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Results of Foundation Engineering Congress Pile Loading Test

Bengt H. Fellenius, M.ASCE

D I S C U S S I O N on

FINNO, R.J., COSMAO T., and GITSKIN B., 1989. Results of Foundation Engineering Congress pile loading test. Proceedings of American Society of Civil Engineers, ASCE, Geotechnical Engineering Division, 1989 Foundation Engineering Congress, Symposium on Predicted and Observed Behavior of Piles, R. J. Finno, Editor, ASCE Geotechnical Special Publication No. 23, pp. 338 - 355.

The 1989 ASCE Foundation Engineering Congress included a prediction event, which attracted considerable interest from participating predictors and congress attendees. The organization and execution of the event was outstanding with a detailed reporting of the event in three papers (Finno, 1989; Finno et al., 1989a; and Finno et al., 1989b) placed in a proceedings volume also containing papers by 23 predictors. The proceedings volume will serve as an important illustration of the present state-of-the-art. However, despite my considerable admiration of the work, I do have some critical views.

The first comment addresses the difficulty in directly comparing one's own prediction with the actual observations when having access only to data plotted in a small scale. However, the prediction event will most certainly be repeated in many engineering education programs for the enlightening of students and it would have been valuable had the authors also tabulated the test data. (Responding most professionally to my comments, Dr. Finno has provided me with the field data for the two driven steel piles).

The second comment refers to the accuracy of the strain data. The authors state that the error is about 4 microstrain, that is, about 2 tons. At first glance, this may seem sufficient, when testing a pile to about 100 tons. However, this error amounts to a considerable portion of the increment of strain between load applications. Sometimes, the error even equals the calculated change of load for the load increment applied to the pile head. Therefore, the accuracy is inadequate, or, in other terms, the records are too insensitive for detailed analysis. By making other choices of pile sizes and instrumentation, the sensitivity of the data would have been improved.

The low accuracy can be demonstrated by means of the tangent modulus approach presented by Fellenius (1989a): When the shaft resistance is fully activated above a level of a strain gage, the ratio of measured increase of strain to increment of applied load should become constant and equal to the theoretical value mentioned above. At least, the uppermost gages would be expected to reach this value during the last two load levels. Table I shows a compilation of the tangent moduli for the three H-pile tests. That none of the gages shows moduli values approaching a constant value is an indication that the desired level of accuracy is lacking.

TABLE 3 TANGENT MODULUS ANALYSIS H-PILE
(Increment of Load/Increment of Strain)

APPLIED LOAD (tons)	Gage 1	Gage 2	Gage 3
TEST 1			
45	0.600	1.667	3.000
60	0.600	1.667	3.750
75	0.682	1.071	3.000
90	1.000	1.071	0.882
TEST 2			
60	0.667	1.538	3.333
75	0.714	1.667	5.000
90	1.071	1.667	3.000
97	2.333	0.583	1.750
TEST 3			
50	0.543	1.389	2.778
75	0.595	1.471	6.250
100	0.610	1.923	-25.000
110	0.588	0.714	2.500

My third comment relates to the third test, where five load increments were used. For both the steel piles, failure started to develop on or after the fourth increment, the 100-ton load. The records for the last increment are those occurring at or after fully developed failure and at a load of 110 tons for the H-pile and 115 tons for the pipe-pile. In reviewing the load-movement curves, one wonders if truly the pile failed immediately after the 100-ton load or if failure occurred at or near the maximum load.

Fig. 16 illustrates a possible load-movement behavior. The figure presents the pile-head load-movement of the H-pile as recorded (the solid points) and a calculated solid line established by employing the Hansen 80%-criterion (Hansen, 1963; Fellenius, 1980), as follows: The data from the third and the fourth load levels (75 tons and 100 tons) are used to plot the square root of the ratio between load and movement versus the movement, i.e., the Hansen line). The line between these two points is then extrapolated to include a third point representative for the movement at a load of 110 tons, the maximum load applied, whereupon the load-movement line is extended to the point. It would take a very observant person in the field to notice if the pile head moved according to the "observed" curve (the dashed line) or according to the so-constructed line (the solid line) or, indeed, if it even peaked at a load above the 110-ton load value making the last recorded point to be a post-peak value. An obvious conclusion is that my submitted predicted failure load of 100 tons (Fellenius, 1989b) may well agree less with the measured capacity than first thought.

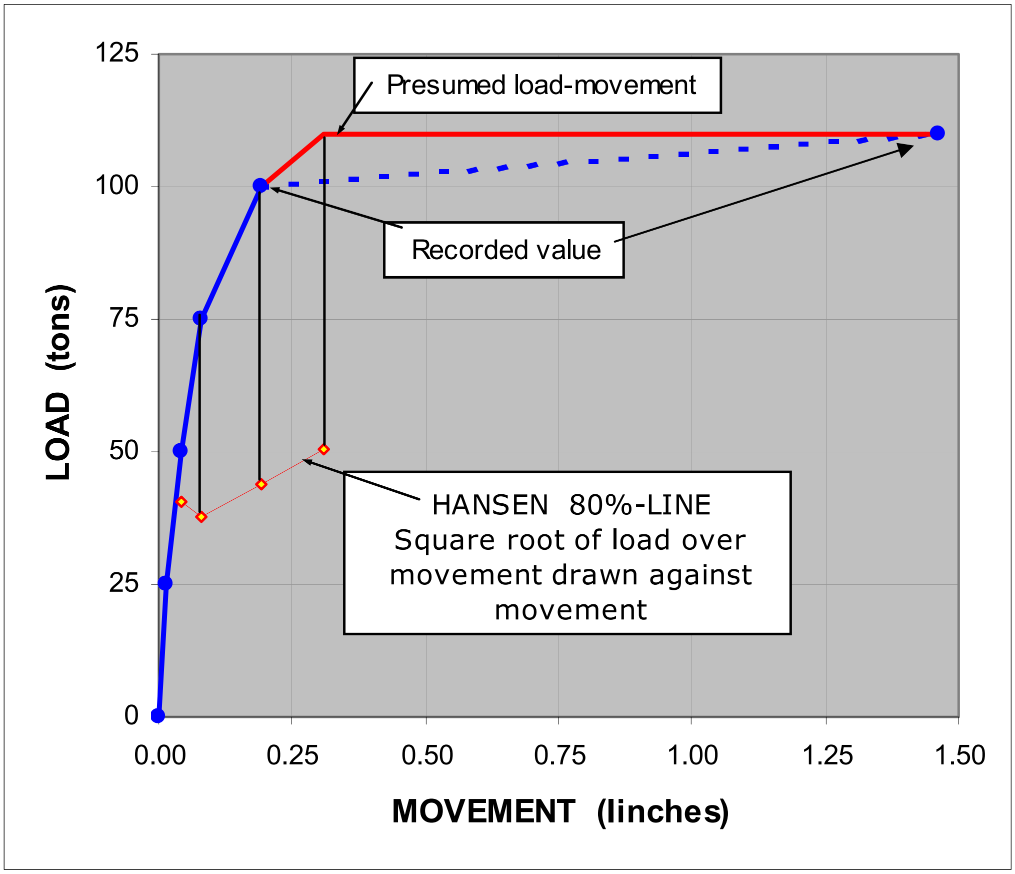

Fig. 16 Presumed Pile-Head Load-Movement Curve with Correction
Construed by Means of the Brinch Hansen 80%-line.

To avoid the question of what is really the failure load, the tests should have been performed using more increments, about 25 small instead of only 5 large. By setting the duration of each increment sufficiently short, the loads would have been applied at much the same rate and the test would have been completed in much the same total length of time.

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