

RELAXATION OF H PILES IN SHALE

by

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A series of dynamic and static tests were performed for the Pennsylvania Department of Transportation on H piles driven to shale at four different sites.

Static testing at some sites exhibited a plunging type failure during a quick compression test. Davisson and Penn DOT failure loads were very similar (the Penn DOT criteria is a tangent slope method at 0.05 in/ton). Sustained load tests at 75% of the maximum applied load had no net settlement even after two weeks, although some sites had an unexplained temporary extra settlement during the period 10 to 15 days after load application.

At some sites the load settlement curve after the "initial break" exhibited gradually increasing loads leading to large differences between Davisson and Penn DOT criteria. Sustained loading at 75% of the maximum load (approximately equal to the Davisson limit) resulted in continuous settlement at a rate of about 0.1 inch every two weeks, indicating the Davisson load may be a better criteria for such tests. Reducing the load to half the maximum applied load stabilized the settlement.

Comparison of dynamic tests at both end of driving and restrike showed significant loss of capacity due to relaxation in the shale. The data from Pile 3-13A is typical of the results. Actually, depending upon the site, the H piles lost from 10 percent to as much as 50 percent of their initial capacity. The CAPWAP "static simulation" results for restrike compare very well with the static load test curve, confirming the validity of the dynamic methods.

Restrike data was normalized to the end of drive tests and plotted on a log-time scale. Results show different speeds of relaxation, but little

evidence of continued relaxation after about two weeks; one day restrikes may or may not exhibit relaxation. The load distribution plot for Pile 3-13A shows that capacity is lost both on the skin and at the tip, but that the total loss is entirely from the shale stratum. Therefore, it is recommended that piles driven to shale should be used with a much higher factor of safety if the PDA is used only at the end of driving, or restrike testing should also be done after a minimum of a one week wait.

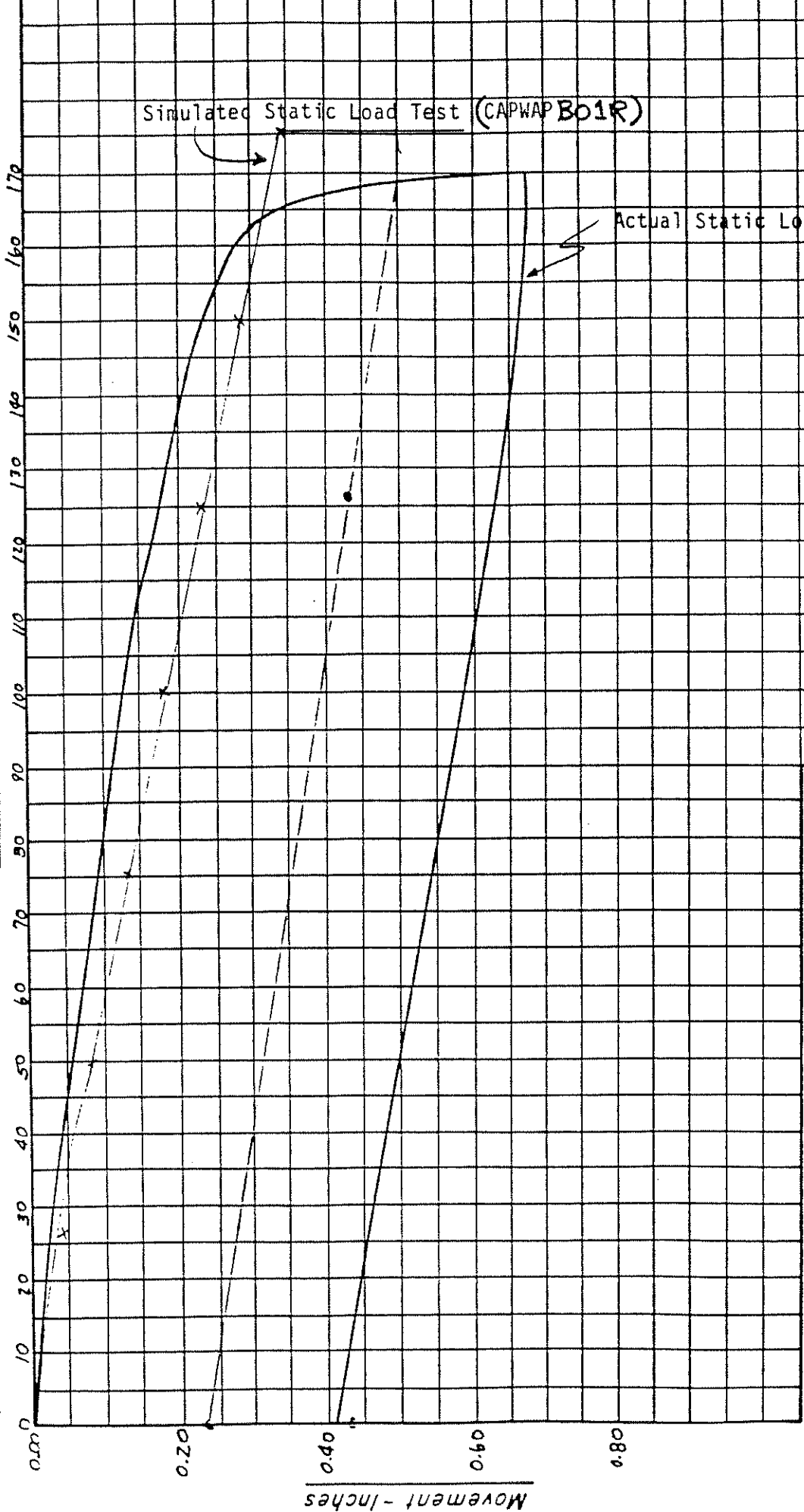
Comparison of CAPWAP capacities with Case Method results indicate that the PDA damping factors for the four sites should have been 0.2, 0.45, 0.65 and 0.55. These values are in many cases much larger than previously observed for shales although perhaps not surprising since the shale is composed of compressed fine grain soils; the shale is in some cases weathered. Therefore, CAPWAP is also now recommended for any pile to shale to avoid serious potential errors.

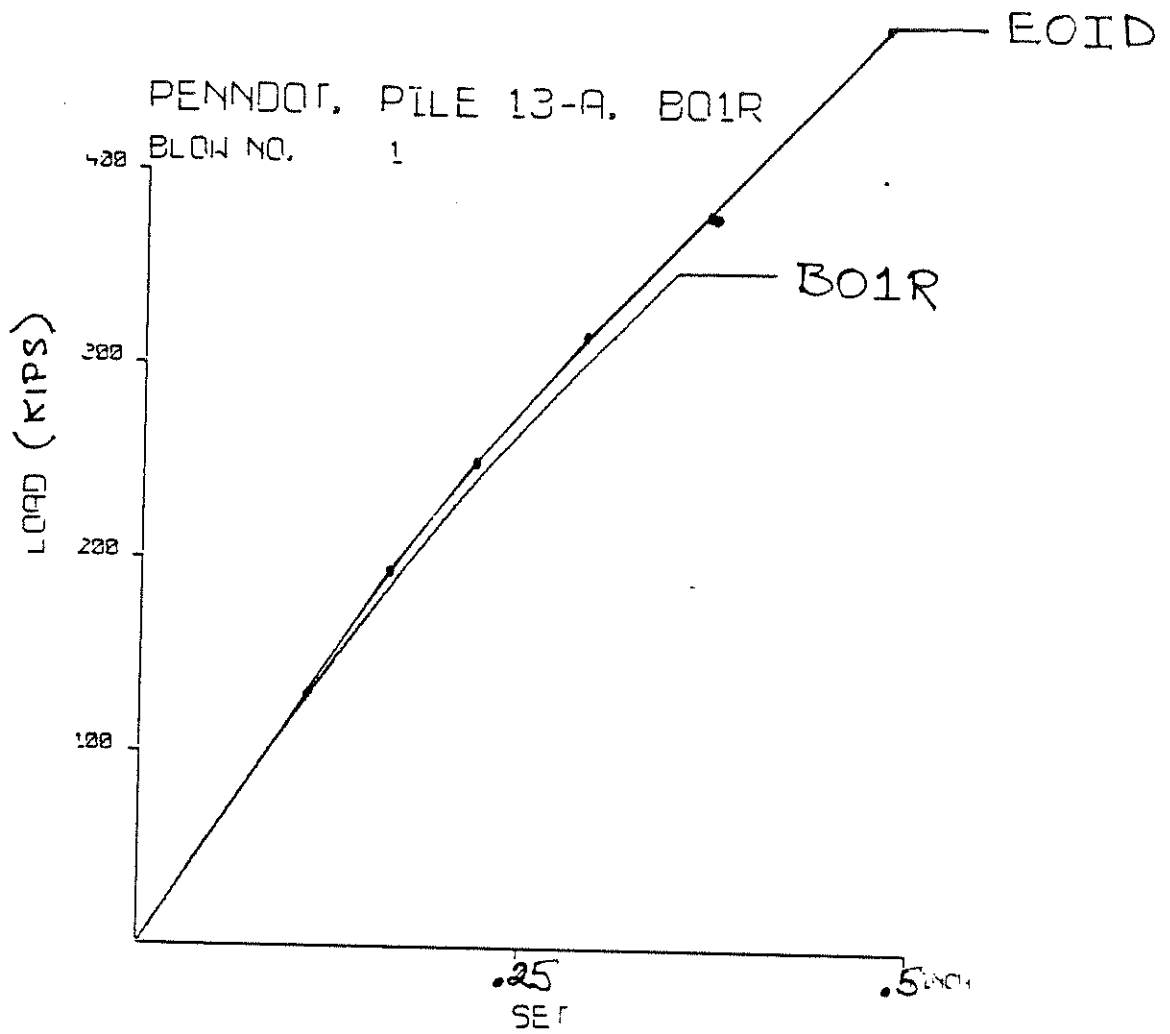
LOAD - MOVEMENT GRAPH

Sheet / of /
Load Test No. 3-13A

Type Of Test COMPRESSIVE

Load on Pile - Tons





PENNDOT, PILE 13-A, B01R
BLOW NO. 1

I	LOAD KIPS	SET INCH
1	0.0	0.000
2	54.1	.044
3	100.5	.084
4	151.7	.130
5	201.8	.179
6	250.0	.229
7	300.3	.286
8	350.0	.346

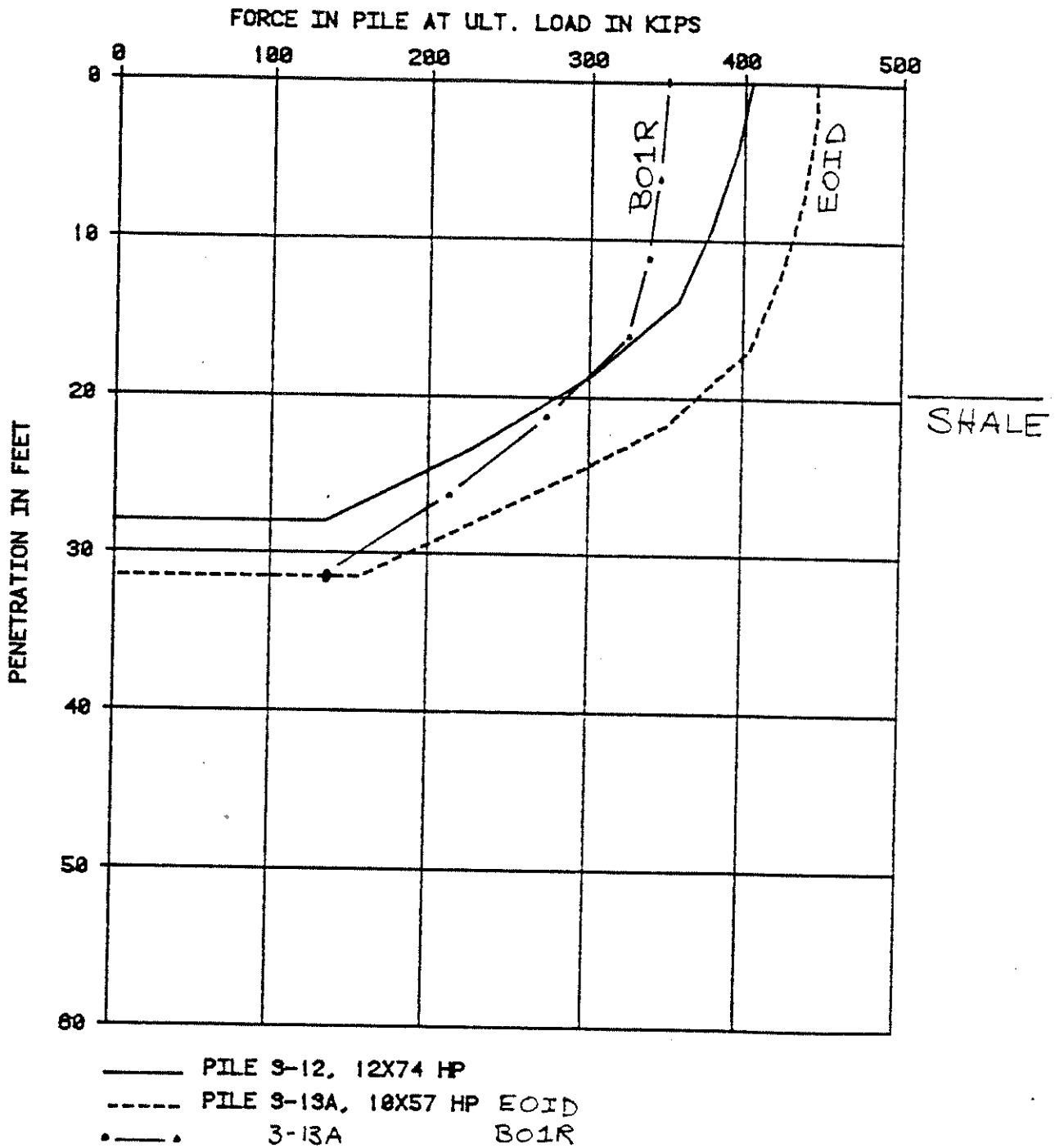
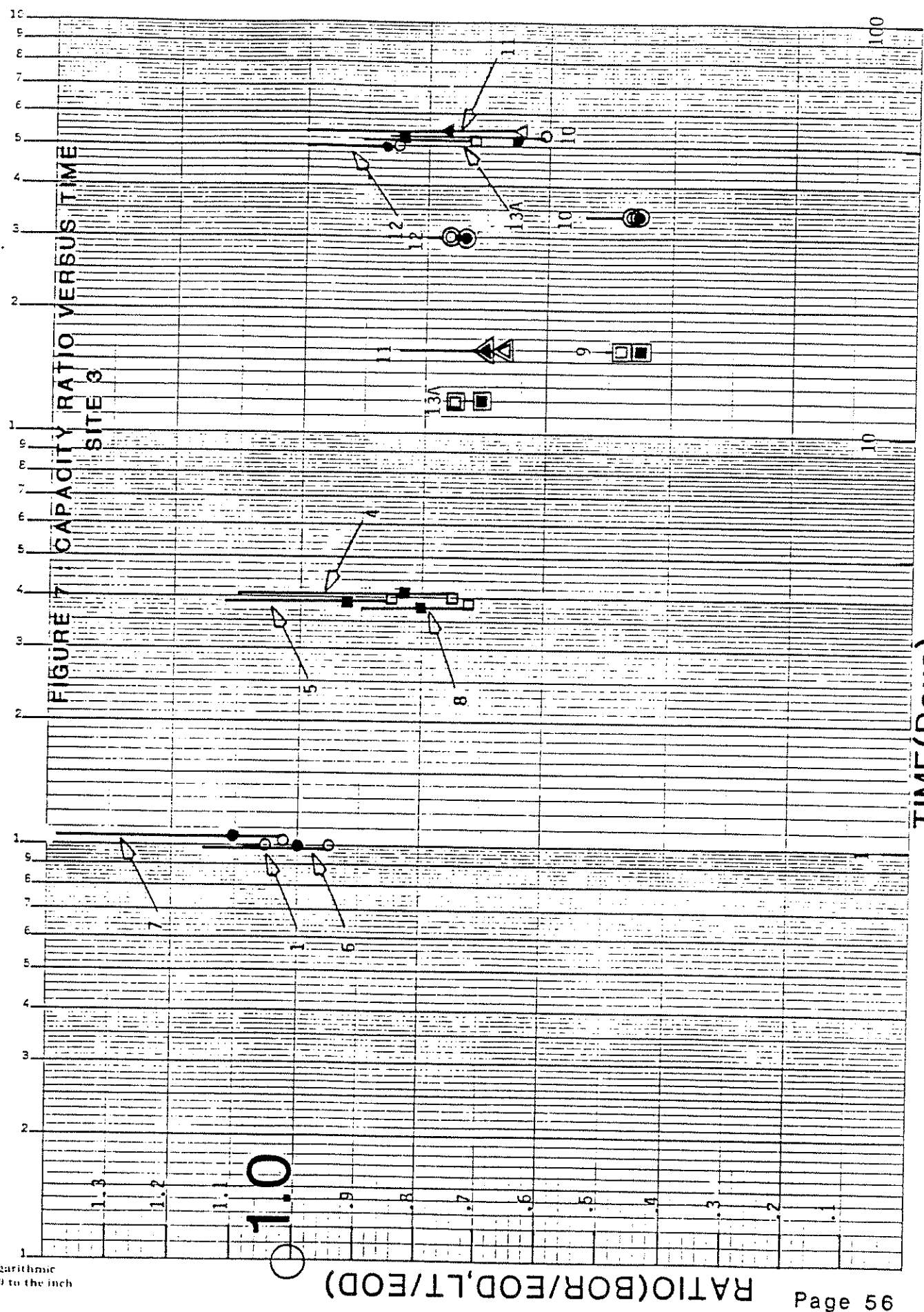


Figure 11: Force in Piles from CAPWAP, Site 3



Semi-Logarithmic
scales x 10 to the inch

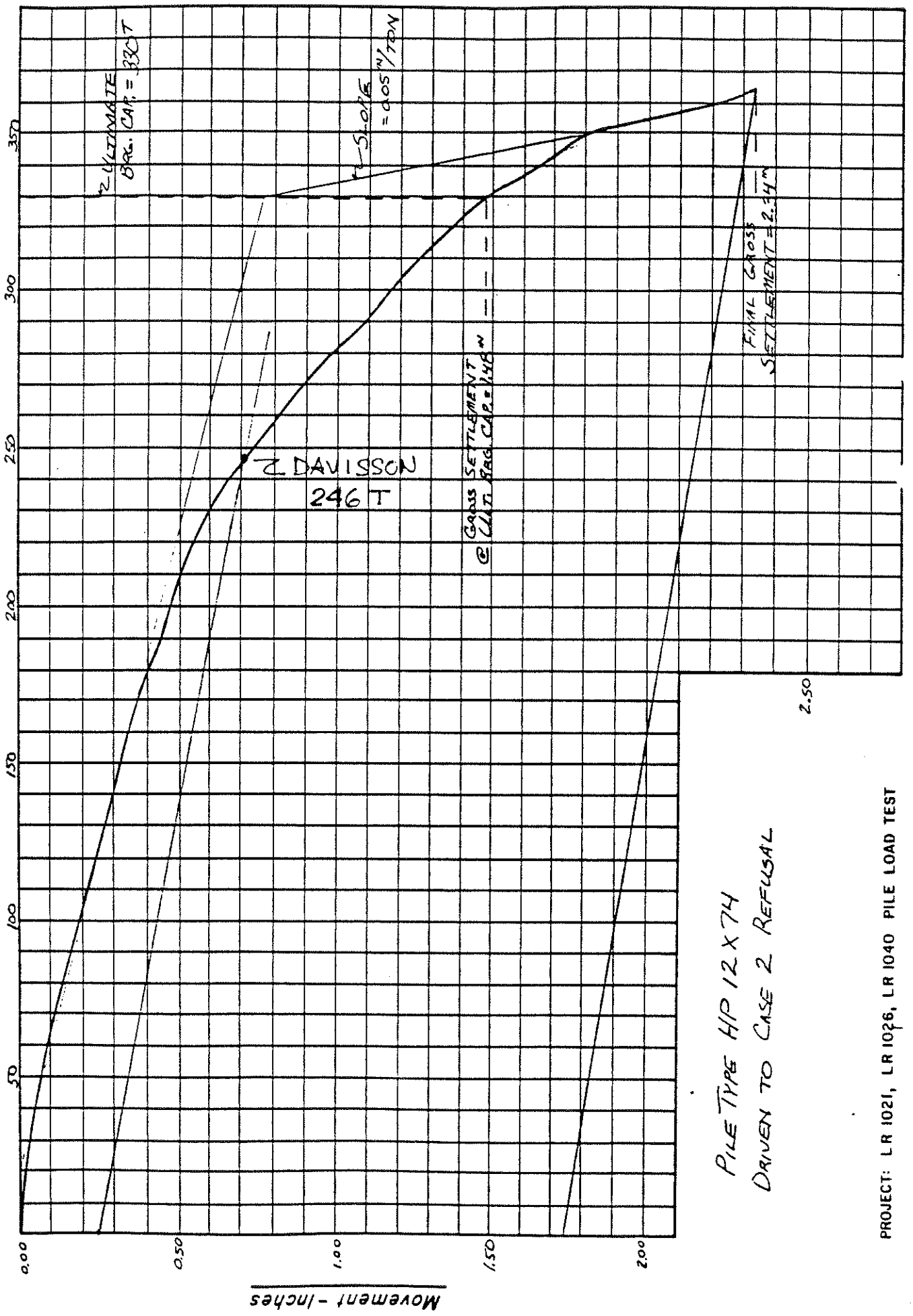
RATIO(BOR/EOD,LT/EOD)

LOAD - MO. - SETTLEMENT GRAPH

Sheet 1 of 1
Load Test No. 1-10

Type Of Test COMPRESSIVE

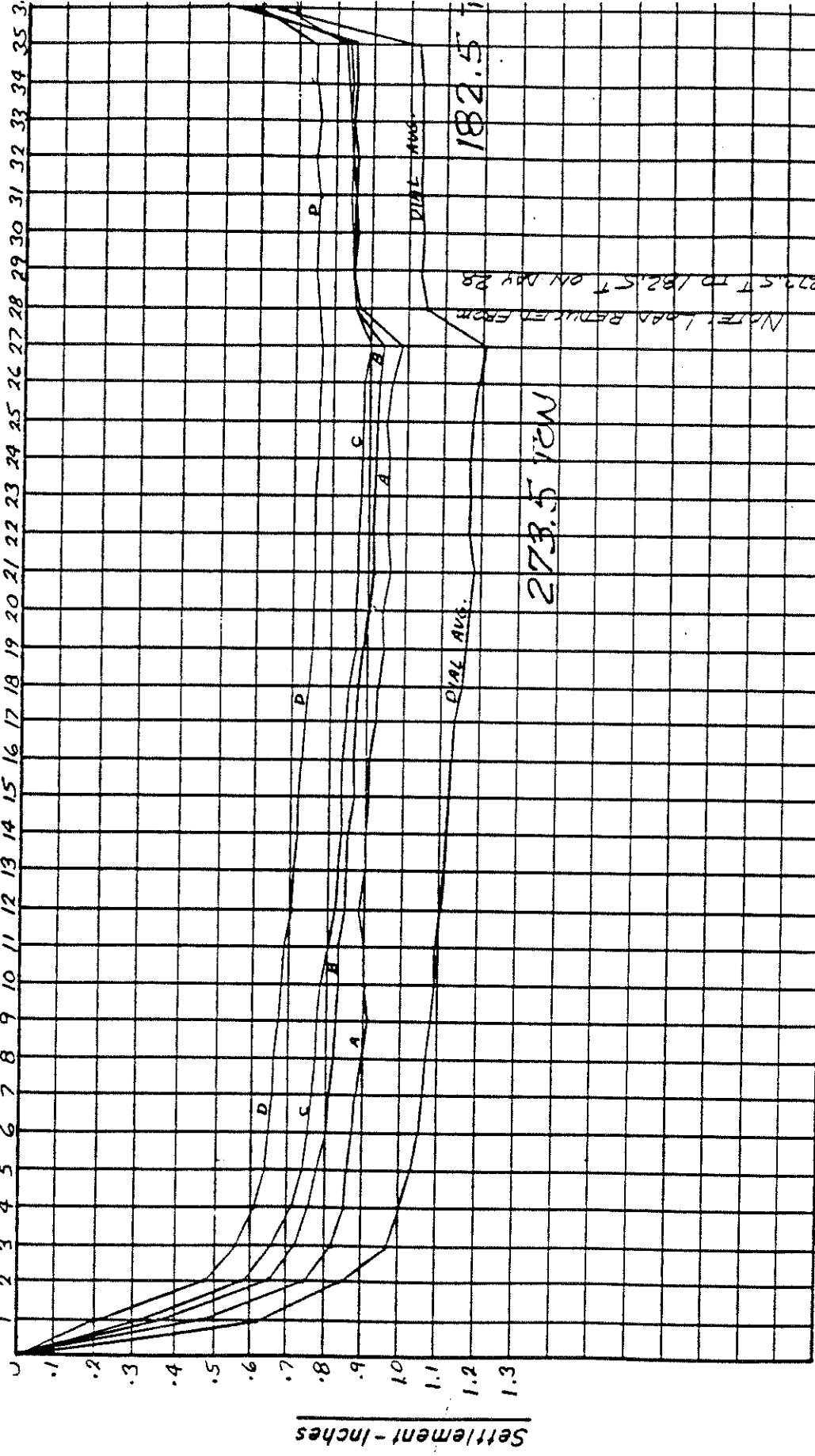
Load on Pile - Tons



PILE TYPE HP 12 X 74
DRIVEN TO CASE 2 REFUSAL

TIME
Days

Type Of Test SUSTAINED 1-10



NOTE: LOAD REDUCED FROM 273.5 T TO 182.5 T ON DAY 28

273.5 TON

PILE AVG.

182.5 T

PILE TYPE HP 12X74
 DRIVEN TO CASE 2 REFUSAL
 273.5 TON DAV 246
 182.5 T REN 330
 ULT 365

**NAPA
USERS DAY
AUGUST 1985**