

How To Supervise Pile Driving

By Thomas J. Lowry

THE purpose of supervising any pile job is to make sure that each pile has penetrated to the proper tip elevation to adequately support the load design and is in the proper location and degree of plumbness, and is still in good condition structurally. Besides these more obvious conditions there are many others that could be vital to your project and should be considered before it can be said that all the piles were driven satisfactorily.

It should be assumed that a proper soil investigation has been made and that the basic driving criteria have been established by the engineer. The pile supervisor must be prepared for the unusual and be able to adapt the basic criteria to the actual field conditions. No matter how thoroughly the site has been explored, Mother Nature has a habit of presenting little surprises by way of varying conditions. It is often less difficult to predict pile capacities than the behavior of the pile during the pile driving stage.

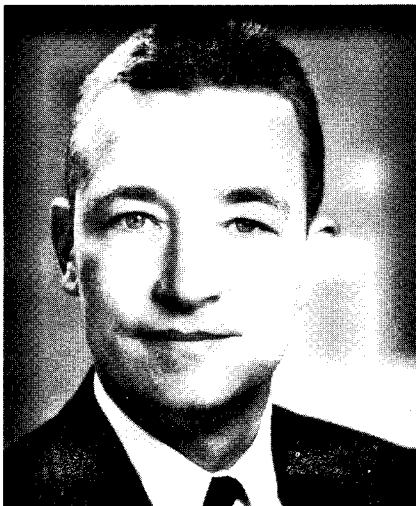
The driving behavior can be affected by many things, such as the pile material, its size, roughness, straightness, as well as location, level and stability of water table, type of driving equipment, delays in driving, efficiency of the crew and, perhaps, even a hang-over experienced by the foreman. The pile inspector

must be constantly alert to detect these changes from the norm, determine if they are important and either make a judgment or know whom to seek to adjust the criteria, if necessary.

Does Pile Driving Need Supervision?

Many engineers and owners may think that special supervision is not necessary and is something that can be eliminated when looking for places to save a dollar. They perhaps rationalize that the project has had a soil investigation which is incorporated into a carefully created set of plans and specifications. The assumptions made might follow this kind of thinking: The pile contractor normally has been in the business for years and often pile driving is his specialty. Certainly he knows his business, and frequently has more experience than the pile supervisor. Of course, the pile contractor wants to create a good name for himself in the field — why would he do anything that isn't just right? After all, one happy client could lead to more work. Finally, the general contractor is responsible for the completed job; he will certainly keep an eye peeled for anything that may go wrong. He is a construction man, and he understands pile driving talk.

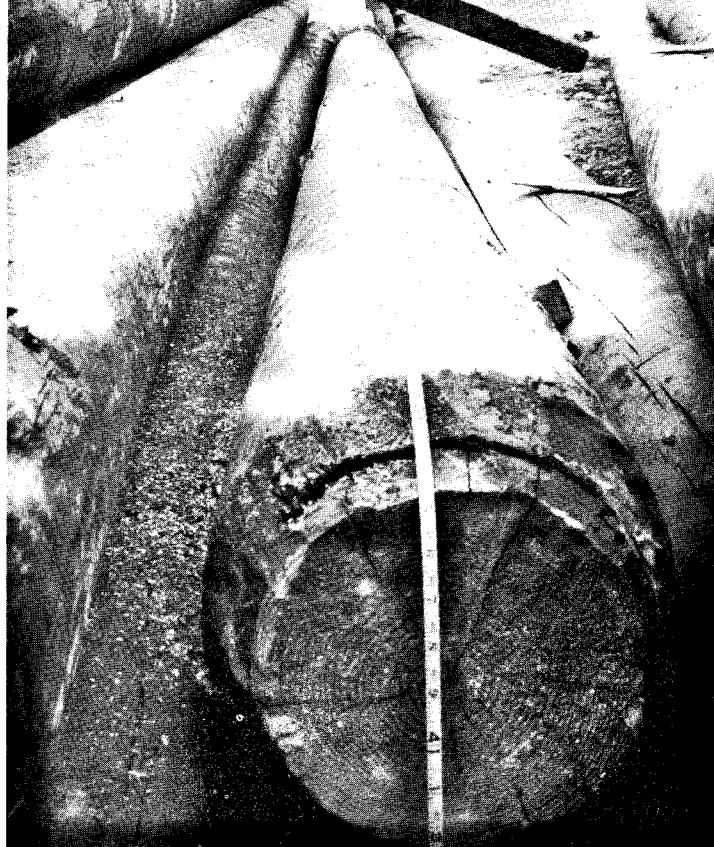
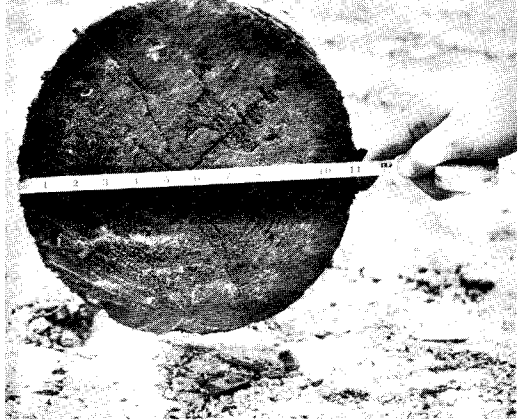
These statements appear to be sound; let's examine



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them. First, many jobs do not have complete soil reports or include results of investigations made next door, across the street, or down the block. There are cases where it is a good gamble to proceed without good surface data, but they are rare and should be approached with caution and conservatism. Without a knowledge of the soil conditions at the site, the owner or pile contractor is inviting trouble, and if it develops, it's usually the owner who suffers most.

In the event you have had a thorough soil investigation with pile lengths given, you are still not home free. The pile lengths given are generally estimated and should be checked in the field to make sure the soil conditions over the entire site are similar to those found in the borings. Usually this is done by comparing blow counts to the soil profile. If this checking of blow count is done, that is about all that can be reasonably asked for to insure that each pile has sufficient penetration. However, proper supervision is advisable at this stage to assure that piles driven later in the area will perform correctly. Borings are often only 100' on center — but 50' (in the middle) may not reveal the same stratum. Even 25' in between may find soft material or hard material where it is unexpected. Somebody should check *across* the site to count the blows during all the drivings — checking against the original profile.

Plans and specifications, as far as pile driving is concerned, are often incomplete, and the soil engineer may not have been given the opportunity to review them. Often, important details are missing or the *pay* items are not given enough thought. Pile contractors are always alert for a loop-hole in the specifications, which they can convert to an advantage in competitive bidding. Many times, such a device is a gamble, but even if the owner wins, the job may suffer because the contractor who is losing money is the one who will try to cut corners. If the specifications are drawn properly and carefully examined there will be little opportunity to short-cut on the job.

Generally, the pile contractor does want to do a good job, but too often his most urgent motive is to drive the specified piles as fast as possible. The contractor's field superintendent may not have the same sense of quality as his boss or the company for which he works. He may not understand the requirements for support and probably considers the piles are over-designed anyway. Whatever the contractor's attitude, to the owner or engineer the current job is very important. All phases must be done correctly to achieve a successful foundation.

The general contractor's superintendent does have a responsibility for the whole job, but usually he is so busy with the job's general problems he simply does not have the time or, incidentally, the background to supervise pile driving. His primary interests lie in getting piles driven as quickly as possible. The motive is not compatible with insistence on detail and quality.

Unbiased pile supervision is necessary. If done correctly, supervision is the best available "insurance" for a good foundation. It does in the end save the owner, and perhaps the contractor, time and money.

Procedure

To supervise correctly the installation of treated timber piles consider the following procedure:

SCOPE

The supervisor should have a clear understanding with the person or company — owner, engineer, or contractor — that hired him. They should be in complete agreement as to scope of activities. The scope could be full-time inspection, part-time inspection, or merely to appear on the job the first day to see that it gets off on the right foot. Good supervision will first involve a careful check of materials, equipment, and procedure. A good check list should include:

Pile Material

1. Correct species of wood.
2. Correct tip and butt size.
3. Acceptable amounts of checks, spiral grain or knots.
4. Is the pile sufficiently straight?
5. Is butt cut perpendicular to center line of pile before driving?

6. If pressure-creosoted, is the correct treatment applied?
7. If hard driving is expected, are butts and/or tips banded or cushion blocks used?
8. Are steel shoes or points needed?

Pile Equipment

1. Is the hammer of sufficient size to advance pile?
2. Is the hammer working correctly?
3. Does the follower properly fit the pile?
4. Swinging leads and drop hammers will require special attention due to the possibility of excess damage in driving and drifting.
5. If pre-drilling or jetting is used, does the auger size or jet hole affect final soil support?
6. What effect does a new hammer have on the established driving criteria?

Pile Installation Procedure

1. Who stakes out piling locations, and who checks location after piles are driven?
2. Who checks plumbness?
3. Who knows what is the depth of the pile tip? This knowledge not only assures that the pile will support the design load but also can be used to check pay quantities.
4. Does the pile drift during driving? Drift may cause brooming of the pile butt, if the hammer is not hitting squarely.
5. Does the pile need lateral support during driving?
6. Does adding water to the pile during driving affect penetration or pile support?
7. Once a pile starts to crack or broom, what can be done to correct the condition?
8. Are pile splices acceptable? What kind?

COMMUNICATIONS

Once responsibility is clearly understood, a proper communication system should be established. Of course, there is a chain of command already established on the job. The communications should follow the chain of command already set up in written correspondence and provide for on-the-job contact that can get action. Good check points should include:

1. Who compiles the pile records and where do they go?
2. What to do if something goes wrong?
3. Who is called or is the pile contractor simply informed and, if so, does he understand the arrangement?
4. Establish exactly what is required in the way of a report when the job is completed.

Design Requirements, Plans and Specifications

The supervisor should review all soil information available on the project and develop an understanding of what the engineer intended in his design. He should know if the piles are friction or end-bearing, if down-drag forces are added, and if uplift or lateral forces are part of the design. This knowledge is necessary in order to make intelligent field decisions when piles do not drive as predicted. This element can most easily be provided if the pile supervision is done by the office of the soil engineer who made the project soil report.

The supervisor must also be familiar with the design drawings and specifications. This will include the

pay items in the contract since very often the field decisions will affect costs. Often, there are several ways to solve a particular problem and the supervisor may want to present alternatives or ask for direction from whoever is involved.

Hopefully, contact familiarization is done prior to the start of driving. In the event something in the contract documents appears incorrect, get clarification *immediately*; do not wait until the job starts.

Job Procedures

It is a good idea to arrive on the job a little before the driving commences and establish as soon as possible a relationship with the contractor. Find out how he plans to drive out the job, what type of equipment he plans to use, etc., and inspect the pile material. Normally it is best to drive the initial piles near a boring and, although the specifications may not so state, the pile contractor will often do this for his own information.

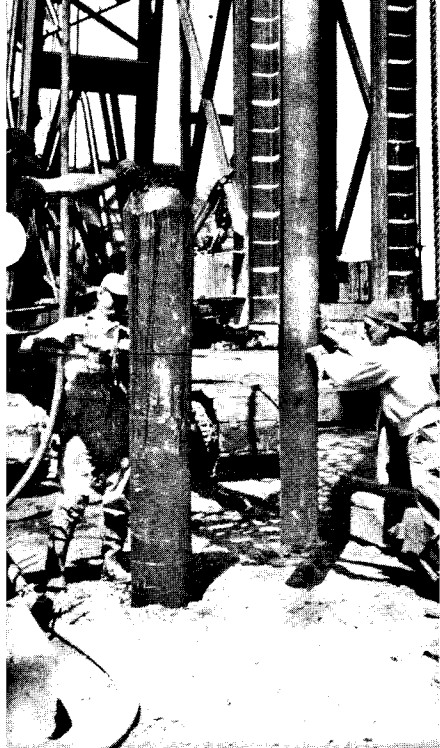
Job Equipment and Material

The supervisor should be familiar with the hammer being used and should know when it is acting properly. In the event the hammer is not operating at the rated blows per minute, it is probably not delivering the proper energy to the pile. The trouble could be a poor boiler, steam leaks at connections in the line, or simply that the hammer is not in good working condition. This could result in insufficient penetration of the pile. The rated blows per minute should be checked throughout the job since something could happen to the equipment at any time. In any case, the speed of blows should be recorded. Fast-acting hammers usually drive a pile with less blows than a slow-acting hammer of the same energy rating.

The pile supervisor should be prepared to cope with a possible hammer change or two during a pile job. It is not unusual for a hammer to break down or the contractor to elect to use a different hammer. When notified of a proposed hammer change, the supervisor should establish a preliminary criteria for the new hammer before the new hammer is used. This criteria can be adjusted as the driving proceeds in order to reduce the possibility of a shutdown, or winding up with poorly driven piles. This procedure is best done by driving either correlation piles adjacent to piles driven with the first hammer or near a boring so that the results can be evaluated.

Also important to the success of the foundation is the type of material used. Has anyone checked to be sure the piles are the species called for on the plans or are they some other species? As an example, during a recent job, receiving only intermittent inspection, almost 200 piles were driven before it was discovered that the wrong species was being driven. It was interesting to note when this discrepancy was discovered how many people did not know the difference in species, even though they thought they did. One cannot help but speculate on how many jobs have been driven using different material than called for in the specifications.

Who decides whether the timber pile is suitable for driving? Does the pile have excessive checks or bends? In the event the pile is pressure-creosoted, does the



treatment meet the standards as called for on the plans? Who checks to see if the tip and butt diameters are as called for by the engineer? If no one is assigned these tasks, you can be sure that some, if not all, could be violated on your job and result in losses for the contractor or even the owner. These questions call for attention to detail that only proper supervision can provide.

Relations With Contractor

Two items to keep in mind: First, it is my firm opinion that the supervisor should *never* tell a contractor how to perform his part of the job. The supervisor can and should tell him what is expected, or notify the contractor in the event it becomes obvious that he is planning to do something that is not right. The pile supervisor is not retained to "boss" the pile installation but merely to see that the job is done correctly. If the supervisor does ask the contractor to do something, the supervisor should be prepared to explain a possible extra on the contractor's final bill. What he asked the contractor to do may not be specifically covered in the contract and the contractor could be entitled to more money. On the other hand, the pile supervisor should make quite clear to the pile contractor how he interprets the plans and specifications, especially if there is a weak point or a point not covered completely or adequately. This is an important part of good communications.

Second, the supervisor should anticipate problems that the contractor may have, and help him solve them, but without telling him how to perform. A few examples are as follows:

1. When the pile is first in the ground it is most critical that it is kept plumb and supported. If the pile begins to drift, the supervisor should notify the foreman so he can correct the alignment before the pile is so far in the ground that it cannot be corrected. If the pile is long and not supported at the mid-point, it is subject to whipping and may cause the pile to crack. The supervisor should notice these conditions and call them to the attention of the pile contractor as they happen so he can correct his operation and do the best possible job.

2. If the pile butt became cracked or broomed during driving, the supervisor should ask the foreman to re-head the pile to prevent additional cracking and to insure that the energy is delivered to the pile tip. Often in hard driving, it is good to recommend banding the upper three feet and/or the tip of the pile to prevent cracking. In the event the pile butt is not cut square

with the axis of the pile, this may cause cracking, or, if the follower does not fit the pile butt firmly, the pile may crack.

3. If piles are rejected for any reason, a judgment for corrective action should be made as soon as possible. Don't wait until the rig has moved to another section of the project or off the job. This causes hard feelings and/or additional cost. If the solution is postponed, the contractor may believe the supervisor is willing to accept an inferior installation and continue to commit the same error. Sometimes the supervisor or the engineer may have wanted some corrective action take due to an inferior pile, but because of the problems involved and the fact that the rig has moved from the spot he may, under the circumstances, feel forced to accept a poor situation.

4. It is to be expected that some piles will not drive "according to the book." For example, if a 95-ft. pile is driven next to a group of 65-ft. piles, the long pile may be difficult to explain or to salvage if the circumstances surrounding the driving of these piles are not all available to the engineer who must judge them. A competent supervisor will have good driving records, and as a result, the behavior can likely be explained and the pile accepted rather than just be listed as questionable.

5. The contractor in driving end-bearing piles will not always select the correct length and will sometimes come up with a short pile. Add on by splicing? Drive another pile? A competent supervisor can help. On a recent job we had three such piles. After consultation with the structural engineer, we elected to drive the piles on down with a follower. This solution caused the general contractor to deepen the caps a foot or two but eliminated the need for a splice or an extra pile.

6. Engineers hold differing views on the use of a splice. Some factors to consider are in the seismicity of the area, whether the splice will be in material that will give lateral support to the pile, and whether the pile is designed to take horizontal forces. It may depend on the actual design load or perhaps even the economics of a particular job. However, in general, splices are not recommended.

Summary

1. There are times when pile inspection is not mandatory but these cases are few and usually cannot be predicted until the job is completed. Experienced, objective pile supervision can benefit the owner, the engineer, the pile contractor, and the pile supplier.

2. Each pile job is different due to soil conditions, pile loading, pile type, and the ideas of the engineers involved. It is important that each pile be judged on its own in the particular conditions where it will be used.

3. Every foundation pile supervisor should know exactly what is included in his scope of work.

4. Be completely prepared for possible problems on the particular job before the job starts.

5. The number of feet of piles driven and in-place should be accurately recorded and accounted for since this is often the basis for payment to the contractor.

6. Timber piles are often the best solution to your foundation problems. Proper installation is all that is required to achieve a most economical and successful foundation. ■