Use of PDA testing on driven H-piles

Q Glen Morris, PE <gmorris@septa.org> asked this question of the Driven Pile Committee:

Is there such a thing as a PDA test for driven "H" piles? I have a contractor that wants to use 1 static and 5 PDAs in lieu of the 6 static piles tests in the specifications.

A Garland Likins <garland@pile.com> responded:

It is quite common to perform "dynamic testing" on H piles with the PDA.

The suggestion to use the PDA in conjunction with a static test is a good idea where there is little previous experience (as ASTM D4945 suggests).

Many codes (such as AASHTO, PDCA, and ASCE to name some) recognize that combining the dynamic and static methods can result in overall savings while maintaining, and in fact improving, overall quality assurance.

I might suggest that the ease of PDA testing and relatively low cost should allow more piles to be tested than the static test alone. For example, the PDCA code suggests to dynamically test 3 piles as a replacement for every one tested statically. This can offer better site coverage geographically, or coverage spaced over the duration of the project to assure consistent hammer performance.

As a further comment, dynamic testing is made during driving or during restrike. The restrike test after an appropriate wait period is usually preferred for evaluation of capacity, allowing setup to be included, and guarding against relaxation. Since you did not mention the soil (rock) conditions, I should note that H piles are often used where piles are driven to weathered rock (e.g. driven many feet into weathered shales) which can experience significant relaxation (capacity decrease with time). To guard against relaxation, the general advice is to wait one week before the restrike and use an early high energy blow to assess the capacity dynamic testing with the PDA should always be accompanied with "signal matching" (commonly "CAPWAP") to assure the dynamic soil characteristics are properly accounted for and that the static capacity estimate has the best statistical correlation with static tests. Most codes mention "signal matching" as a requirement for PDA capacity evaluations.

A Reply from Bengt H. Fellenius <Bengt@Fellenius.net>:

Question 1: Yes, the Pile Driving Analyzer dynamic test is eminently suitable for H-piles.

Question 2: Wise contractor. The PDA test is much cheaper and the results are compatible with the static loading proof-test. Though, he must include CAPWAP analysis for each PDA-tested pile. It is advisable to test piles with the PDA both at end-of-initial-driving and at restrike after set-up has developed (same wait-time after driving as you use for the static loading test. Naturally, the pile selected for a static loading test must also be subjected to a PDA test. Count on using more than 5 PDA tests, therefore -- say a dozen. This will give the project a more assured estimation of capacity than the six static loading tests would have provided -- at a lower testing cost.

A Reply from William E. Kruse <bkruse@verizon.net>:

Typically, with regard to capacity evaluation, the predictions generated from the PDA when a pile is retapped (or redriven) are more meaningful than on the initial drive. On the initial drive the disturbance of the soil usually diminishes the bearing capacity, and on rare occasions increases the capacity. With the passage of time the soil "restores" itself to a more normal condition which, as the case may be, improves or diminishes the bearing capacity. The appropriate time period is a function of the character of the soils. In granular materials the period is usually very short; perhaps overnight. Cohesive soils are quite a different story and are best evaluated on the basis of prior experience. In sensitive clays this could be several weeks, even longer. The longer the delay before retapping the better, but we must establish some practical limitation.

In the situation you describe the PDA serves, in this writer's opinion, one of its best purposes: the elimination of 5 expensive load tests with the substitution of relatively inexpensive PDA evaluations. It also eliminates the delays implicit in the conduct of static tests. This presumes that all of the six piles are driven in generally similar soils, and to the same final resistance with identical hammer type and energy at final drive. The lengths of the piles should be similar: perhaps a limit of 20% from the length of the load tested pile would be appropriate. The static load test should be conducted to failure. Failure is defined as that load at which the jack pressure can not be increased. The load tested pile then allowed to "freeze" for the prescribed period of time as was initially required for the test pile, after which it is redriven and monitored with the PDA. The recorded PDA capacity is then compared to the actual failure load. This is always an immensely interesting observation. In this manner we have "calibrated" the PDA device. The 5 remaining piles can be redriven, when required, and their capacity evaluated using the calibrated PDA.