

# Does Size Really Matter? In Hammer Cushions, Little Things Count!

Someone once made the remark that if you worry about the pennies, the dollars will take care of themselves; meaning that if each of the small items is taken care of along the way, the major items will have been taken care of incrementally many times over. The same can be said of the planning and execution of a piling project. By paying attention to the details the job runs smoother and without unexpected breakdowns and delays, allowing the contractor to work more efficiently and economically.

One item frequently overlooked or misunderstood is pile-driving cushions. Cushions are usually a minor item in the total scheme of the project. If cushions become a problem during the course of the project they can rapidly become a major cost item; not only from the standpoint of the cushion cost but, usually and more especially because of the crew and equipment downtime necessary to change out the cushion — time better spent in driving piles.

Pile-driving cushions are provided primarily to protect the hammer or the pile, and are referred to as Hammer Cushions or Pile Cushions. Although they have a similar purpose, they are two different things. Pile-driving cushions are contradictory items by nature. They are provided to protect the hammer and/or pile by softening (cushioning) the energy of the hammer blow. In doing this, they work at odds with the objective of transmitting maximum available energy to the driving process.

Hammer cushions are the most common cushions encountered on the project and, with a few exceptions, almost all impact pile hammers require the use of a hammer cushion of some sort. Manufacturers design their hammers with the intention of transmitting the most available energy to the pile. However, they recognize that in so doing, and by

their design and use, pile hammers are subjected to considerable rebound forces and stresses. Unless managed properly, these forces and stresses can cause major damage to the hammer, increased maintenance, and a threat to the safety of the crew. Damage from these forces that can occur over time can cause fatiguing (crystallization), or fractures of the metal structure, and loosening and eventual dislodging of attached components due to

helmet. The cushion material is situated in this cushion pot and topped with a heavy steel striker plate or anvil. Ideally, what is looked for in a cushion is material that provides adequate protection to the hammer while transmitting the most energy to the pile, provides longest life possible, and requires the least maintenance.

Early mechanical impact hammers, first used to drive timber piles, did not require a cushion as the top of the tim-

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vibration. In order to mitigate the effects of these dangerous forces, the manufacturers have designed a provision for cushion materials into the driving system. The use of the cushion to protect the hammer (and crew) presents a contradictory situation in that by dampening the reflected forces, it also reduces the effective transmission of the full potential energy to the pile. This presents a problem in that while the ideal is to transmit as much energy to the pile as possible, the produced rebound forces must be tempered to protect the hammer.

Regardless of the make, model, and other variables in pile hammer design, the cushion is situated in a receptacle (or cushion pot) located directly under the point of impact of the ram or piston. Often this cushion pot is incorporated into the drive cap or helmet, an accessory that adapts the hammer to the particular size and type of pile being driven. In the case of some hammers, this cushion pot is located in a “universal” head or adaptor that then fits with the drive cap or

ber pile provided some cushioning to the hammer. With the advent of other, stiffer pile materials, the industry came to realize that additional protection was required for the hammer, and incidentally to some degree the pile. Many different materials have been used over the years to accomplish this task — blocks and chips of various species of wood, asbestos materials, coiled cable, woven wire mesh encapsulated in plastic, coils of paper and aluminum, phenolic laminate, aluminum, nylon blocks, and many others. Modern hammers most commonly use either a “sandwich” of phenolic laminate material (called by several common trade names), and aluminum, or special alloyed nylon blocks with aluminum layers arranged to achieve the manufacturer’s required stack height. Proper cushion stack height is important to adequately protect the hammer and because stack height affects the hammer stroke and/or timing.

Over time, two things occur during driving which affect the efficiency

of the cushion as energy is transmitted through the hammer-cushion drive-cap pile system. First, as driving progresses, the cushion undergoes compression. As the cushion compresses it becomes harder, and will eventually lose its cushioning and ability to protect the hammer. The second thing to occur is the development of a significant amount of heat. Heat is usually most detrimental to cushion life, causing the breakdown of the cushion and loss of cushioning ability. When this happens, the cushion's ability to protect the hammer diminishes, and the energy transmission to the pile drops considerably, causing the pile to require more blows from the hammer for the same amount of penetration — i.e. longer driving time and more cost. Factors affecting the life of a particular cushion are the relationship between the energy of the hammer and size of the cushion, the cushion material, and perhaps most importantly, the driving conditions due to the soil.

It is hard to predict the useful life of a cushion on a given project. Many claims have been made about how long a particular cushion will last or how many piles were driven with it. As mentioned previously, heat is a major factor in the breakdown of cushions. It is useful at this point to recall that the cushion pot used to hold the cushion material is usually a relatively substantial steel structure. This provides a tremendous heat sink, absorbing and retaining large amounts of heat during driving. In situations where there is prolonged hard or heavy driving, tremendous amounts of heat can be generated. This, depending upon the cushion material used, can cause the cushion to smolder or melt. In the event of smoldering, considerable amounts of smoke can be generated. If the cushion gets to this point it is a safe bet that it has been used well beyond its useful life. Likewise, if the cushion begins to melt, it is softening and loses its ability to transmit driving energy. To help alleviate the problem of heat buildup, many contractors have used water cooling of the cushion pot or drive cap. This has proved effective in prolonging the life of the cushion in many cases. However, prolonged immersion in water can cause phenolic materials to delaminate, leading to more rapid deterioration of the cushion.

It is necessary to recognize that hammer cushions are consumable items

that get “used up” during the course of use, much like fuel and lubricants on other equipment. Proper selection of hammer cushion is important to maintaining progress in driving, ensuring that the anticipated energy is getting to the pile, and that downtime due to changing cushions is kept to a minimum. An additional consideration is the actual cushion cost. A cheap cushion that lasts only half as long as a little more expensive one recommended or specified by the manufacturer or consultant, is no bargain over the long term.

PDCA member hammer manufacturers are sources of information about cushion materials for their particular line of hammers. Additionally, several PDCA associate members specialize in cushion materials and are good sources of information for the available cushion choices for differing applications. For contact information, visit the Member Search section of the PDCA Web site (<http://www.piledrivers.org>).

Look for a discussion on pile cushions in a future article in Piledriver magazine. ▼



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