CHAPTER 8.0
PILE INSTALLATION

8.1 INTRODUCTION

The installation of timber piles is a process that involves dropping a weight on top of the pile in order to drive the pile into the ground. Timber piles have been used for centuries to support man-made structures. The installation process has not changed much over the years. The equipment that is used to install timber piles includes a crane, a boom, a set of leads, a hammer, a helmet, a pile gate, pile monkey, and pile (Figure 8-1). This chapter will briefly discuss the equipment used to install timber piles, preliminary selection of hammer size, pile accessories which facilitate the installation while minimizing damage from the installation process, and treatment of pile butts after cutoff. This chapter will only briefly touch on these items as they pertain to the installation of timber piles.

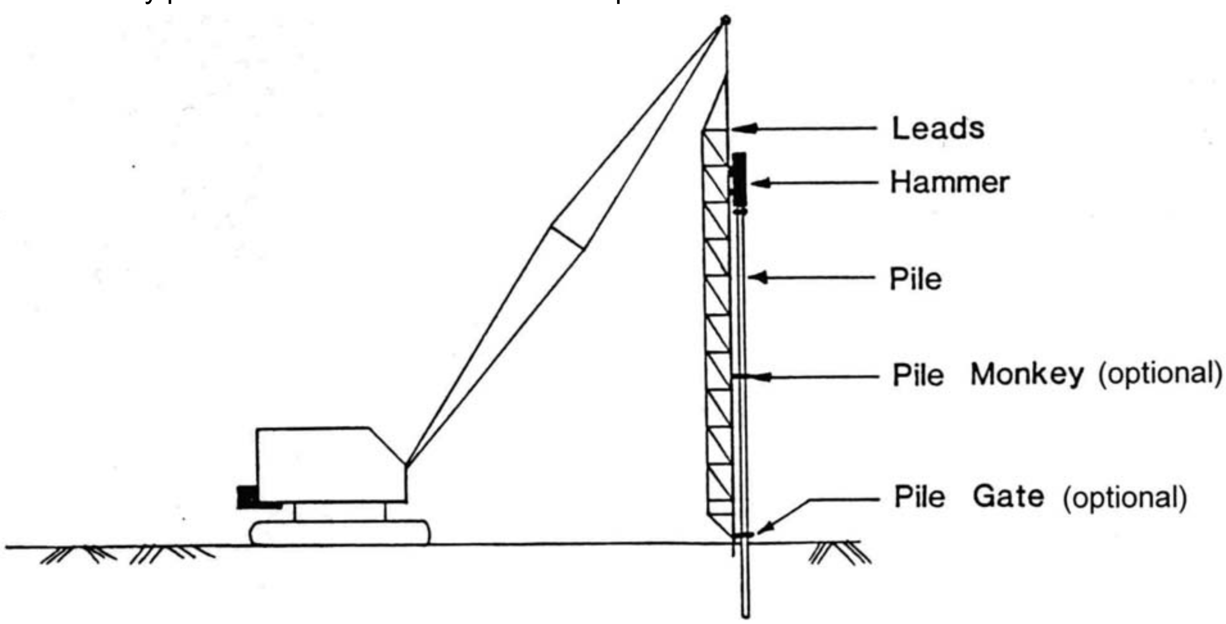

Figure 8-1: Swinging Leads

8.2 PILE DRIVING EQUIPMENT

The equipment necessary to install timber piles includes a crane that is capable of handling the loads from the pile driving equipment with sufficient capacity so that the reach of the crane does not limit the productivity of the installation process. The boom on the crane must be long enough to allow the maximum length pile to be installed without severely limiting the reach of the crane. The crane may be either a truck mounted or a crawler mounted rig. The selection of truck versus crawler will depend of the site conditions, maximum loads anticipated, and availability. The selection of the most economical crane for a project is typically left to the contractor.

8.2.1 Leads

There are predominantly two types of leads used for the installation of timber piles: swinging leads and fixed leads. The function of the leads is to maintain alignment of the hammer-pile system so that a concentric blow is delivered to the pile from the hammer for each impact. Swinging leads are the most commonly used leads because of their simplicity and economy. Figure 8-1 shows a typical swinging lead arrangement. The leads and hammer are usually held by separate lines from the crane. The name swinging leads comes from the leads ability to rotate freely so that the hammer and pile may be aligned without precisely aligning the crane with the pile butt (head). Swinging leads are typically lighter in weight than fixed leads and therefore allow for a larger crane radius than when using fixed leads. Thus, the contractor may install more piles from the same setup.

Fixed leads have a pivot point at the crane's boom top and are braced between the crane and lead, at the bottom of the leads (Figure 8-2). Fixed leads offer good control of the pile alignment. This control does not come without cost. Fixed leads are typically more expensive than swinging leads. The production rate may also be slower when using fixed leads as opposed to swinging leads. Regardless of the type of lead chosen for a project, the leads should keep the pile in good alignment with the hammer so that eccentric impacts which may cause local stress concentrations and pile damage are minimized.

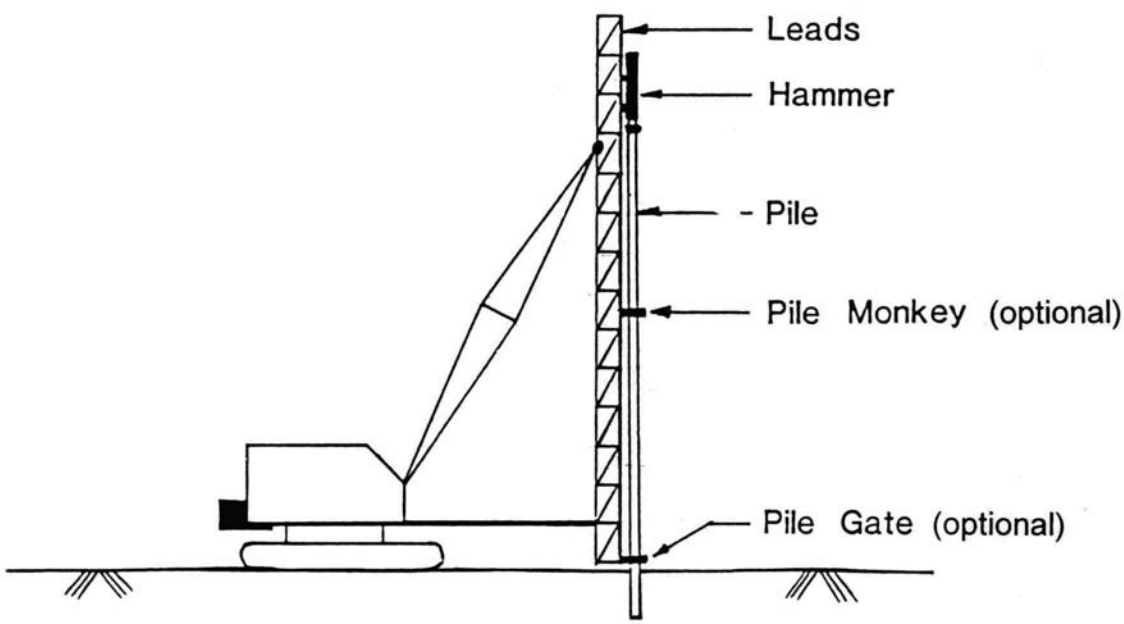

Figure 8-2: Fixed leads

8.2.2. Pile Hammers

There are two general categories of pile hammers; vibratory and impact hammers. Vibratory hammers use counter rotating weights to impart a sinusoidal vibrating axial force to the pile. Vibratory hammers are typically used for non-displacement piles. It has been found difficult to install displacement piles, using vibratory hammers, due to the difficulty in displacing the soil laterally at the pile toe with vibrations. Vibratory hammers are, therefore, typically not used to install timber piles.

Impact hammers may be categorized as either external combustion hammers (i.e., steam, air, or hydraulic) or internal combustion (i.e., diesel hammers). External combustion hammers use cables, steam, compressed air or pressurized hydraulic fluid to raise the ram. Figure 8-3 shows the typical components of an external combustion hammer. The energy delivered to the pile when using a drop hammer (a type of external combustion hammer) is very dependent on the operator. Internal powered hammers use diesel combustion inside the hammer to move the ram.

Another way to categorize hammers is single or double acting. Single acting hammers are essentially gravity or drop hammers. Double acting diesel hammers work very similarly to the single acting diesel hammer. The main difference between the single and double acting hammer is that the top of the double acting hammer is closed. When the ram moves upward, inside the hammer, the air in the chamber is compressed, which causes a shorter stroke, and therefore a higher blow rate. Double acting hammers, because of this faster blow count are typically more efficient than single acting hammers. For a more detailed discussion of pile hammers see FHWA-RD-86-160 *"The Performance of Pile Driving Systems: Inspection Manual".*

8.2.3 Helmet

The helmet is a heavy steel block between the hammer and the pile. A schematic of a helmet is shown in Figure 8-4. The helmet should provide a smooth surface for contact between the hammer and the pile. The helmet should fit snugly over the pile (less than 2 inches of lateral movement). The top of the helmet is typically recessed for a hammer cushion. The hammer cushion is used to relieve the impact shock between the ram and the pile. Cushion materials eventually become compressed, lose their effectiveness, and must be replaced. Hammer cushion materials are usually proprietary man-made materials. Pile cushions, cushions between the pile butt and helmet are typically not required for timber piles, but are typically used for steel and concrete piles.

8.3 HAMMER SIZE SELECTION

The selection of the hammer size for a project is an important consideration that will affect not only the performance of the pile but the efficiency with which the piles are installed. A hammer that is too small may not be able to install the pile to the required depth, capacity, or may require an excessive number of blow counts. A hammer that is too large may damage the pile. A wave equation analysis which considers the hammer cushion pile soil system may be used to determine the optimal hammer size.

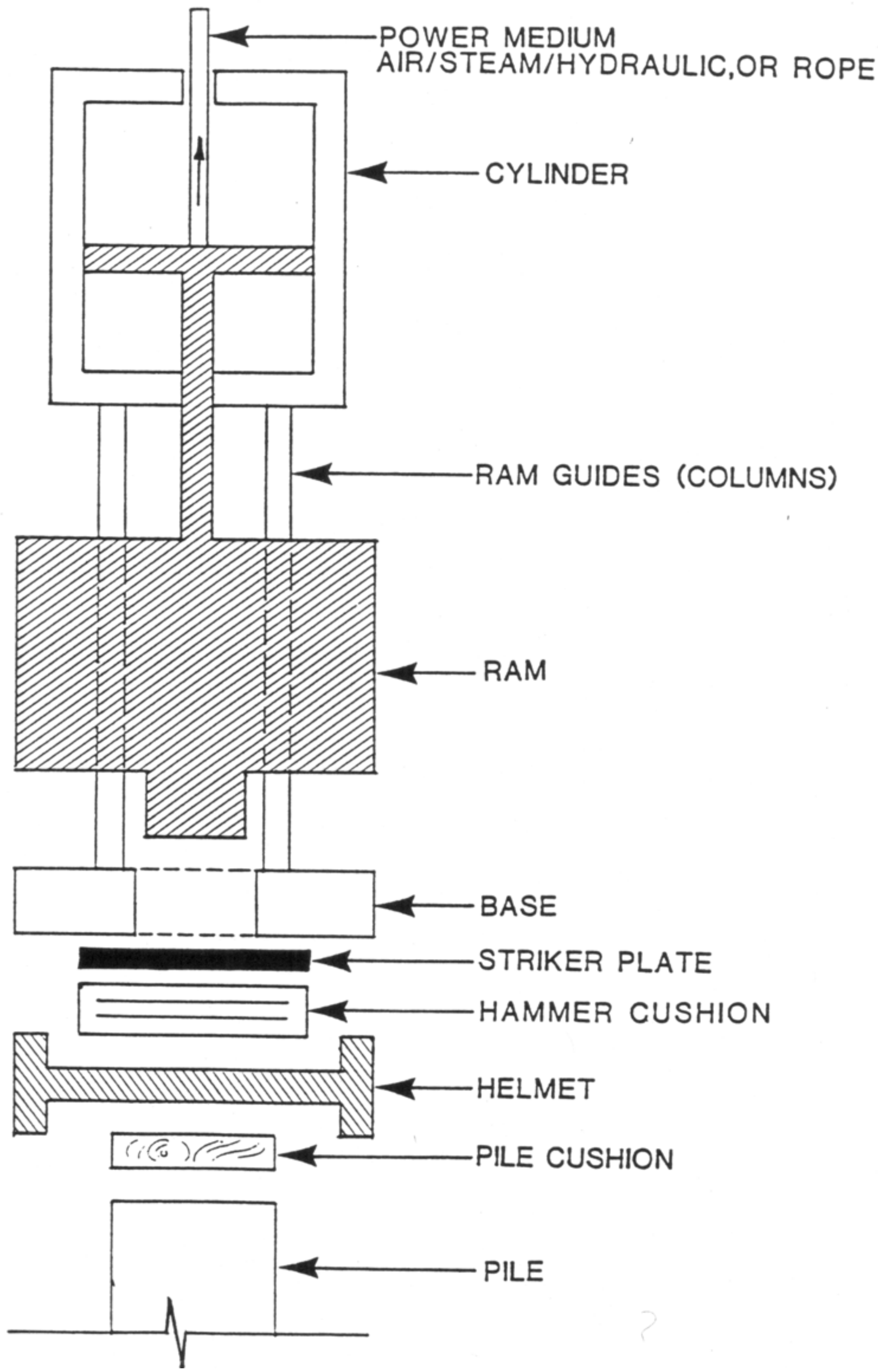

Figure 8-3: Basic components of an external combustion hammer

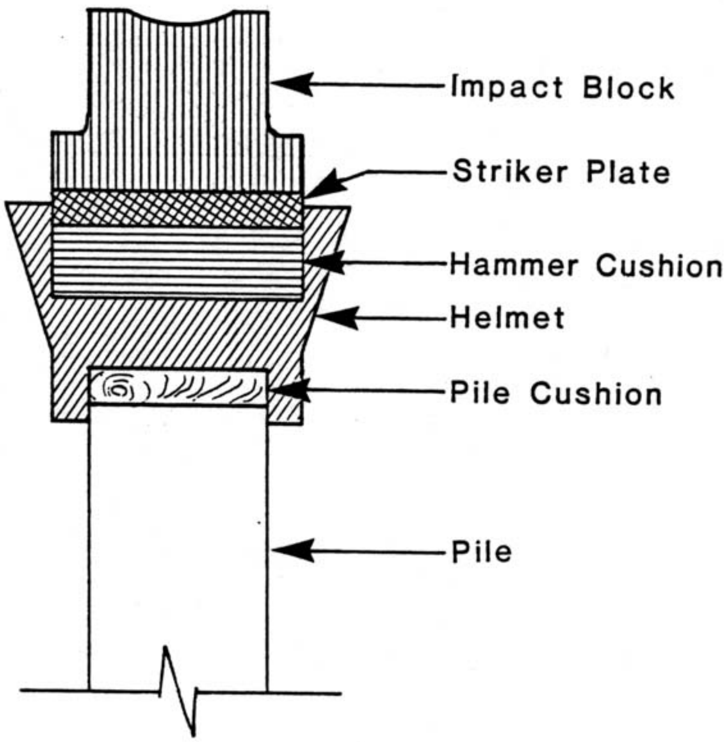

Figure 8-4: Helmet and adjoining parts

8.4 PILE ACCESSORIES

Difficult driving of timber piles through dense soils may cause splitting or brooming of the pile tip. In difficult driving conditions plywood or steel plates fastened to the pile can aid driving. Metal boots or points may be added to the pile tip to reduce the potential for damaging during driving. Boots typically fit over the pile tip without any required trimming of the pile. Pile points, on the other hand, typically require trimming of the pile tip. Both systems have proven effective in reducing the damage to the pile tip during driving in difficult ground.

8.5 PILE CUTOFFS

One advantage of timber piles is that after installation, the pile butt may be easily cut off to the correct elevation, typically with a chain saw. The cutoff surface should be treated with creosote or CuNp (copper naphthenate), in accordance with AWPI Standard M-4, to protect the end of the pile from organic degradation.