Comparative Pile Study

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H, pipe, concrete and monotube piles were competitively tested.

Results of dynamic testing using a diesel hammer with a 7 kips ram indicate significantly better performance during restrike; comparison of wave traces indicates preignition at the end of driving.

Blow counts were very high. Stresses of 34 ksi and 4 ksi caused pile top damage for pipe and concrete piles, respectively. At 45 ksi, the weld in the monotube failed (see figure).

Even though the soils were completely dry, restrikes at one day showed about a 20% setup increase in capacity. Projection of these results to 30 days using a log time graph gave very good correlation with the Davisson failure load for the pipe, concrete and monotube from a static test at that time delay. Although these displacement piles had good agreement, the H pile using the same technique was low by about 50% of the actual increase, perhaps due to geometry (two flanges only during driving - perhaps plugged - compared with four sides after soil pressures are equalized) or driving into a different soil layer with different time dependent properties.

Comparison of Davisson with the slope method (0.05"/ton) failure criteria shows the Davisson value to be 7.5% lower than the slope criteria on the average. The displacement at the slope criteria is twice that at the Davisson limit.

REF:PAPERS001.28

Table 1 Summary of Static Load Tests

Pile	Davisson's Failure Load kips	Double Tangent * Method kips	Maximum Applied Load kips
TP1	880	990	1050
TP2	1460	1400	1420
TP3	1270	1240	1260
TP4	760	820	860
TP5	730	990	1040
TP6	950	1050	1080
TP7	970	1190	1230
TP8	626	650	680
TP9	690	670	680

@ 0.05"/TON
(Quick Load)

RE:GA009.40

* Generally at about twice the DAV [illegible] it displacement.

Table 2: Summary of Processing Results

Pile	Data	Average Maximum Energy Ft-kip	Average Maximum Force kips	Bearing Capacity Case Method J=0 kips	Bearing Capacity Case Method J=* kips	Blow** Count Bl/ft
TP1***	EOID	15.0	760	700	475	86
TP2	BOIR	20.6	887	830	618	180
TP3	EOID	8.9	544	649	548	307
TP3	BOIR	21.4	900	897	700	237
TP4	EOID	12.4	524	552	509	783
TP4	BOIR	25.2	677	677	640	
TP5	BOIR	20.9	604	610	573	322
TP6	EOID	10.6	621	812		292
TP6	BOIR	11.8	752	722	568	
TP7	EOID	13.1	705	665	531	675
TP7	BOIR	22.3	997	770	638	
TP8	EOID	14.7	529	527	484	112
TP9	EOID	15.7	533	537	487	111

* Refer to the text in the report for the appropriate J value used in each case.

** Equivalent blow counts in blows per foot.

*** Values listed are field results measured at a penetration of 43.5 ft (final depth was 45 ft).

Ref:GA009.30

- Diesel - 7 kip

(5.5"

Table 3: Summary of CAPWAP Results

Pile	Data	Ultimate Bearing Capacity			Damping Parameters				Quake	
					Case		Smith			
		Skin kips	Toe kips	Total kips	Skin	Toe	Skin s/ft	Toe s/ft	Skin inch	Toe inch
TP2	B01R	437	225	662	.35	.08	.049	.022	.13	.27
TP3	EOID	326	228	554	.35	.10	.066	.027	.09	.12
TP3	B01R	360	276	636	.37	.10	.063	.022	.07	.07
TP4	EOID	77	431	508	.25	.50	.092	.033	.10	.18
TP4	B01R	100	530	630	.12	.50	.034	.027	.15	.30
TP5	B01R	103	515	618	.20	.40	.055	.022	.16	.26
TP6	B01R	107	434	541	.10	.30	.087	.065	.10	.15
TP7	EOID	225	304	529	.20	.20	.078	.058	.20	.22
TP7	B01R	302	318	620	.18	.16	.052	.044	.25	.30
TP8	EOID	372	83	455	.60	.15	.030	.034	.08	.08
TP9	EOID	404	66	470	.063	.01	.033	.030	.10	.10

Note: End bearing is associated with the pile toe or tip. These terms are used interchangeably.

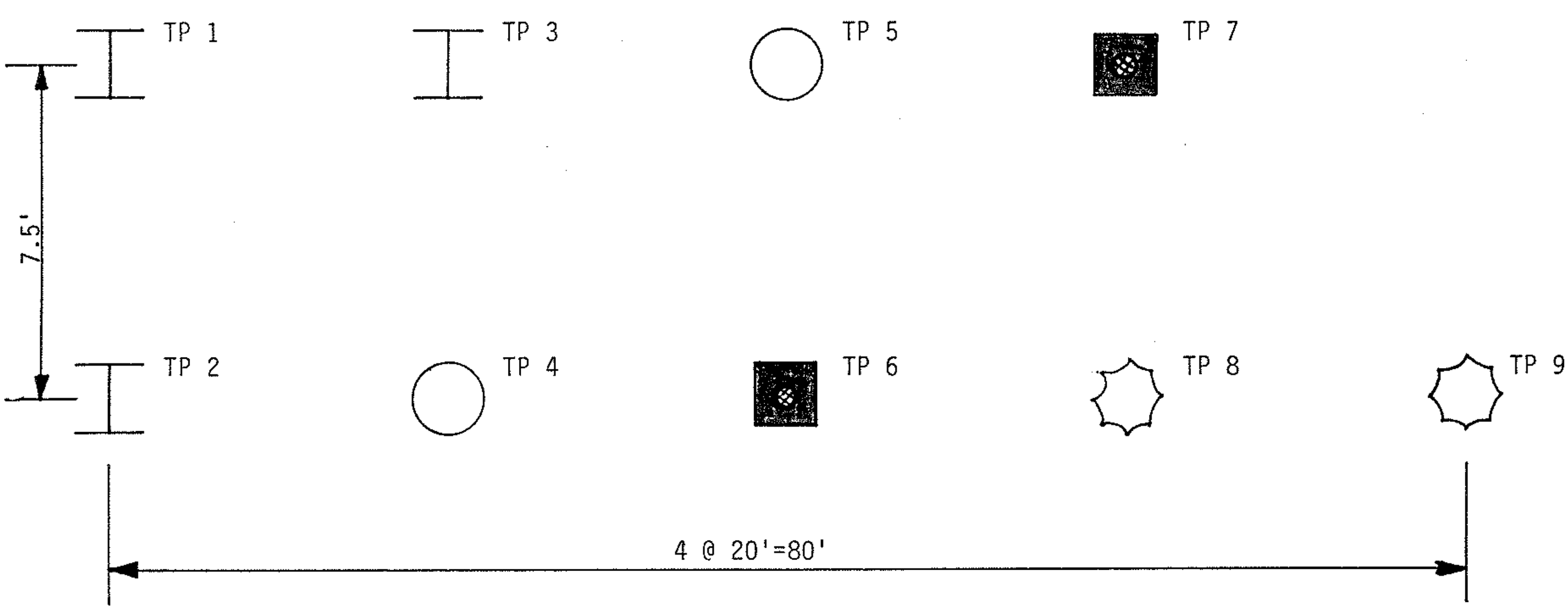


Figure 1: General Layout- Test Pile Plan

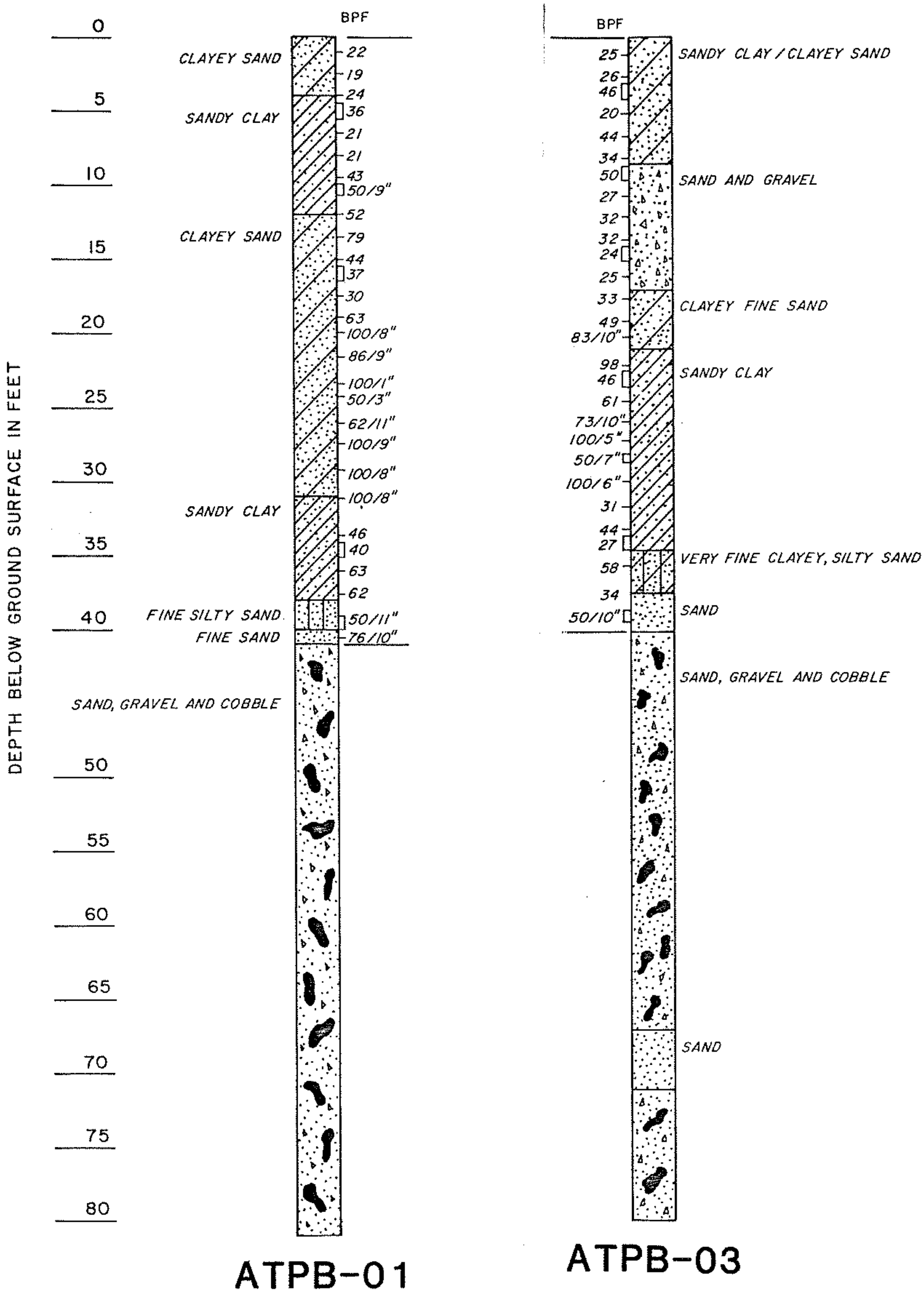
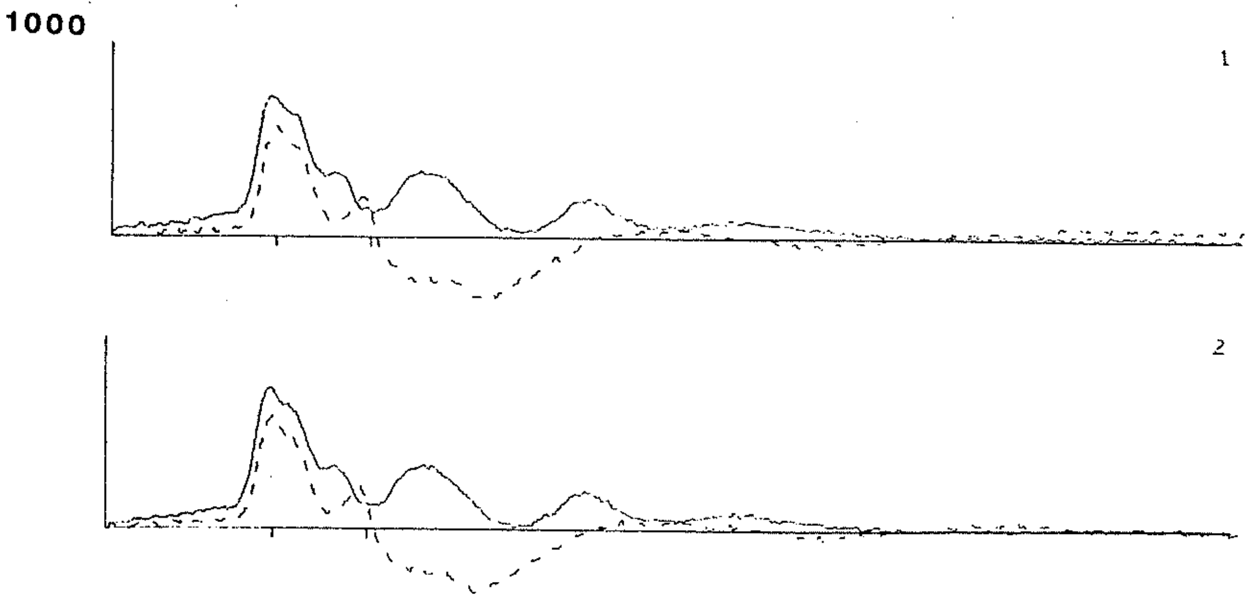
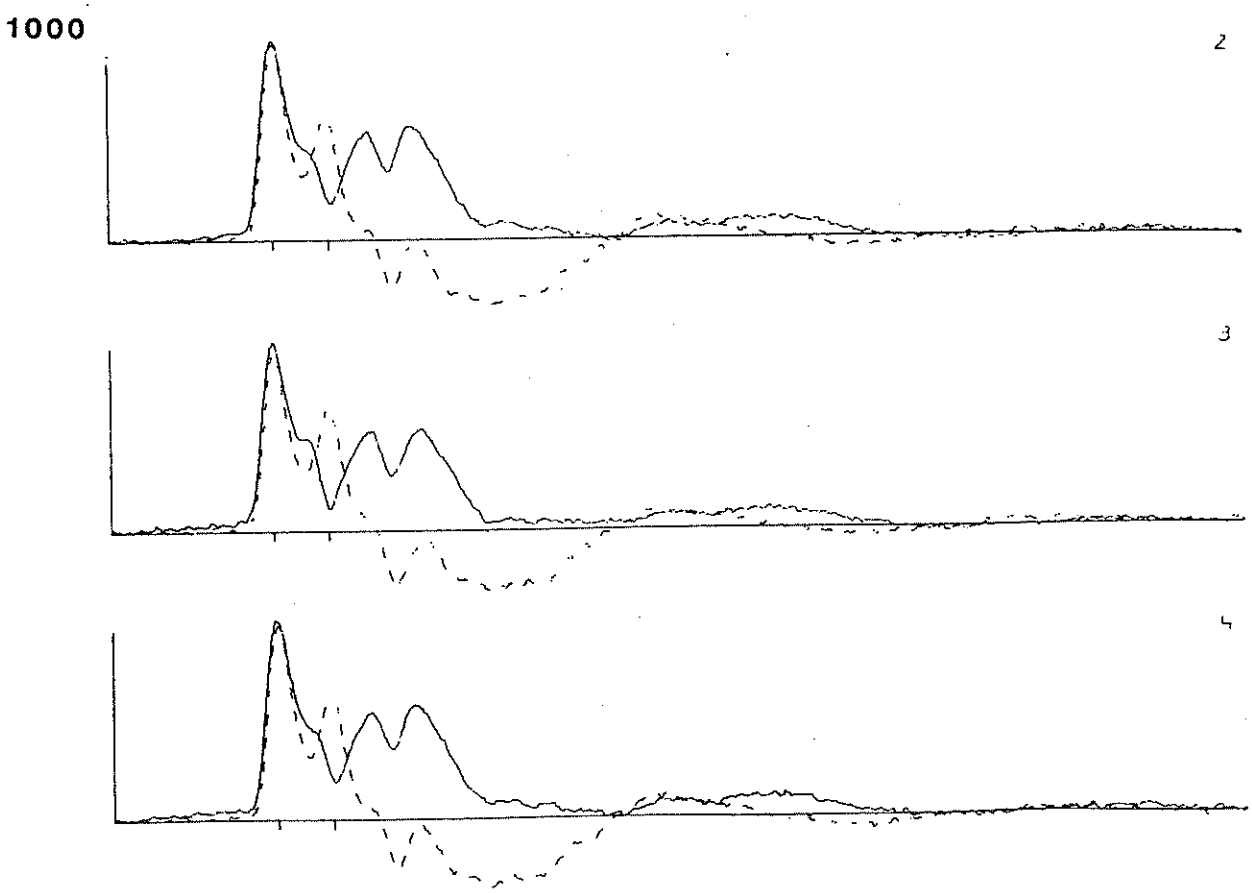


Figure 2: Two soil borings showing the soil conditions at the site.

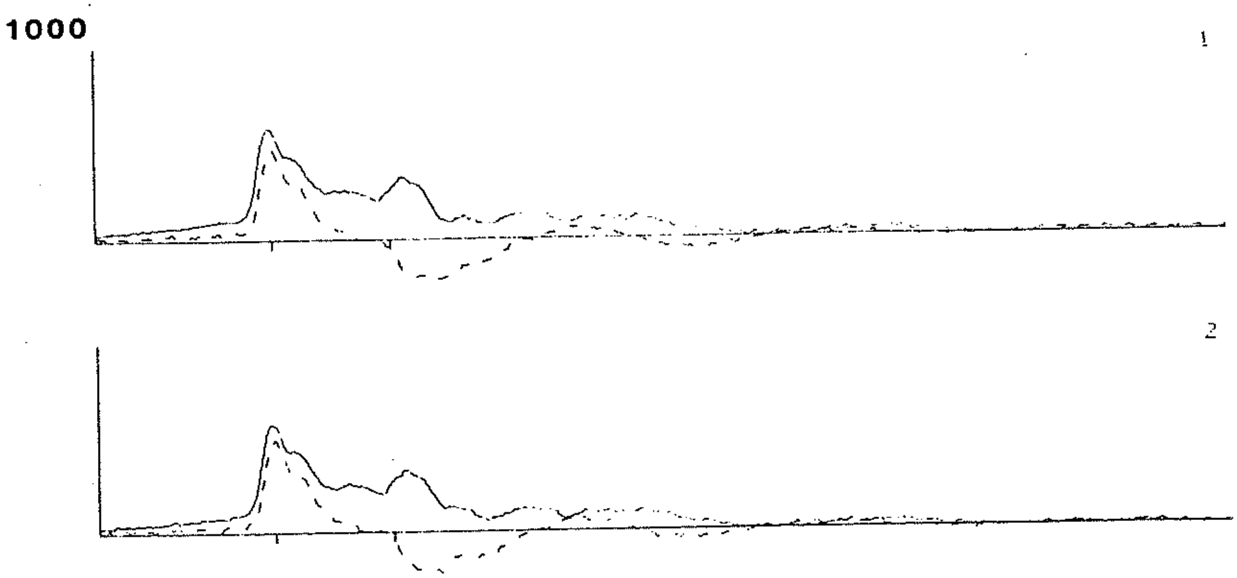
WEST PAPAGO/I-10. TEST PILE 7, E01D



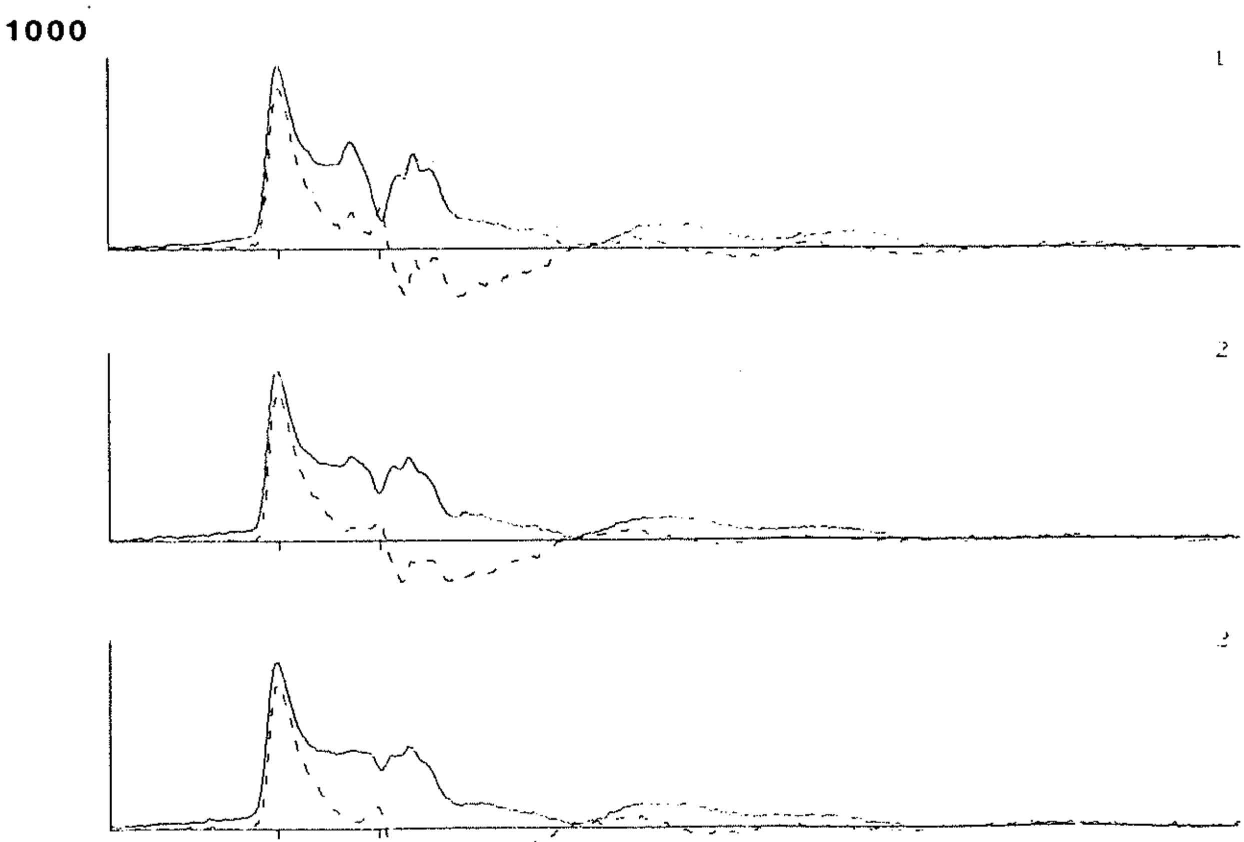
WEST PAPAGO/I-10. TEST PILE 7. B01R



WEST PAPAGO/I-10. TEST PILE 3. E0I0



WEST PAPAGO/I-10. TEST PILE 3. B0IR



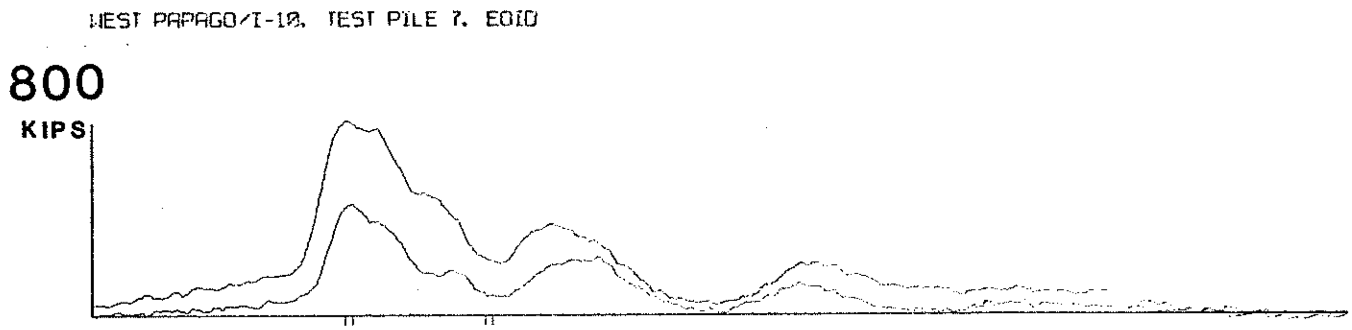


Figure 5: Plots of force versus time records measured at opposite sides of Test Pile 7, end of initial driving. The difference in magnitude between the two traces indicate nonuniform impact stresses.

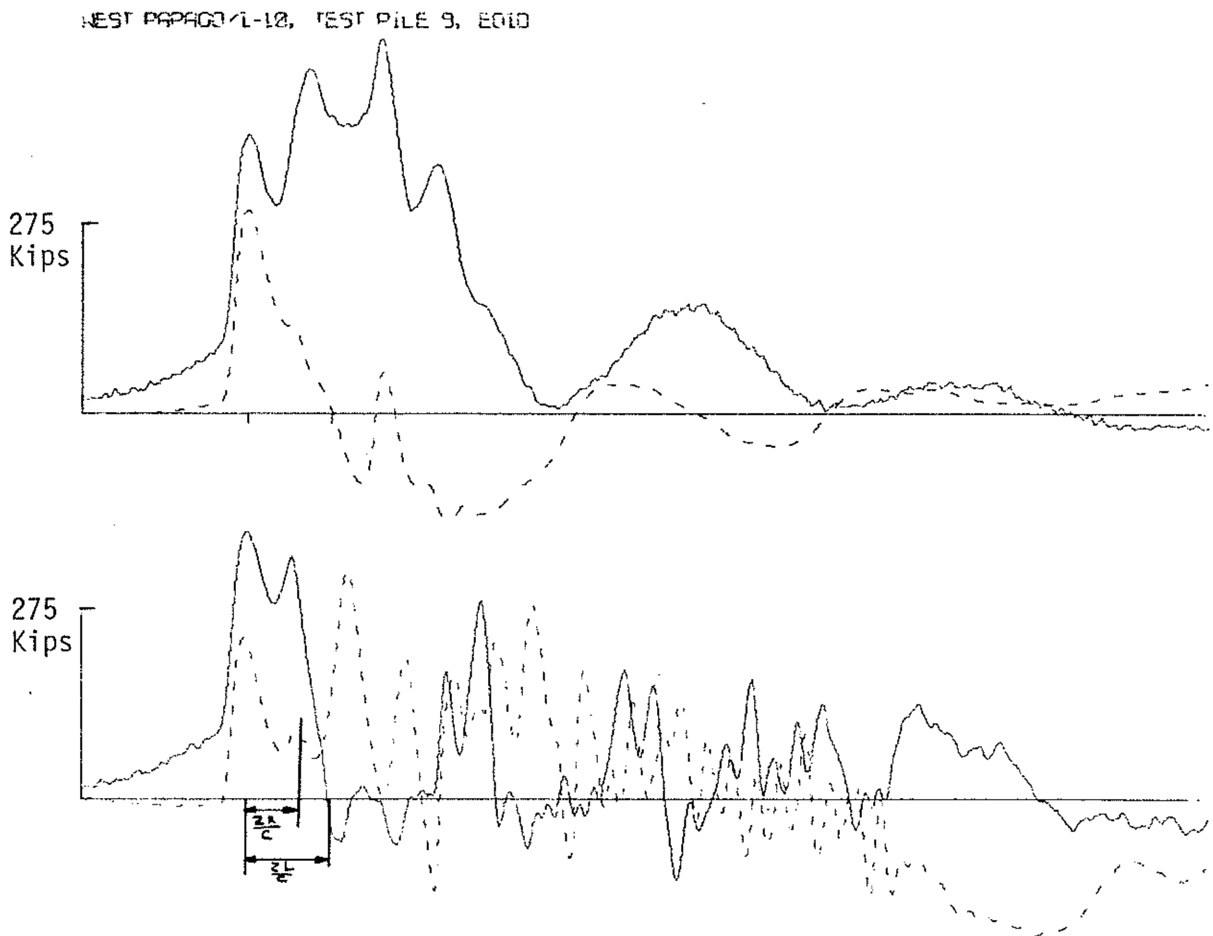
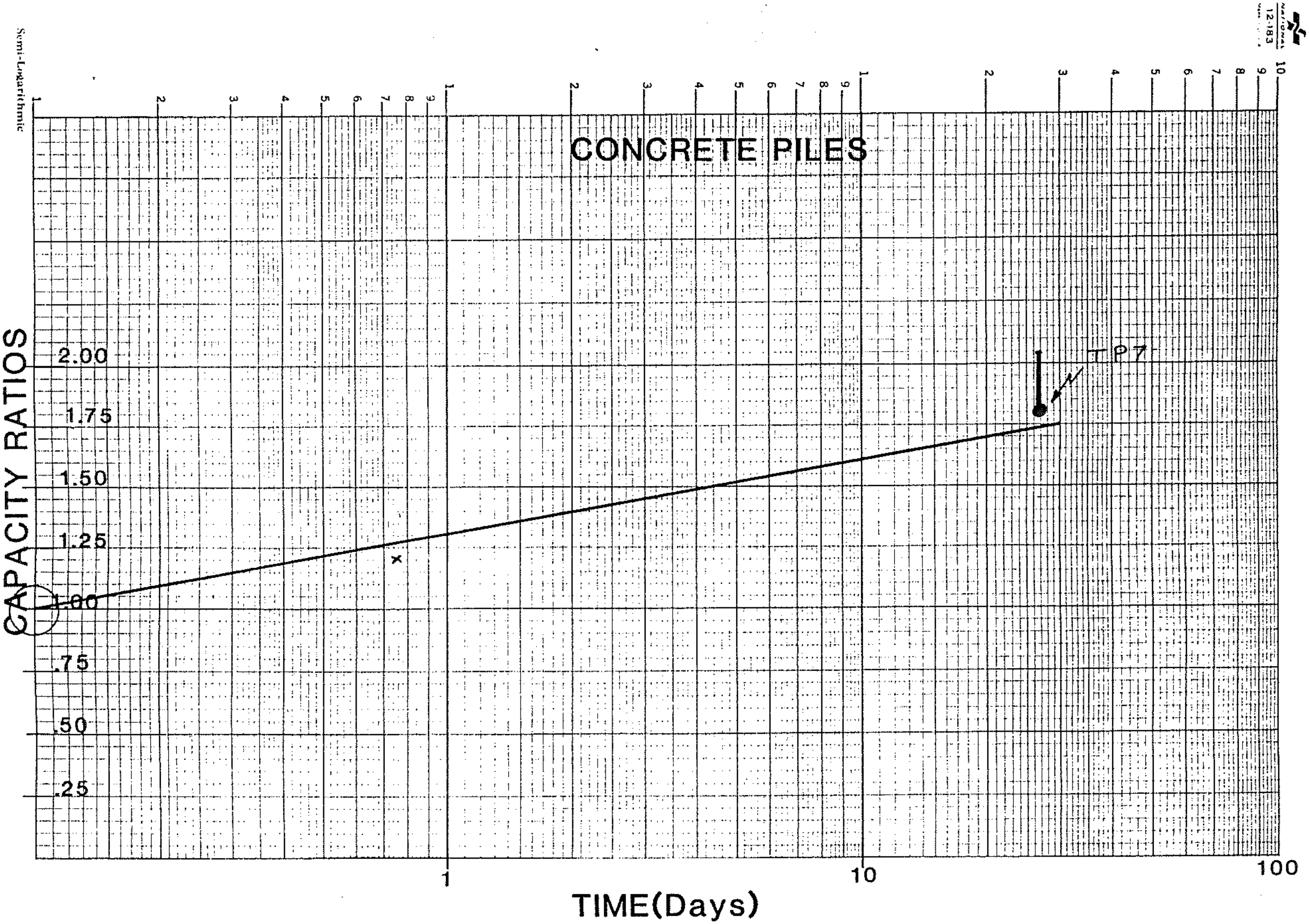
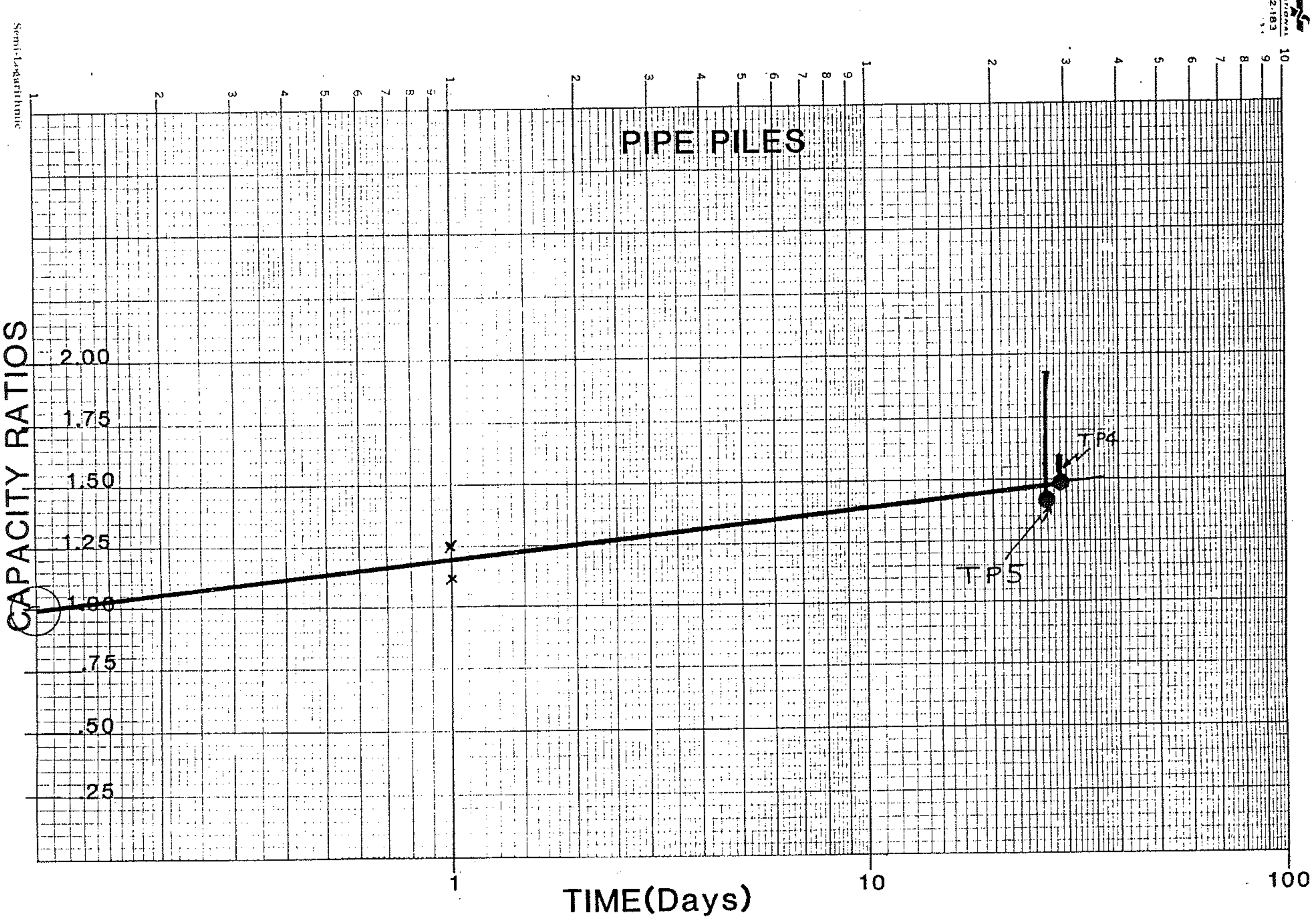


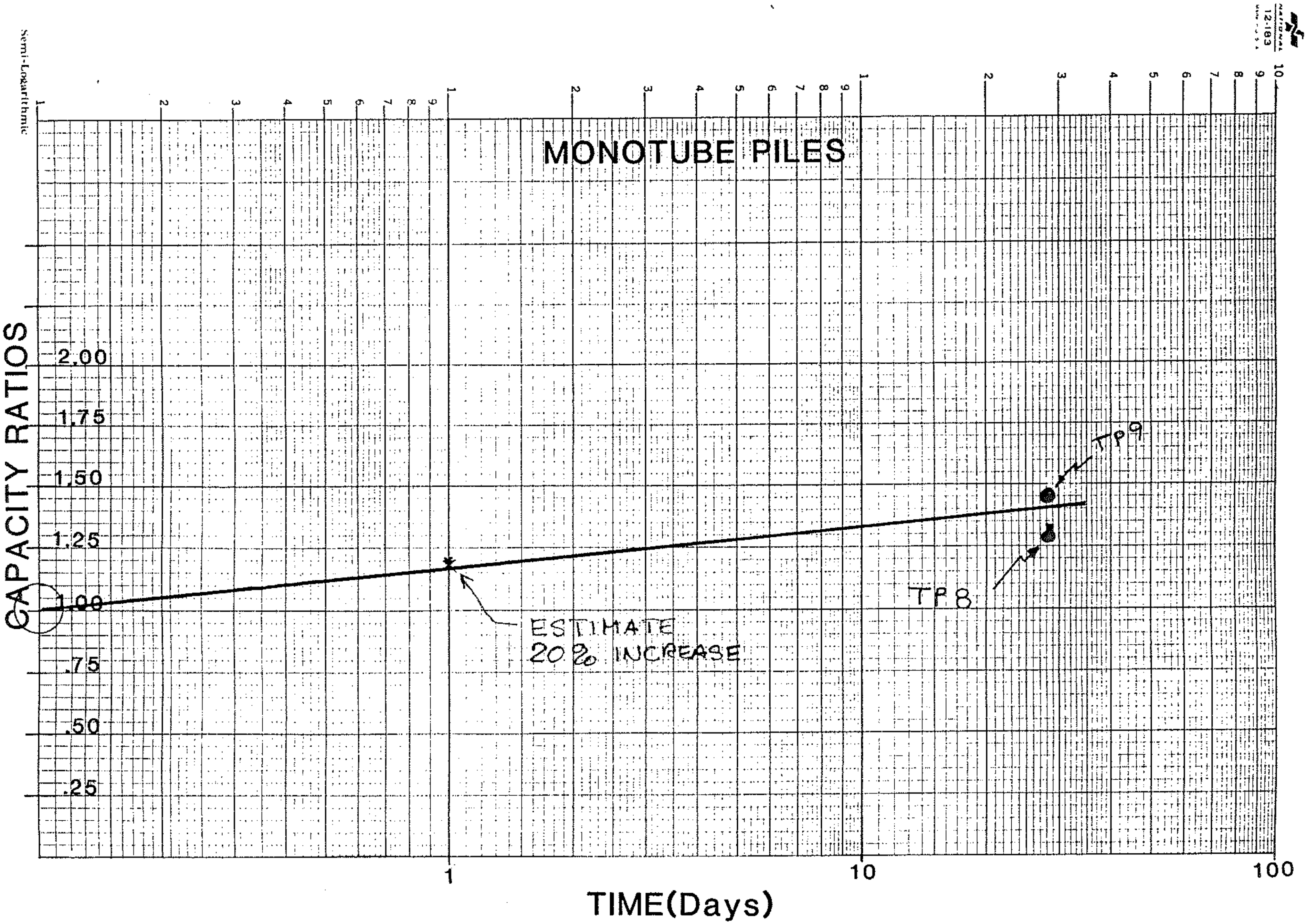
Figure 6: Plots of pile top force and velocity versus time showing the records for the last two blow of driving Test Pile 9: top figure undamaged pile, bottom figure damaged pile.

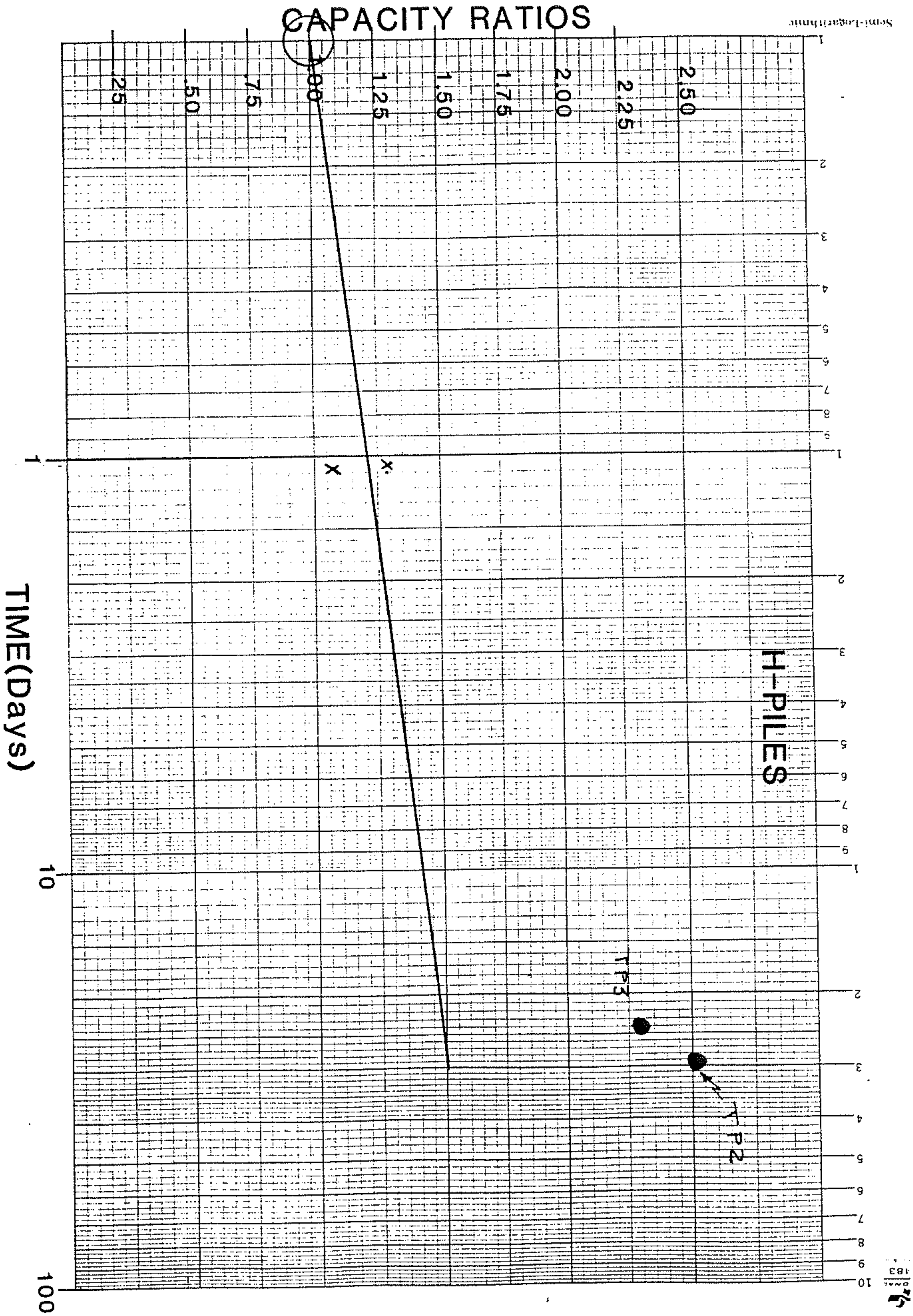
$$\frac{2x}{c} = 3.59 \text{ msec; } x = 30.16 \text{ ft, } c = 16800 \text{ ft/sec}$$

Pile damage occurs at approximately 15 feet above pile tip.


CONCRETE PILES
CAPACITY RATIOS
2.00
1.75
1.50
1.25
1.00
.75
.50
.25
TP7
TIME(Days)
1
10
100
Semi-Logarithmic
12-183


PIPE PILES
CAPACITY RATIOS
2.00
1.75
1.50
1.25
1.00
.75
.50
.25
TIME(Days)
1
10
100
TP4
TP5
Semi-Logarithmic
NATIONAL
12-183


MONOTUBE PILES
CAPACITY RATIOS
2.00
1.75
1.50
1.25
1.00
.75
.50
.25
TIME(Days)
1
10
100
ESTIMATE
20% INCREASE
TP9
TP8
12-183
Semi-Logarithmic



CAPACITY RATIOS
.25
.50
.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
TIME(Days)
1
10
100
H-PILES
TP3
TP2

1984

PDA USER'S DAY
STOCKHOLM, SWEDEN

May 24 – 26, 1984

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CAPWAP/ C Description and Development

Hammer Performance Measurements
By F. Rausche and G.E. Likins, Jr.

Relaxation of H Piles in Shale
By Garland E. Likins, Jr. and M. Hussein