Questions & Answers

Use of PDA testing on driving H-piles

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

Is there such a thing as a PDA test for driving "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 Liktins <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 with H piles. 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 increasing, the accuracy of the tests.

I might suggest that the ease of PDA testing and relatively low cost should allow few piles to be tested than the static test. For example, if a 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 easy during driving or during restrike. The restrike test after an appropriate embedment time is used 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 into rock (e.g. driven many feet into weathered shales) which can experience significant relaxation (capacity decrease with time). To guard against relaxation, both the dynamic and static test should be performed after restrike and using an early high energy blow to assess the capacity dynamic testing with the PDA should always be accompanied with “signal matching” (commonly "C/AVP") as the PDA equipment are properly accounted for and that the static capacity estimate has the best statistical correlation with static tests. Most codes require a "signal matching" as a requirement for PDA capacity evaluations.

A: Reply from Bengt H. Fellenius <BengtF@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 much less complicated to perform than traditional static testing for proof-testing. Though, he must include CAPVAW analysis for each PDA test-pile. It is advisable to test piles with the PDA both at end-of-initial-driving and at restrike after set-up for development of expected static 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. Court will not accept such a test done by the PDA. 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 <kruse@verizon.net>

Typically, with regard to capacity evaluation, the precautions mentioned (i.e., the static test or verification piles bored (or redriven) are more meaningful than on the initial drive. On the initial drive the disturbance of the soil below the cap normally 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. Thus the appropriate condition can be selected as the best or worst condition 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 active or seasonal loading the inspection is even more critical. The longer the delay before retapping the better, but we must establish some practical limitations.

In the situation you describe the PDA serves, in this writer's opinion, as an economical 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 capacity is obtainable from the load test and to the same final resistance with identical hammer type and energy at final drive. The lengths of the piles should be seven times the diameter to allow for the length from the load test pile would be appropriate. The static load test should be conducted to failure. Failure is defined as that load at which the load pressure cannot be increased. The load test pile and the PDA test pile should be placed in the same prepared 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 static load. This is always an immensely interesting observation. In this manner we "validate" the PDA device. The 5 remaining piles can be redriven, when required, and their capacity evaluated using the calibrated PDA.