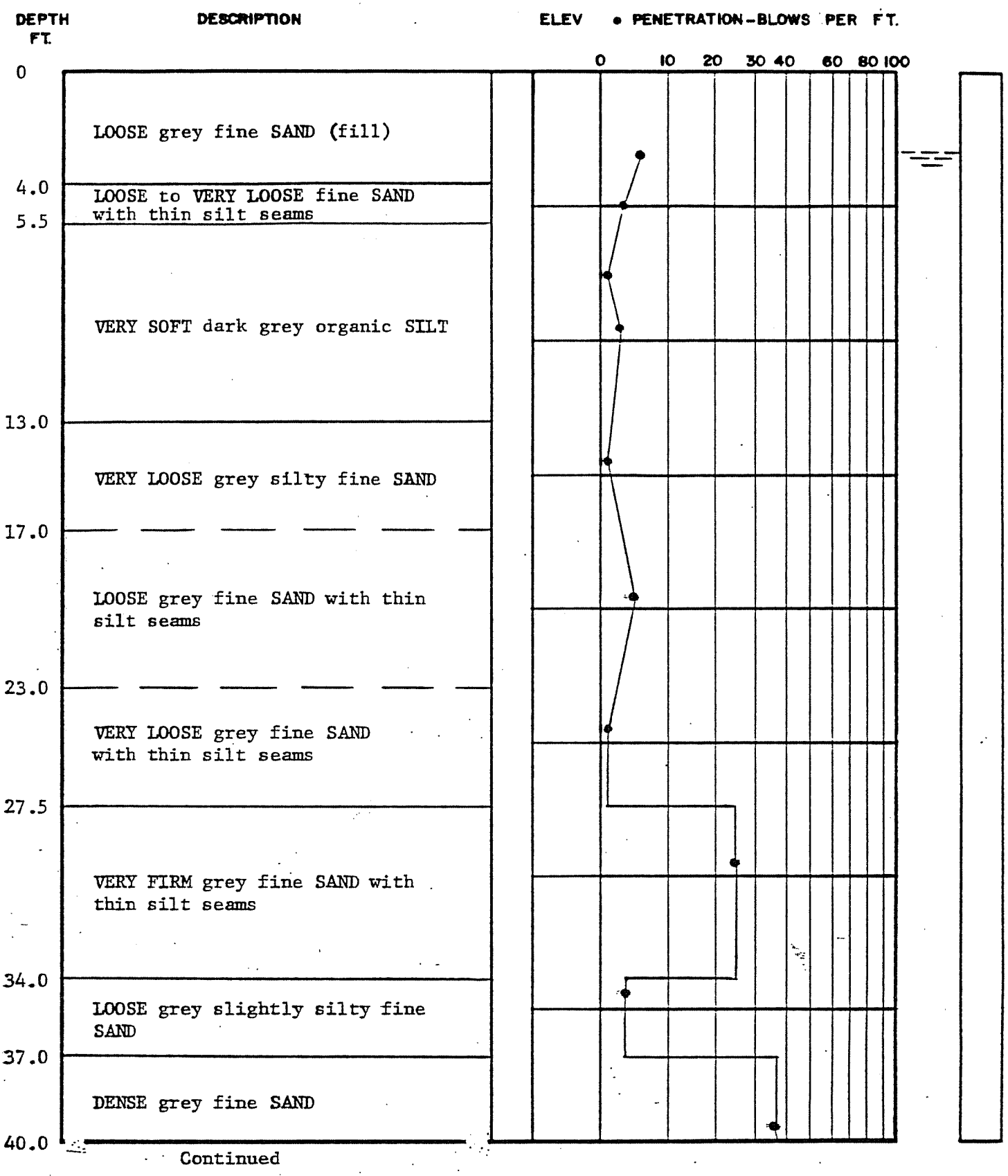
Loss of Drilling Fluid

B.T. Boring Terminated

GENERALIZED SUBSURFACE PROFILE AND DRIVING RESISTANCE

– Site No. 3 Pile 'C' –

DRAWN: W·WEEKS	DATE: 9/29/87	SCALE:
CHECKED: KFK	JOB NO: ASCE	As Noted



TEST BORING RECORD

Site No. 3

Pile 'C'

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

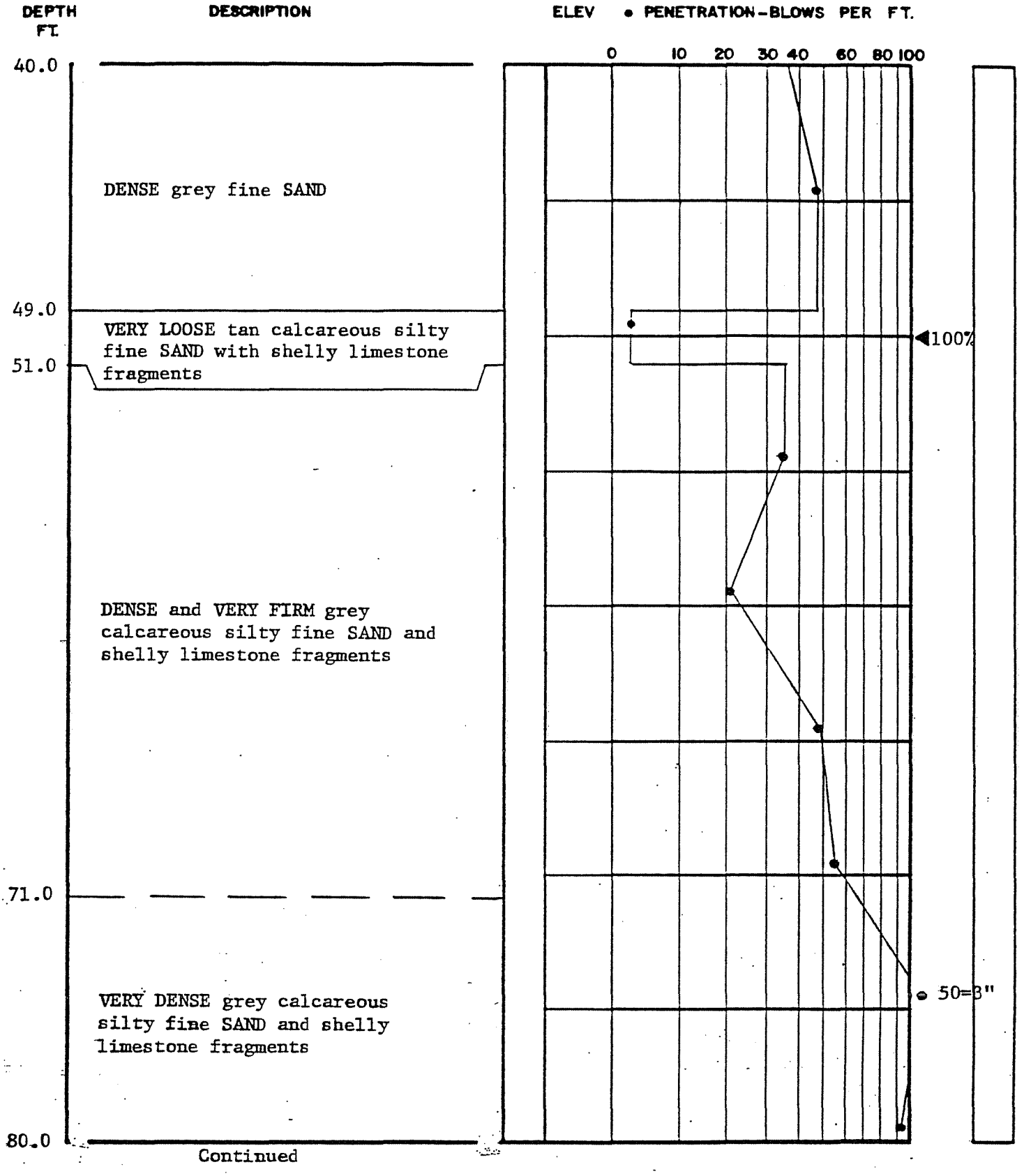
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

[50] % ROCK CORE RECOVERY



TEST BORING RECORD

Site No. 3

Pile 'C'

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

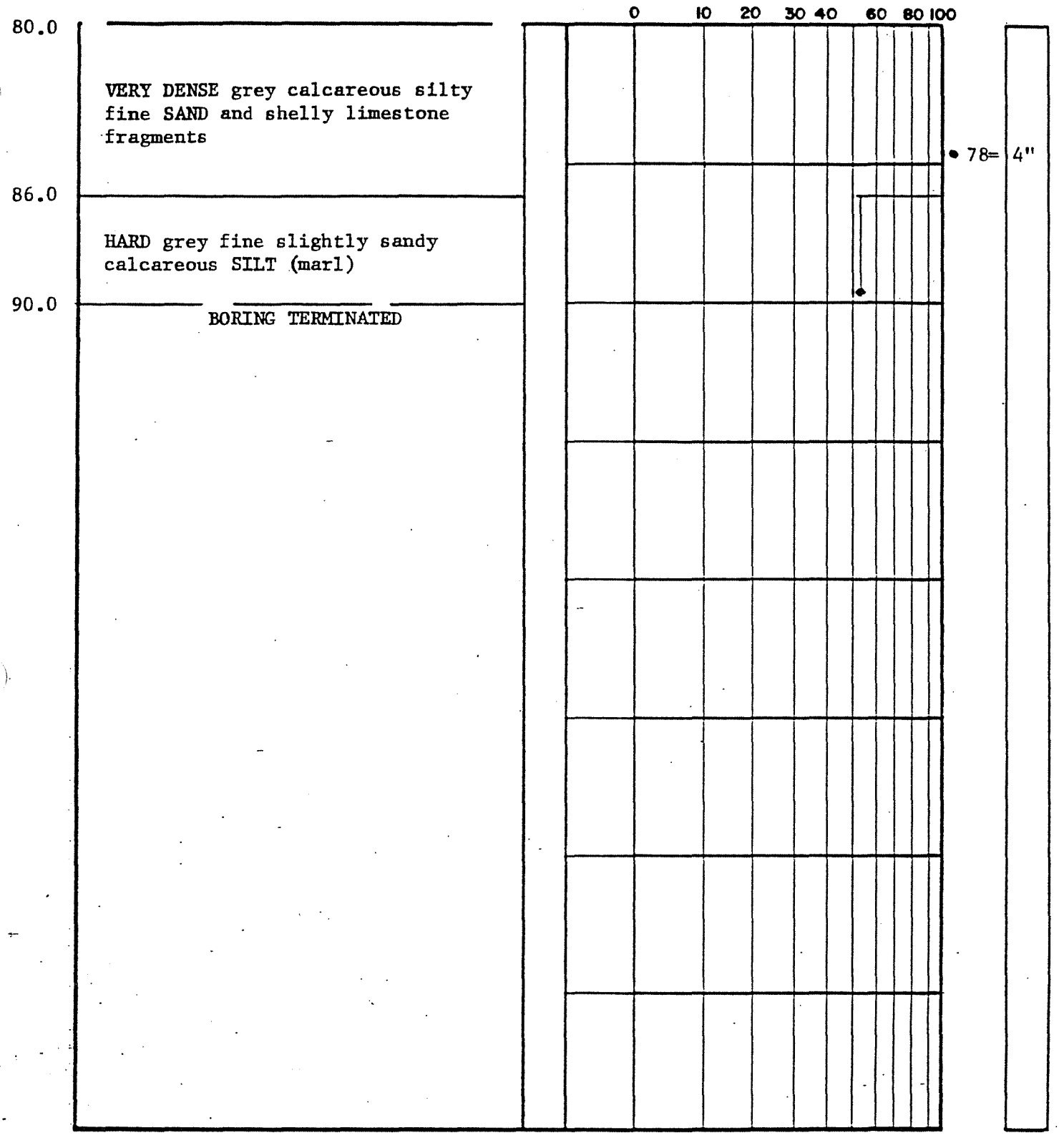
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

(50) % ROCK CORE RECOVERY



TEST BORING RECORD

Site No. 3

Pile 'C'

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

| 50 | % ROCK CORE RECOVERY

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: SITE NO. 3
Location: JACKSONVILLE, FLORIDA

-- TEST PILE --

PILE DATA

Pile Number	C
Orig. Length	79 FT.
Date Driven	4/13-14/87
Jetting Depth	0
Surface Elev.	+5.32 FT (MSL)
Driving Time	39 MINUTES
Cut-Off Elev.	N/A
Tip Elevation	-54.68 FT (MSL)
Cut-Off Length	N/A

Specified Capacity: 300 TONS COMPRESSION
Required Blows: NONE

Pile Type: PRESTRESSED CONCRETE (SOLID)
Pile Size: 14-INCH SQUARE

HAMMER DATA

Make: VULCAN

Model: 80C

Stroke: N/A

Ram Weight: 8000 LBS.

Rated Energy: 24,450 FT-LBS.

Type: AIR/STEAM

Action: DOUBLE

Hammer Cushion 7½" HAMMERTEX

Pile Top Cushion: 6" PLYWOOD (PINE)

PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft	DEPTH	BLOWS Per Ft
1	PUSH	20		39	59	58	115				
2	↓	21		40	71	59	95				
3	1	22		41	67	60	81				
4	2	23		42	66						
5	2	24	↓	43	62						
6	DROP	25	11	44	59						
7		26	15	45	67						
8		27	13	46	70						
9		28	10	47	65						
10		29	11	48	63						
11		30	18	49	65						
12		31	17	50	61						
13		32	25	51	65						
14		33	26	52	63						
15		34	31	53	66						
16		35	42	54	66						
17		36	42	55	69						
18		37	50	56	89						
19	↓	38	56	57	116						

RESTRIKE

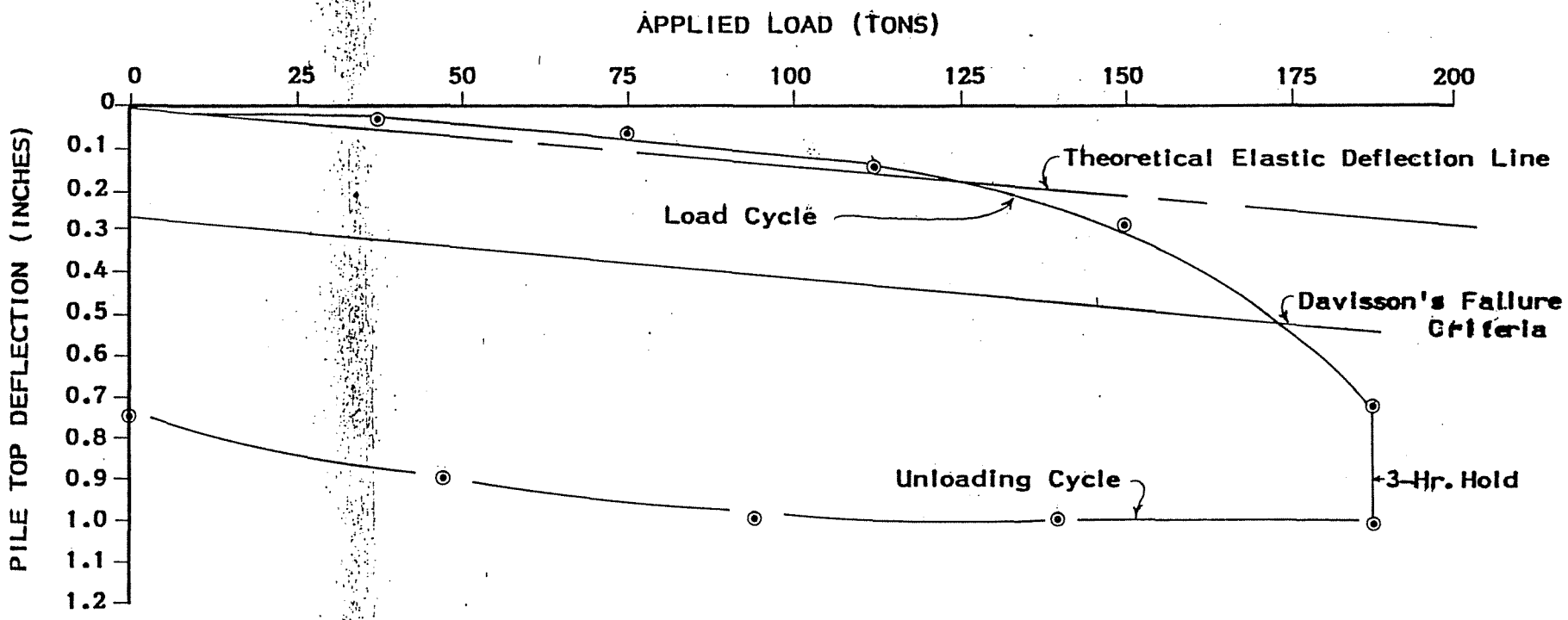
DATE/TIME: 4/14/87

1" = 10=3/4"

REMARKS

PILE MONITORED WITH PDA.

NOTE: THE INITIAL PILE DRIVING WAS PERFORMED WITH THE VULCAN 80C HAMMER BECAUSE THE VULCAN 510 HAMMER WAS NOT WORKING. THE PILE WAS RE-STRUCK WITH THE VULCAN 510 HAMMER.



Pile Information:

Type: Prestressed Concrete

Size: 14-Inch Square

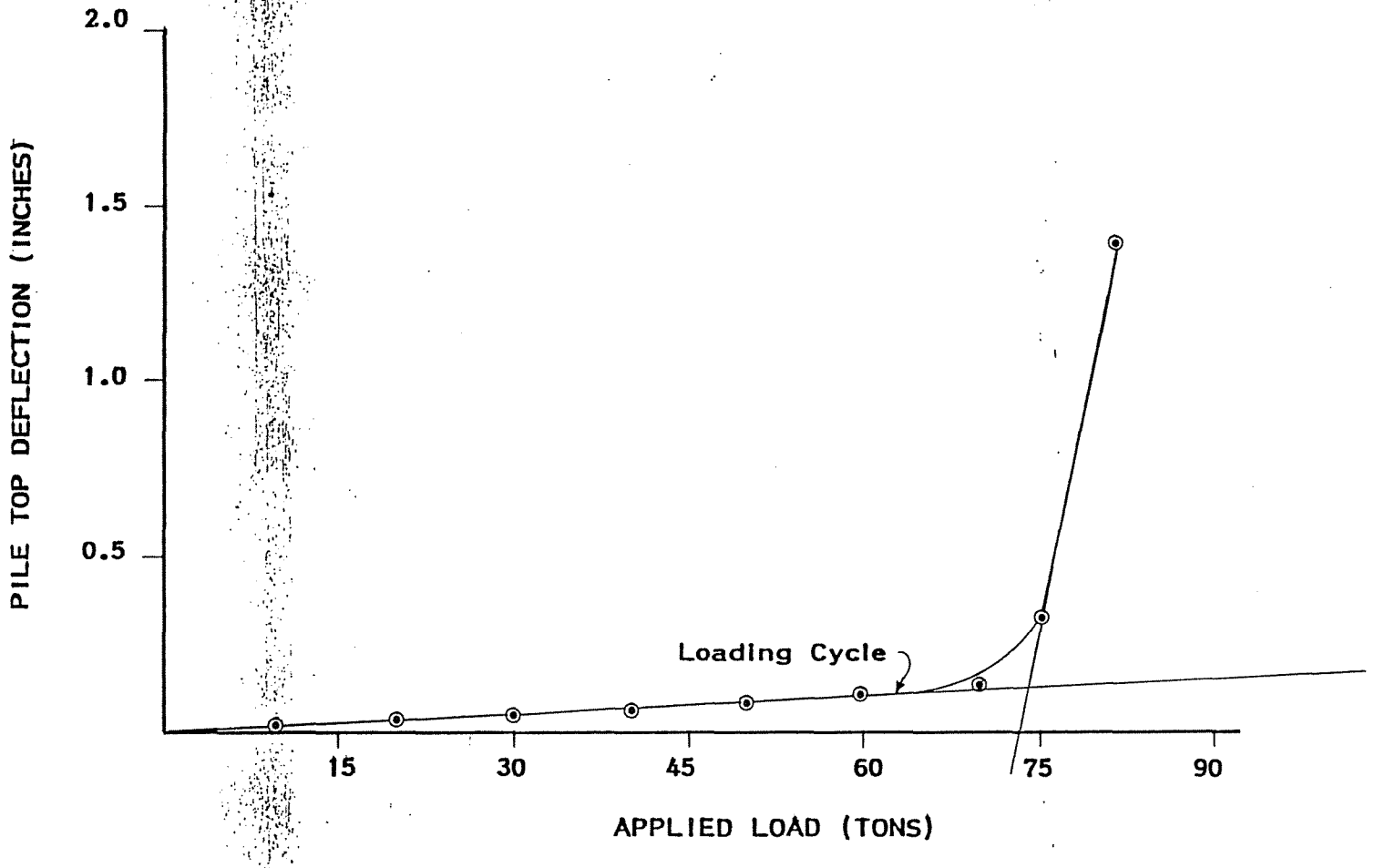
Length: 60 Feet

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

- Site No. 3 Pile 'C' -

DRAWN: WRW	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	



Pile Information:

Type: Prestressed Concrete

Size: 14-Inch Square (Solid)

Length: 60 Feet

TENSION STATIC LOAD TEST RESULTS
LOAD VERSUS PILE TOP DEFLECTION

– Site No. 3 Pile 'C' –

DRAWN: WRW	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	

Final CAPWAPC Capacity: Ru 477.1, Skin 437.7, Toe 39.4 Kips

Soil Sgmnt No.	Depth Below Gages ft	Depth Below Grade ft	Quake in	Soil Damping Case Kips/ft/s	Visc s/ft	Smith	Ru Kips	Sum of Ru Kips	Unit Skin Frict Kips/ft2
								477.1	
1	20.2	2.8	.150	.003	.2	.166	1.5	475.6	.05
2	26.9	9.5	.150	.003	.2	.166	1.5	474.1	.05
3	33.6	16.3	.150	.003	.2	.166	1.5	472.7	.05
4	40.4	23.0	.150	.056	5.3	.166	32.0	440.7	1.02
5	47.1	29.7	.150	.108	10.3	.166	61.9	378.8	1.57
6	53.8	36.5	.150	.165	15.8	.166	95.4	283.5	3.04
7	60.5	43.2	.150	.180	17.1	.166	103.1	180.4	3.39
8	67.3	49.9	.150	.134	12.7	.166	76.8	103.5	2.44
9	74.0	56.6	.150	.112	10.7	.166	64.2	39.4	2.04
Sum				.762	72.6		437.7		
Avrge			.150			.166	48.6		1.55
Toe			.120	.245	23.4	.593	39.4		25.97

Soil Model Extensions		Skin	Toe
Unloading Quake	(% of loading quake)	50	100
Reloading Level	(% of Ru)	5	0
Unloading Level	(% of Ru)	0	
Resistance Gap	(inch)		.05

CAPWAPC RESULTS

- Site No. 3 Pile 'C' -

DRAWN: [illegible] | DATE: 9/20/97 | SCALE:

SITE NO. 4

PILE 'A'

SITE NO.: 4

PILE NO.: A

LOCATION: (BRIEF DESCRIPTION) St. Augustine, Florida. Near the Atlantic Ocean. The test pile is located in a private school facility. The generalized subsurface profile described below is located approximately 25 feet from Test Pile 4-A.

GENERALIZED SUBSURFACE PROFILE

DEPTH (FEET)	SOIL DESCRIPTION
0 - 5	LOOSE slightly silty fine SAND
5 - 22	VERY LOOSE clayey fine SAND
22 - 32	FIRM to DENSE slightly silty fine SAND
32 - 40	FIRM to DENSE shelly fine SAND

PILE DRIVING HAMMER INFORMATION

MAKE: ICE STROKE: N/A ACTION: Double

MODEL: 440 RAM WEIGHT: 4000 lbs. HAMMER CUSHION: 2½" Al. & Micarta

TYPE: Diesel RATED ENERGY: 19,840 ft-lbs PILE CUSHION: 4½" Pinewood

PILE INFORMATION

SIZE: 12-inch square

LENGTH: 28 Feet

TYPE: Prestressed Concrete

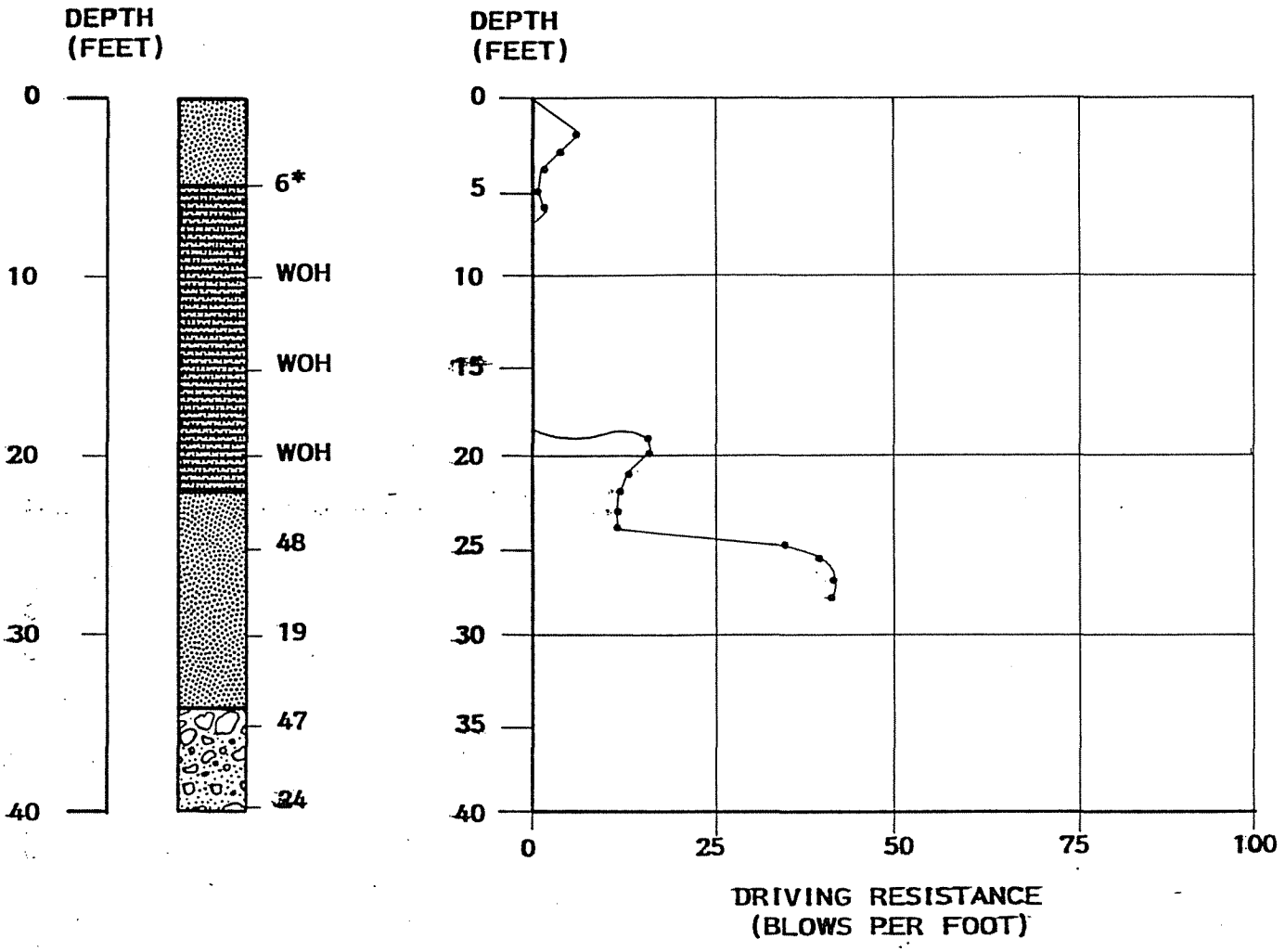
SUMMARY OF ANALYSIS

	STATIC LOAD TEST		NORDLUND METHOD			SCHMERTMAN METHOD			CAPWAPC		
	TENSION	COMPRESSION	SKIN	END	TOTAL	SKIN	END	TOTAL	SKIN	END	TOTAL
ULTIMATE CAPACITY (TONS)	N/P	67	13	65	78	24	96	120	N/P	N/P	N/P
DESIGN CAPACITY (TONS)	N/A	33	4	22	26	12	32	44	N/A	N/A	N/A

N/P: NOT PERFORMED
N/A: NOT APPLICABLE

RECOMMENDED FACTOR OF SAFETY (USED TO DETERMINE DESIGN CAPACITIES)

STATIC LOAD TEST	NORDLUND METHOD	SCHMERTMAN METHOD	CAPWAPC
COMPRESSION: FS=2.0	SKIN FRICTION: FS=3.0	SKIN FRICTION: FS=2.0	SKIN FRICTION: FS=2.0
TENSION: FS=2.0	END BEARING: FS=3.0	END BEARING: FS=3.0	END BEARING: FS=2.0



LEGEND

Slightly silty fine SAND

Clayey fine SAND

Shelly fine SAND

Groundwater Level (Time of Drilling)

Loss of Drilling Fluid

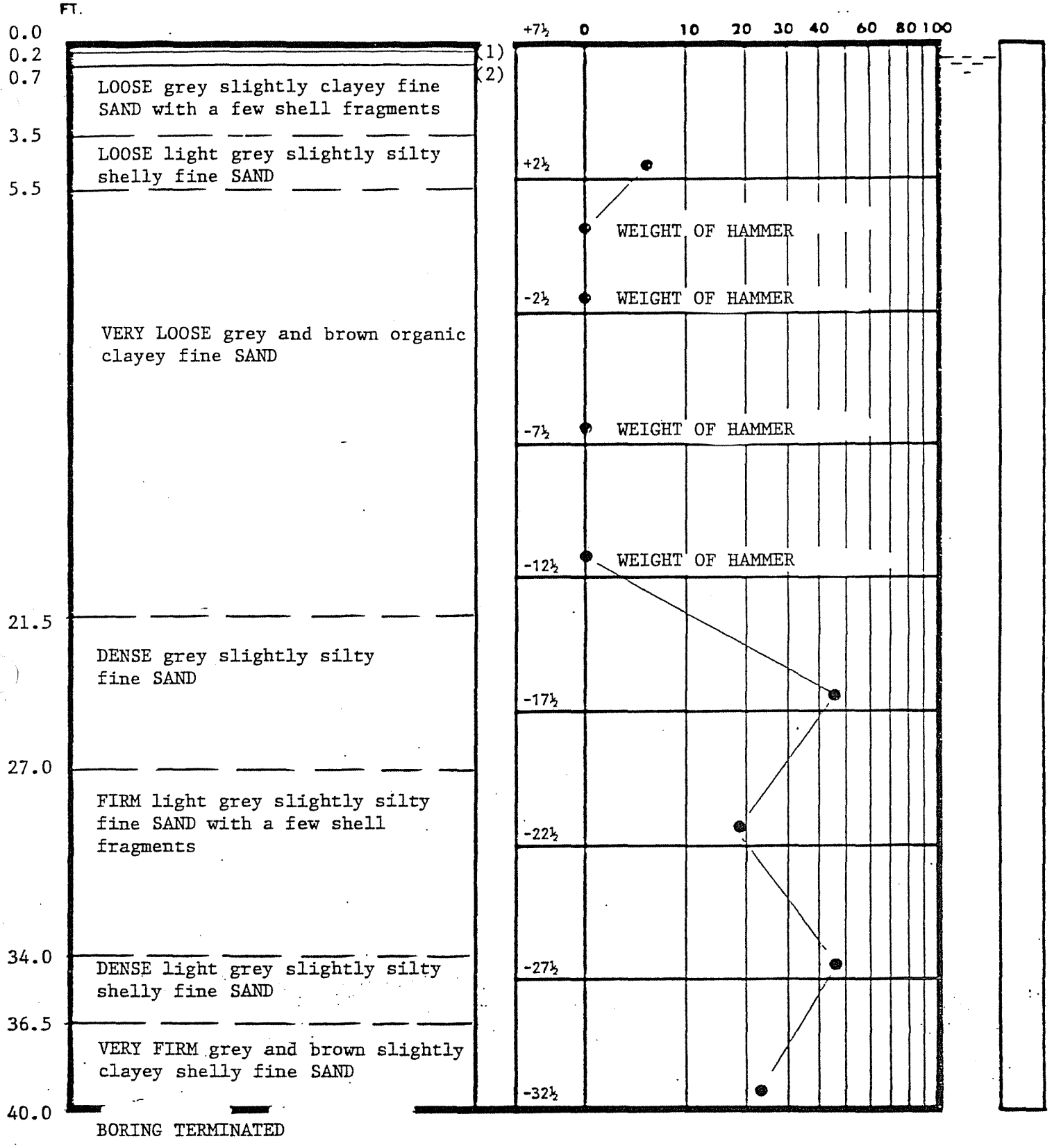
WOH Weight of Hammer

B.T. Boring Terminated

GENERALIZED SUBSURFACE PROFILE AND DRIVING RESISTANCE

– Site No. 4 Pile 'A' –

DRAWN: W. WEEKS	DATE: 9/29/87	SCALE:
CHECKED: KFK	JOB NO: ASCE	As Noted



(1) ASPHALT
(2) LIMEROCK

TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

% ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE AT TIME OF DRILLING

LOSS OF DRILLING WATER

Site No. 4

Pile 'A'

RECORD OF PILE DRIVING

GENERAL INFORMATION

Project: SITE NO. 4
Location: ST. AUGUSTINE, FLORIDA

-- TEST PILE --

PILE DATA

Pile Number	A
Orig. Length	50 FEET
Date Driven	8/18/87
Jetting Depth	0
Surface Elev.	N/R
Driving Time	N/R
Cut-Off Elev.	N/A
Tip Elevation	N/R
Cut-Off Length	N/A

Specified Capacity: 100 TONS COMPRESSION
Required Blows: NOT SPECIFIED

Pile Type: PRESTRESSED CONCRETE
Pile Size: 12-INCH SQUARE

HAMMER DATA

Make: ICE

Model: 440

Stroke: N/A

Ram Weight: 4000 LBS.

Rated Energy: 18,200 FT-LBS.

Type: DIESEL

Action: DOUBLE

Hammer Cushion N/R

Pile Top Cushion: 4½" PINE

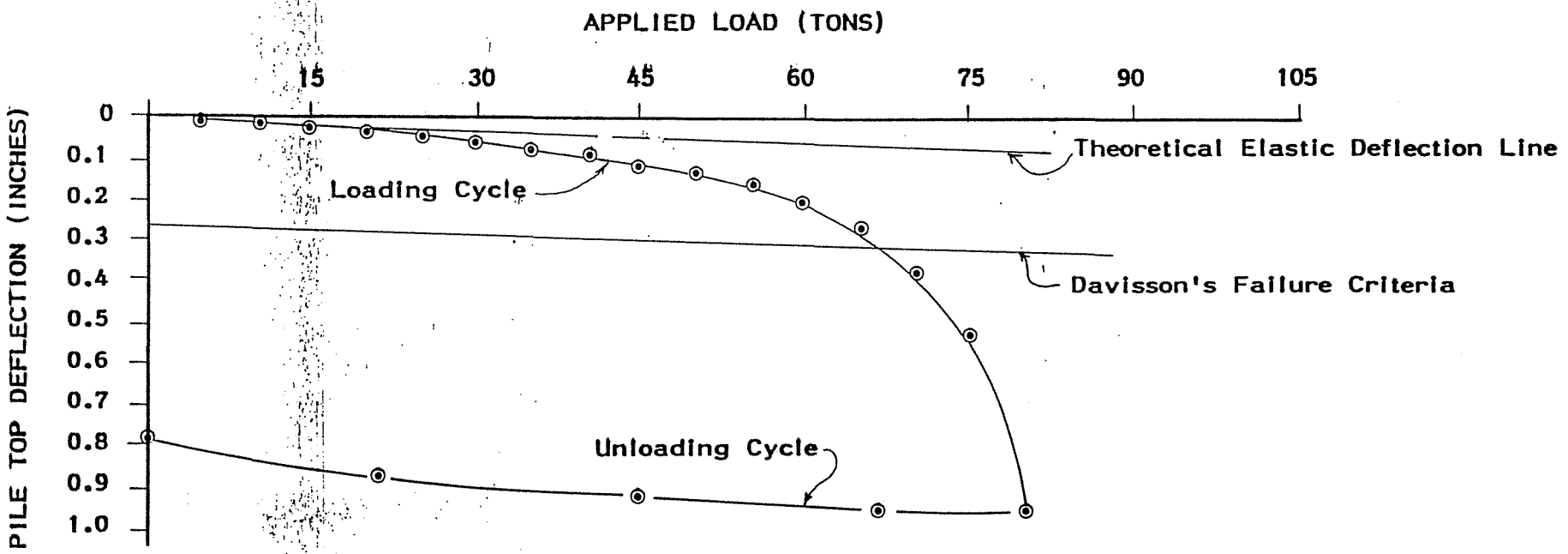
PENETRATION RESISTANCE

DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.	DEPTH	BLOWS Per Ft.
1	--	20	16								
2	6	21	13								
3	4	22	12								
4	2	23	12								
5	1	24	12								
6	2	25	35								
7		26	40								
8		27	42								
9		28	42								
10											
11											
12											
13											
14											
15											
16											
17											
18	↓										
19	16										

RESTRIKE

DATE/TIME: _____

REMARKS



Pile Information:

Type: Prestressed Concrete

Size: 12-Inch Squre (Solid)

Length: 28 Feet

COMPRESSIVE STATIC LOAD TEST RESULTS

LOAD VERSUS PILE TOP DEFLECTION

– Site No. 4 Pile 'A' –

DRAWN: WRW	DATE: 9/29/87	SCALE: As Noted
CHECKED: KFK	JOB NO: ASCE	