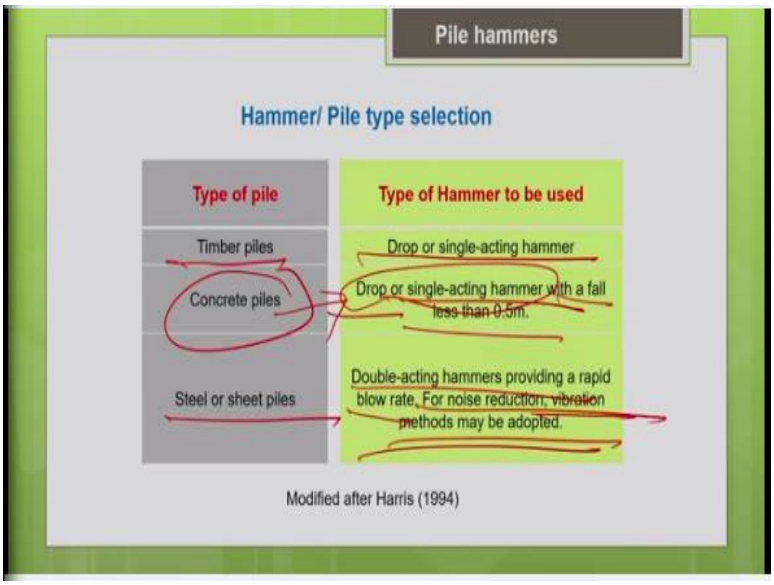

So, we have discussed about the functioning of different types of hammers and let us discuss about how to make the hammer selection. Your pile material type, the soil type everything is going to govern your selection of your pile hammer. So, with respect to material type as I told you particularly for the concrete piles you should be very careful, we should go for heavier hammer, heavier in the sense you can go for drop or single acting hammers which are basically heavier.

So, if you go for heavier hammer, you can reduce the height of fall, that will reduce the driving stresses on the concrete pile head. So, that is why for concrete piles go for drop or single acting hammer with a fall less than 0.5 meter. If you are more concerned about the productivity, you should go for single acting hammer instead of drop hammer, single acting steam hammer. So, next is about a timber pile**,** timber also it is preferable to go for drop or single acting hammer.

But for the steel piles or the sheet piles, I can go for double acting hammer which gives you a rapid blow rate. And if you want the silent driving method you can go for the vibrator methods for noise reduction I can go for vibratory hammers.

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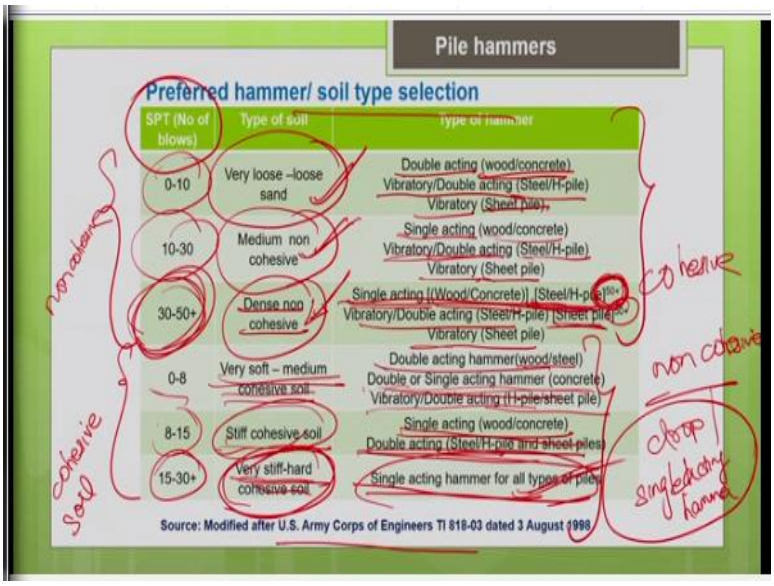

Now how to make the pile hammer selection with respect to your soil type, as I told you we can classify the soil into different categories. So, based upon there are some standard tests to categorize the soil into different categories. Like once this test is your standard penetration test where you find what is the number of blows needed for the standard penetration. So, based upon the number of blows you classify the soils into different categories are shown here.

Basically, you classified into cohesive soil and non-cohesive soil. So, the first three refers to non-cohesive soil and this is a cohesive soil. So, they are further classified into three different categories depending upon a number of blows. So, for 0 to 10 blows, it is very loose to lose sand, for 10 to 30 it is medium non-cohesive sand, for 30 to 50 plus blows it is dense non-cohesive sand as a number of blows increase the densification increases.

So, one basic guideline we need to keep in mind is for very tough soil conditions, it is preferable always go for heavier hammer, which is nothing but your drop hammer or single acting hammer that is always heavier, single acting hammer for tough soil condition and for the heavier pile. So, for lighter conditions, it is preferable to go for double acting hammer. To the maximum possible try to avoid double acting hammer for the concrete piles.

So, with this basic guideline let us discuss what are the guidelines available from U.S army corps of engineers. So, for very loose to loose sand, it is given that for concrete pile or the wood pile you

can go for double acting. So, I mentioned that for concrete pile it is preferable to go for single acting hammer. But if the soil condition is very loose, in that case it is exceptional, you can also go for double acting hammer even if it is concrete pile.

And for steel piles commonly you can see pipe steel piles or H-piles, you can either go for double acting or vibratory hammer. For sheet piles commonly, we use it vibratory pile driving method. Now for medium non-cohesive sand, so in this case you can see that single acting hammer should be used for concrete pile, do not use double acting hammer for concrete pile.

So, double acting you can use it for the steel pile either you can use double acting or vibratory. And for the sheet piles you can go for my vibratory hammer. Now as a densification of the sand increases, though the sand is non-cohesive but the densification increases, indicated that increase in number of blows 30 to 50 plus. Now you can see what is the change in the guideline, for wood or the concrete pile you can go for single acting hammer as we discussed earlier but for very high number of blows say 50 plus.

Even for the steel pile, steel H-pile you need more blow energy, so you can go for single acting hammer. Generally, for steel piles we recommend double acting hammer only but when the number of blows are more it indicates more densified sand. In that case you can go for single acting hammer for steel pile. And for the sheet pile also when the number of blows are more 50 plus you can go for double acting hammer instead just vibratory hammer, fine.

Now we discussed about the non-cohesive sand let us now discuss about the cohesive soil. Cohesive soil is also classified into three different categories now let us start from the bottom. 15 to 30 plus blows indicates very stiff to hard cohesive soil, very tough soil condition in this case as I told you it is preferable to go for heavy hammer, go for single acting hammer always for all type of piles.

So, the blow is medium 8 to 15, so stiff cohesive soil, in this case you can go for single acting hammer for wood or concrete pile and double acting hammer for steel or H-pile. For stiff soil you should note that you should use single acting hammer for all types of piles whether it is a steel pile

or concrete pile for every pile you should go for only single hammer. Because the blow energy needed is very high here, you have to go for heavy hammer.

But for stiff cohesive soil, you can go for single acting hammer for concrete pile and double acting hammer for steel pile. And but here they are not recommending vibratory hammer because it is stiff cohesive. Vibratory hammer can be recommended only for soft, medium, cohesive soil where the blow range is 0 to 8. So, you can see vibratory hammer or double acting is recommended for sheet pile, double or single acting hammer you can recommend for concrete.

Here also you can see you can even recommend double acting hammer for concrete because the soil is very soft medium. In that case only for concrete you can recommend double acting hammer. And for wood or steel you can go for double acting hammer, so these are the basic guidelines, so you can refer these guidelines. So, based upon the material type and based upon the soil type, so you can make the hammer selection.

So, that is why I told you first we have to do some geotechnique investigations basic investigations such as site to categorize the soil type**.** Once you know the soil type then only you can make the selection of your pile hammer accordingly.

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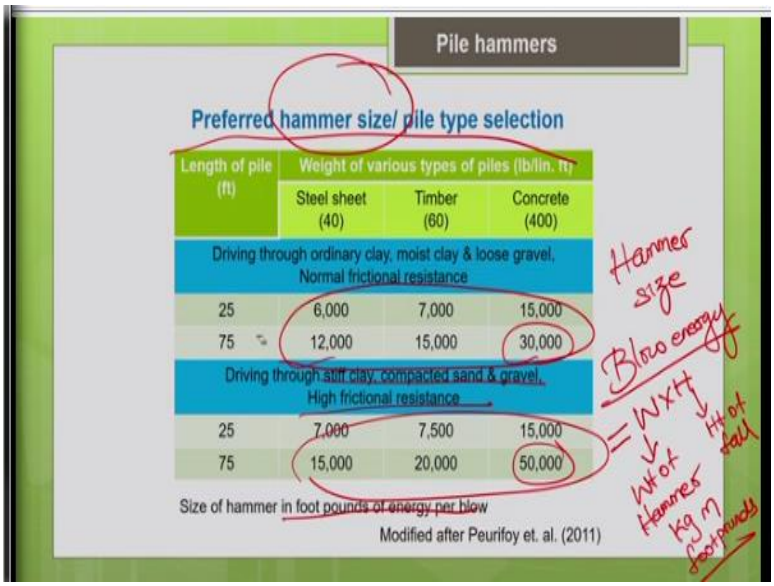

So, makes this about the how to select the pile hammer based upon your weight of your pile, length of your pile and the material type. So, hammer size, here we are going to select the hammer size, so hammer size is generally defined in terms of blow energy, hammer size is defined in terms of blow energy, so how do you determine the blow energy? It is nothing but W into H, W is your weight of hammer and H is your height of fall, so kg meter or whatever.

In this the unit is given as foot-pounds, so that is a unit of blow energy, this is how you define the size of a hammer. So, for very tough soil conditions and for bigger size pile, heavier pile you need a very high blow energy. So, you need a bigger size hammer. So, you can see this table where they have classify the soil into 2 types, one is soil with normal frictional resistance. Like your ordinary clay, moist clay and loose gravel and other one is a soil with high frictional resistance thus that is nothing but stiff clay compacted sand and gravel.

So, now obviously you can say that for tough soil conditions with high friction resistance you need more blow energy when compared to normal friction resistance. The blow energy requirement you can see the difference, so, here the blow energy is very high when compared to this value. So, based upon the soil type the blow energy requirement that is a size of hammer requirement varies. And another important thing to be noted is based upon the length of pile.

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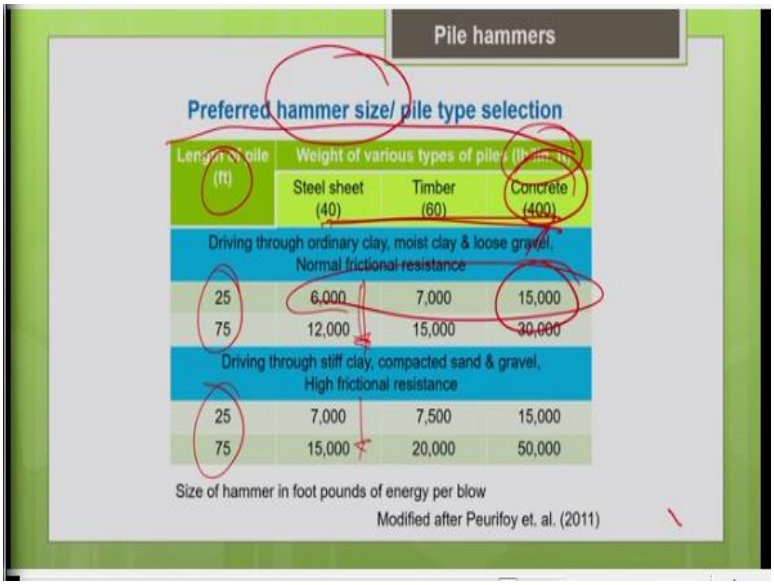

As your length of pile increases you can see that the blow energy requirement increases this is your pile length is given in feet. And another important thing to be noted is as your weight of pile increases, here they have given the weight per unit length that is pounds per linear feet. As your weight of the pile increases you can see that your blow energy requirement also increases.

And obviously for the concrete piles you can say you need a high blow energy when compared to steel pile and timber pile, it depends upon the weight, weight per unit length. So, your pile hammer selection depends upon the soil type, depending upon your pile type, your pile length, pile material type and the weight of your pile. All these things are going to affect your hammer selection.

Apart from this whether there is an restriction on noise, whether you have overhead space for placing all these supporting equipment ok, what is the productivity needed, all these things are also going to govern your pile hammer selection. So, we have come to the end of this lecture, let me summarize what we have discuss in this lecture.

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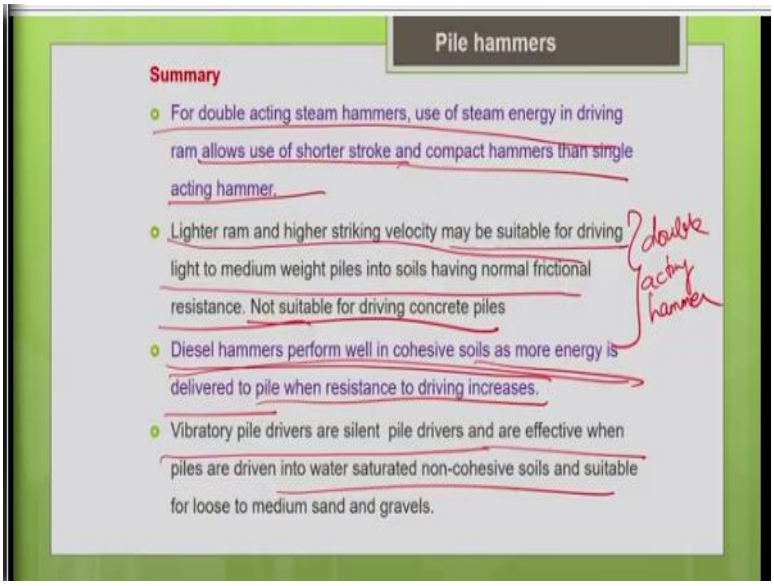

For double acting hammer, use of steam energy in driving ram allows use of shorter stroke and compact hammers than the single acting hammer. So, double acting hammers are basically smaller in size and they go with shorter stroke when compared to single acting hammer. So, they have basically recommended for the soil with normal friction resistance and for light to medium weight piles.

So, lighter ram and higher striking velocity of the double acting hammer will be suitable for driving light to medium weight piles into soil having normal frictional resistance. Here we are talking about double acting hammer, so it is not suitable for driving concrete piles. Generally for concrete piles I need a heavier pile, so that I can reduce the height of fall and also the blow rate of double acting hammer is very high which can easily shorter your concrete pile.

For concrete pile go for a hammer which is very heavy which can offer you more blow energy at a lesser height of fall. Diesel hammers perform well in cohesive soil, as I told you in the tough soil conditions where the driving resistance is high that will result in greater rebound of the hammer which will offer more energy for pile driving. That is why diesel hammer perform well in cohesive soil as more energy is deliver to the pile when resistance to driving increases.

So, vibratory pile drivers are silent pile drivers and are very effective for loose soil conditions or water saturated non cohesive soil. So, these are the important points which were discussed in the lecture.

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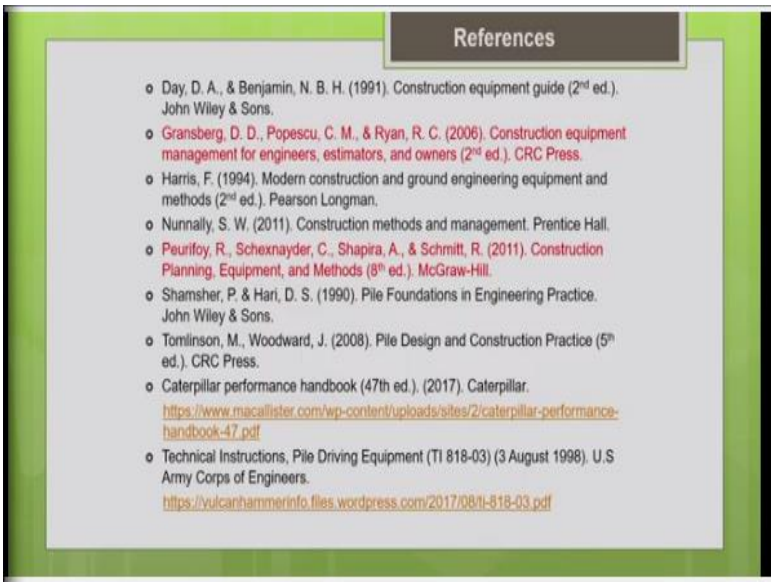

These are the references which I have referred for the lecture preparation. So, in the next lecture we will be discussing about the cranes, the lifting equipment cranes. So, what is the lifting

mechanism of the crane? What are all the different types of cranes merits and demerits, all those things we are going to discuss in the next lecture, thank you.