

CHAPTER 10.0

QUALITY ASSURANCE DURING PILE DRIVING

10.1 INTRODUCTION

The performance of a timber pile foundation system is not only a function of the design of the foundation but also its construction. If either is deficient, the performance of the foundation may not be as desired. Construction control of driven piles is much more difficult than for shallow foundations where the footing excavation and footing construction can be visually observed to assure quality. Since piles cannot be seen after their installation, direct quality control of the finished product is impossible. Construction monitoring should be exercised in three areas; pile materials, installation equipment, and the estimation of static load capacity. This chapter will focus on pile material inspection and installation equipment observations.

10.2 TIMBER PILE QUALITY REQUIREMENTS

Timber piles should be monitored at the project site to assure that they meet project specifications with respect to length, size (butt and toe diameter), sapwood, straightness, twist of grain, knots, and pressure treatment. ASTM D 25-99 *Standard Specification for Round Timber Piles* should be used for establishing the acceptance requirements for timber piles delivered to the project site.

Pile lengths should be measured and recorded along with butt and toe diameters. ASTM D 25 provides tables for determining if the timber pile meets the minimum nominal circumference measured 3 feet from the butt and toe of the pile. Piles that do not meet these requirements shall be rejected.

The straightness of the piles shall also be checked. A straight line from the center of the butt to the center of the tip shall lie entirely within the body of the pile. Piles shall also be free from short crooks that deviate by more than 2.5 inches from straightness in any 5 feet length. Sound knots shall be no larger than one sixth the circumference of the pile located where the knot occurs.

10.3 MATERIAL CERTIFICATION

Piling manufactures shall submit certification that supplied piles comply with ASTM D25 provisions and appropriate AWPA standards.

10.4 PILE DRIVING EQUIPMENT AND PILE INSTALLATION

The pile driving equipment, crane, leads, hammer, hammer cushion, and helmet are all important in the proper installation of a pile foundation. The inspector should check that the contractor's driving equipment is in accordance with the project plans and specifications. The inspector should perform the following tasks prior to pile driving:

- Verify that the pile driving hammer meets the specifications for type and size
- Hammer cushion (if used) meets the specifications for type, size, and thickness

- Helmet (drive cap) fits the pile
- The lead system conforms to the project specifications.

Inspection of the pile driving equipment during driving is important to assure that the piles are installed so that they meet the driving criteria and that the pile remains undamaged. The driving criteria is often defined as a minimum driving resistance as measured by the blow count in blows per foot or fraction thereof, and is to assure that the piles have a desired capacity. The driving resistance is also a function of the performance of the pile driving hammer. A hammer operating at lower energy levels than specified will result in pile blow counts that are higher than for the same pile, with the same capacity, with the same hammer operating at a high energy level. In order for the inspector to assure that the minimum driving criteria has been met, and therefore that the capacity is adequate, she/he must evaluate if the hammer is performing properly. Each hammer has its own operating characteristics.

During the production pile driving operation, the inspector should check the following items:

- Pile size, length and type
- Location of pile
- If pile toe protection is specified, is it installed?
- Is the pile plumb?
- Is the hammer the specified hammer, and is it working properly?
- Is the hammer cushion the correct type and thickness? Is it being replaced regularly?
- Did the pile meet the driving criteria?
- Did the pile have unusual driving criteria?
- Is there any indication of pile heave?
- Is the pile cutoff at the correct elevation?
- Has the exposed pile cut been treated?
- Is there any visual damage?

Pile driving records are an important part of the quality assurance program. The following information should appear on the pile driving records:

- Project identification number
- Project name and location
- Date and time of driving (start, stop, and interruptions)
- Name of contractor
- Hammer make, model, ram weight, energy rating. The actual stroke and operating speed should be recorded.
- Hammer cushion description, size, and thickness
- Pile location, type, size, and length
- Pile ground surface, cut off, and final penetration elevations and embedment length
- Driving resistance data in blows per foot, with the final foot normally recorded in blows per inch
- Graphical presentation of driving data
- Comments or unusual observations, including reasons for all interruptions
- Signature and title of inspector.

Driving records are an extremely important part of any deep foundation project. The records provide information which greatly assists the design engineer in assessing the adequacy of the

installed foundation system to support the design loads. No timber pile project should be complete without pile driving records.