IIT BOMBAY

**NATIONAL PROGRAMME ON
TECHNOLOGY ENHANCED LEARNING**

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Geotechnical Engineering Laboratory

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Lecture No – 08
Compaction

Welcome I am professor J. N. Mandal department of civil engineering Indian institute of technology Bombay.

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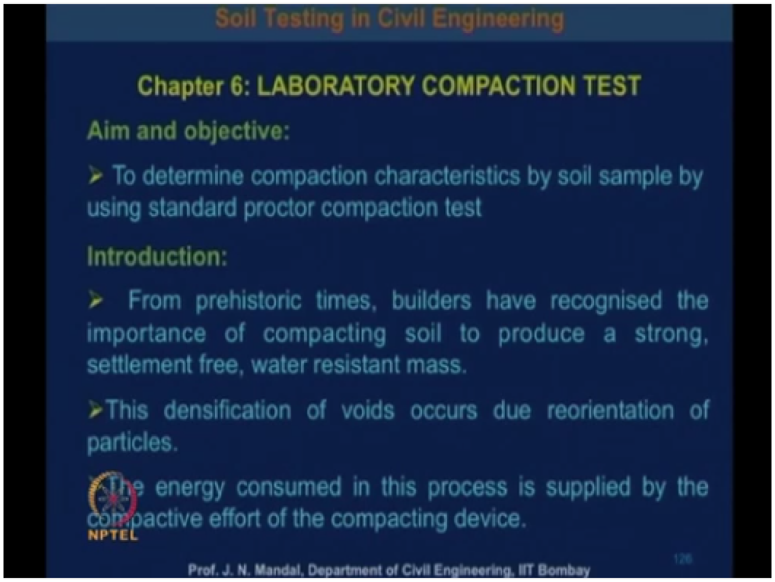

I talk about laboratory compaction test, this compaction test is very important for any kind of the project, how much the soil has been compacted. Because there is a certain code and the specification which one has to maintain and it should achieve the targeted compaction, without go for compaction various structure the name also collapse. So you need to go for verification for the compaction test and also go for to check up whether the soil has been compacted properly or not.

So for this it is very important to determine the compaction characteristics of the soil sample by using the standard proctor compaction test. So this, from the prehistoric time the builders have recognized the importance of compacting soil to produce a strong settlement free, and water resistant mass. The densification of the void occurs due to reorientation of the particle. Then energy consumed in this process is supplied by the compacted effort or the compacted devices.

So you need that how you can reduce the void issue and increase the density of the soil to achieve the proper compaction.

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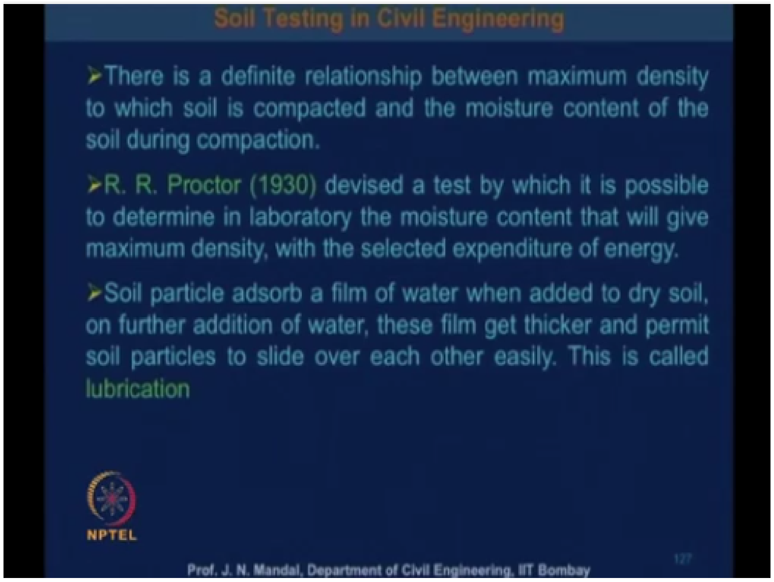

So there is a definite relationship between the maximum density to which the soil is compacted and the moisture content of the soil during the compaction. First of all that R. R. Proctor 1930 and device a test by which it is possible to determine in the laboratory the moisture content that will give the maximum density, with the selected expenditure of the energy. Soil particle absorb a film of water when added to dry soil.

On further addition of the water, these film get thicker and permit soil particle to slide over each other easily. And this is called the lubrication.

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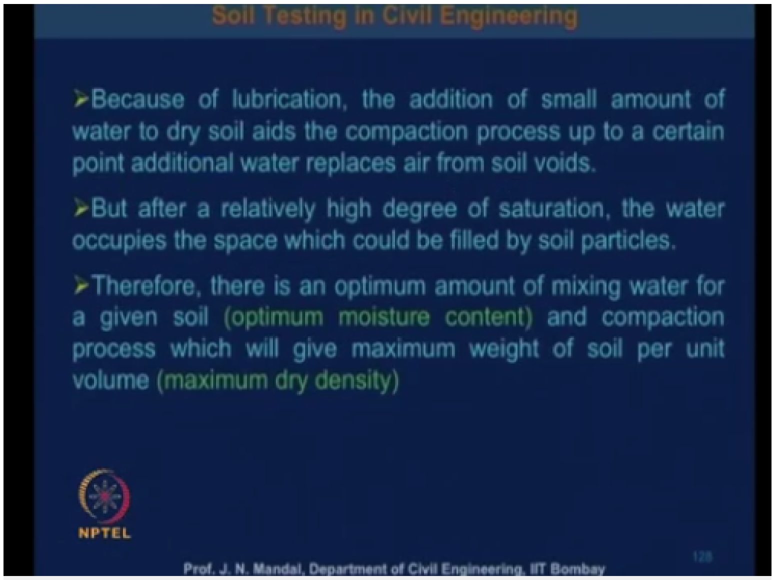

Because of the lubrication, the addition of small amount of water to dry soil aids the compaction process up to a certain point additional water replaces air from the soil voids. But after a relatively high degree of the saturation, the water occupies the space which could be filled by the soil particle. Therefore, there is an optimum amount of mixing water for a given soil that means that optimum moisture content.

And compaction process which will give the maximum weight of soil per unit volume that means what should be the maximum dry density. So you will be knowing that what would be the maximum moisture content, what would be the maximum dry density, and then you can establish a correlation between the maximum dry density and the corresponding the moisture content.

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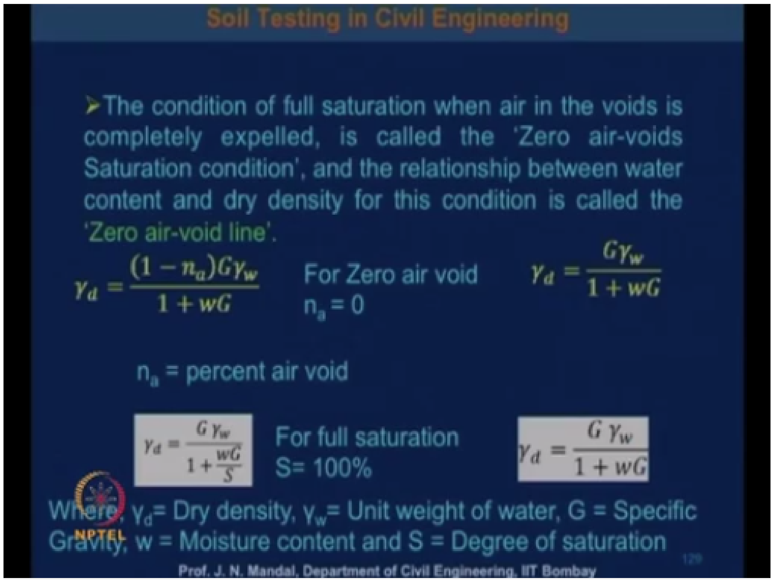

So the condition of full saturation when air in the void is completely expelled is called the zero air void or saturation condition. And the relationship between the water content and the dry density of this condition is called the zero air void line.

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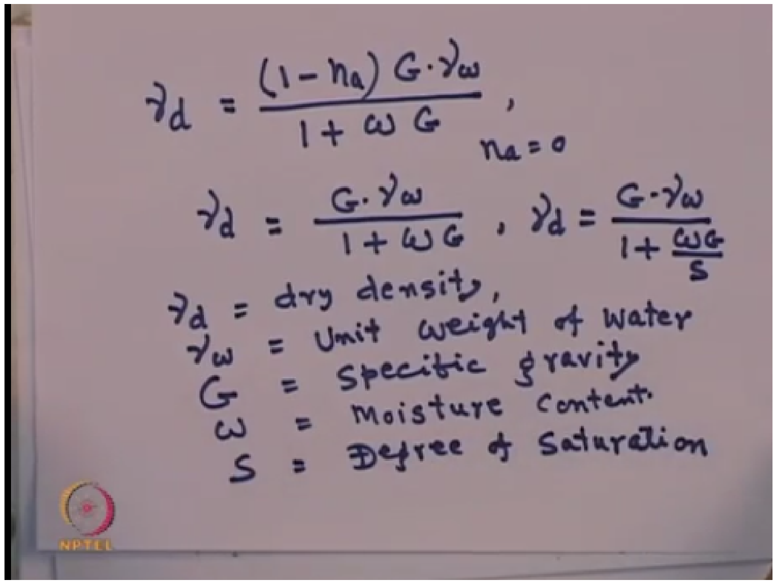

For example, that let us say that $\gamma_d = (1\text{-na})G\gamma w/1+wG$ for zero air void this na= 0 so this is the percentage air void. So $\gamma d = G\gamma w/1+wG$ so here γd is the dry density, and γw is unit weight of water, and G is the specific gravity, and w is the moisture content. But this also you can write this $\gamma d = G\gamma w/1+wG/S$, where S is the degree of saturation that is, if it is 100% degree of saturation then its value will be 1, that means equation will be $\gamma d = G\gamma w/1+wG$.

So S value may vary for example, this is 100% S value then equation will be $\gamma d = G\gamma w/1+wG$ when this is 100% degree of saturation. So here S = degree of saturation. So from this equation we can draw the zero air void line, so for the compaction test we require that some operators and assessory.

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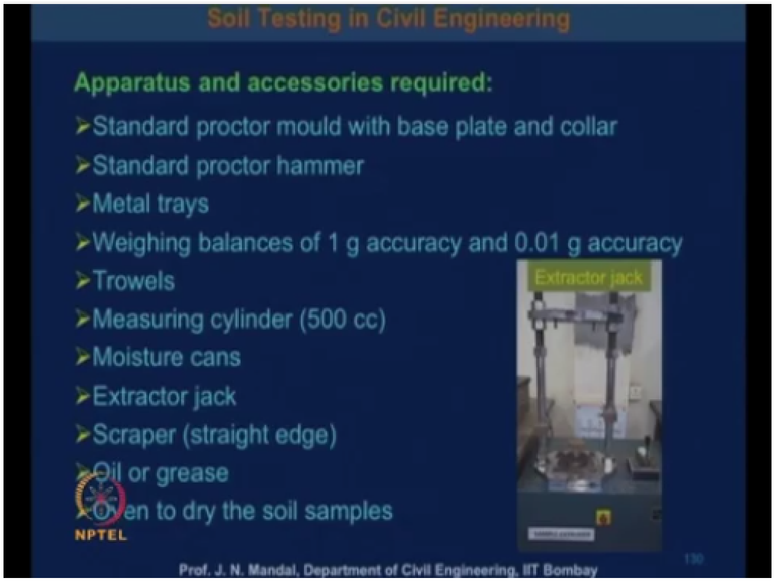

There is a standard proctor mould with a base plate and collar, you require the standard proctor hammer, you need metal tray, weighting balance of 1h accuracy and 0.01g accuracy, then it require towels, measuring cylinder which is about 500cc, moisture cans, and extract jack, and scraper that is straight edge, you require oil and grease, or oven to dry the soil sample.

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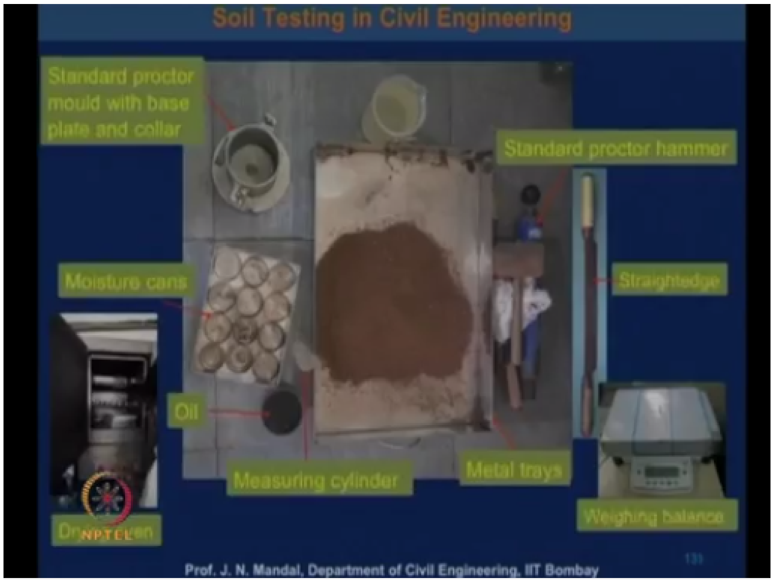

So these are some of the equipment which is required for the compaction test, here you can see this is the standard proctor mould with a base plate, this large one is the base plate and then collar. And this is the standard proctor hammer, this one is the standard proctor hammer, that is blue collar, this is standard proctor hammer, you need the soil is to be compacted into this mould. And this is the straight edge, this is the moisture can, you need soil is to be placed for dry, this is the oil and this is the dry oven for the determination of the moisture content.

And this is the measuring the cylinder, and this is the metal tray in which soil is placed. So these are some equipment you require and this is the weighting balance with here.

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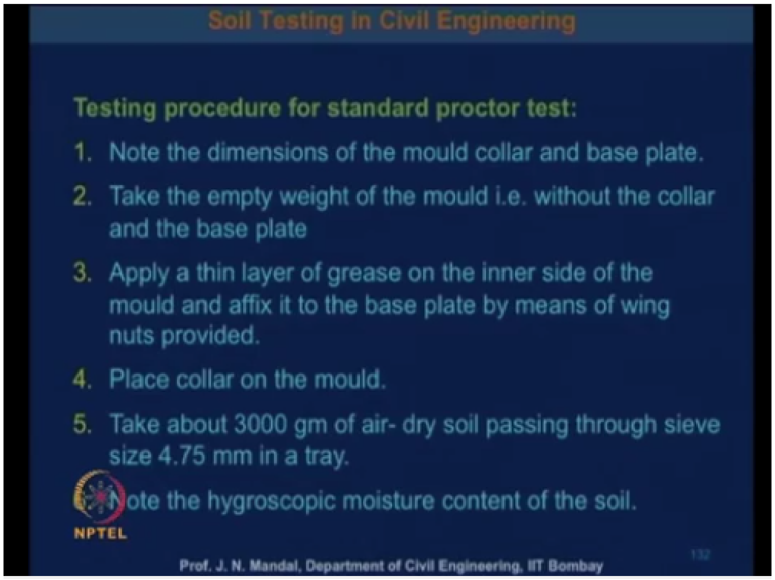

So testing procedure for standard proctor test, note the dimension of the mould collar and the base plate. Take the empty weight of the mould that is without the collar and the base plate. Then we apply a thin layer of grease on the inner side of the mould and affix it to the base plate by means of a wing nuts provided. Place collar on the mould. Take about 3000gm of air dry soil passing through the sieve size 4.75mm in a tray.

Note the hygroscopic moisture content of the soil, you know that how to determine the hygroscopic moisture content of the soil.

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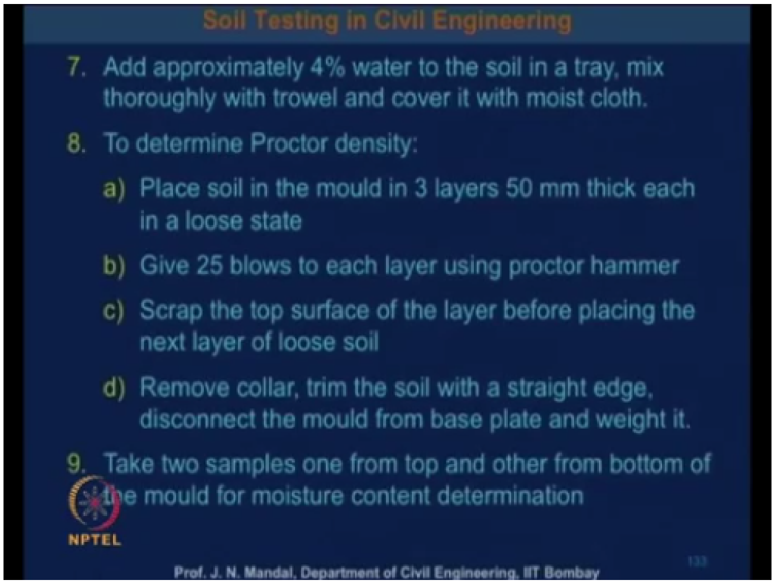

Now add approximately 4% of water to the soil in a tray, mix thoroughly with the trowel and cover it with the moist cloth. Next determine the proctor density. Place the soil in the mould in three layer 50mm thick each in a loose state. Give 25 blows to each layer using the proctor hammer which is showed what is that proctor hammer. Scrap the top surface of the layer before placing the next layer of loose soil.

Then remove the collar, trim the soil with a straight edge, disconnect the mould from the base plate and then it take weight. Take two sample one from the top and other from the bottom of the mould for the determination of the moisture content.

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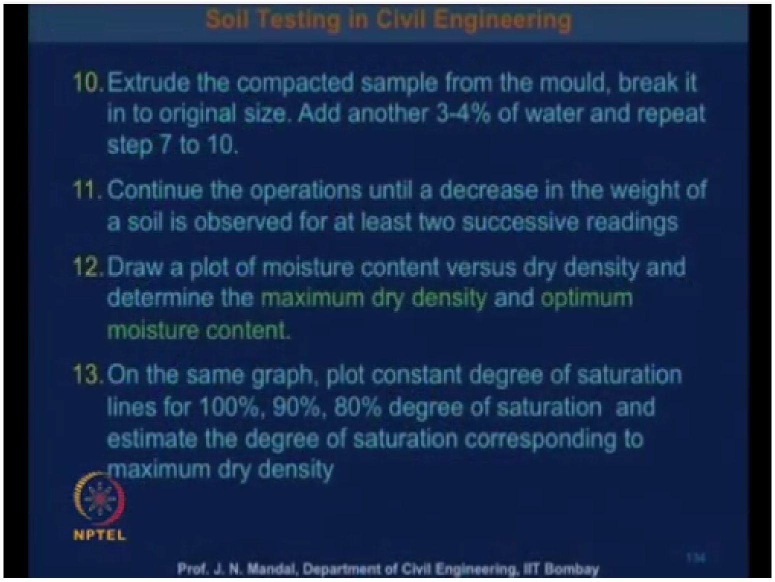

Extrude the compacted sample from the mould, break it in the original size, add another 3-4% of water and repeat step 7 to 10. Continue the operations until a decreases in the weight of the soil is observed for at least two successive readings. Draw a plot of moisture content versus the dry density and determine the maximum dry density and optimum moisture content. On the same graph, you can plot the constant degree of saturation line 100%, 90%, 80% degree of saturation and estimate the degree of saturation corresponding to the maximum dry density.

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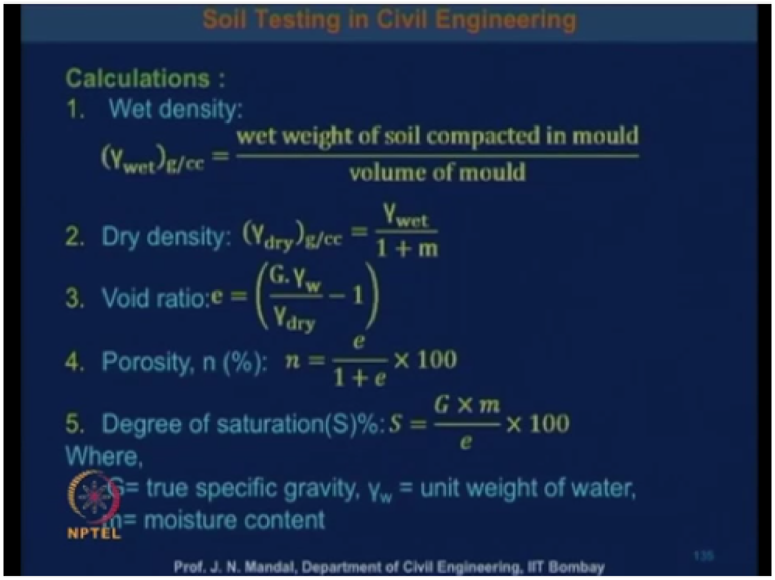

So we can from the compaction test result we can determine the relationship between the moisture content and dry density and we can determine what is the optimum moisture content and corresponding the dry density and as well as we can determine for any degree of saturation, either 100%, 80%, 70%, 60% let us say from this curve we can determine, thank you.

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