Forest Biometry
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Lecture – 22
Canopy attributes - Part II

[FL]. Today we will continue with our discussion on canopy attributes.

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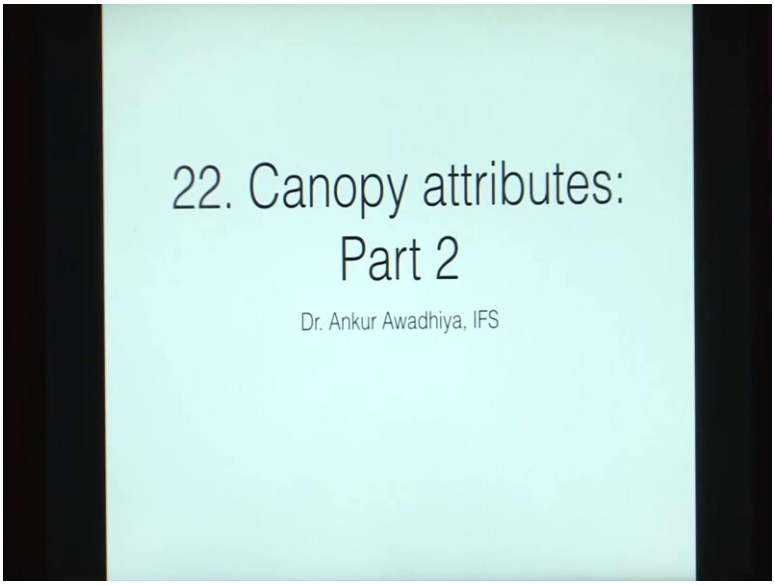

Here is a recommended reading for you.

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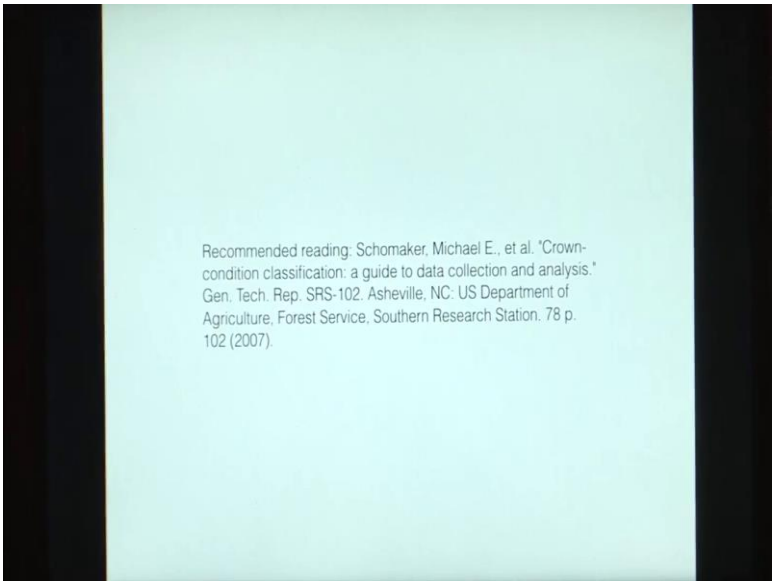

So, now let us begin our discussion. So, we know the importance of canopy, but how do we take measurements of the canopy is what we are going to look at in this class and the next class.

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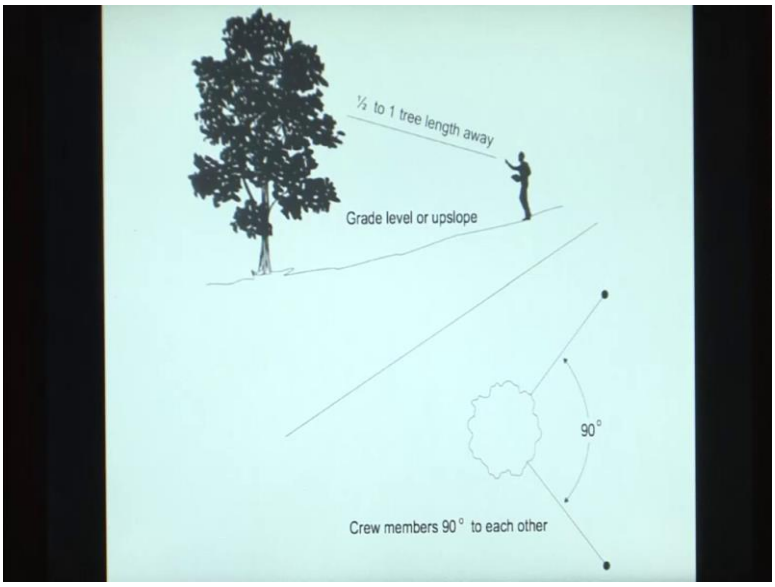

So, if you look at this figure. So, here you can see an observer who is trying to take the measurement of this tree canopy. The person needs to stand at the grade level that is the ground level or on in upslope position. The distance from the tree should be

approximately half to one tree lens away, so that the whole canopy is visible from that point.

In the bottom chart, you can see where the crew members need to stand if you need to take two measurements, so for instance if this is your canopy.

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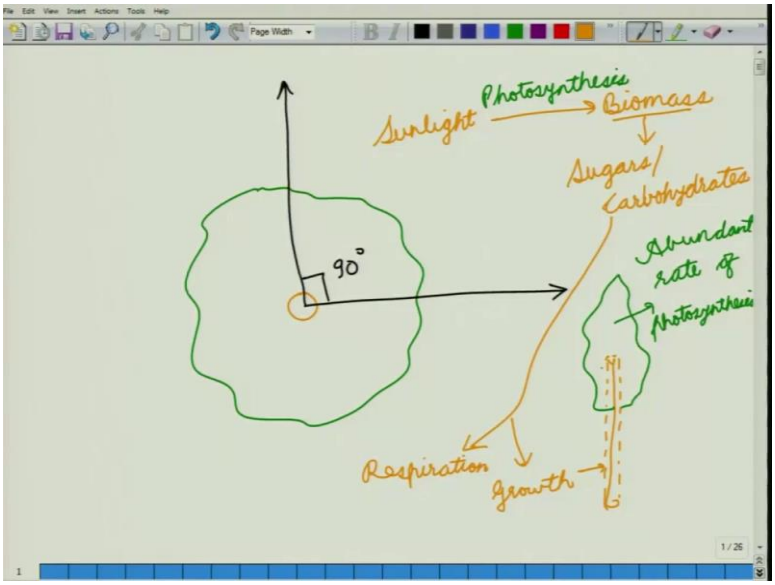

We take measurements at 90 degrees. So, suppose this is your tree stem. If you take one measurement along this direction, the other measurement has to be at 90 degrees from the first measurement. So, what do we measure? We measure a number of attributes.

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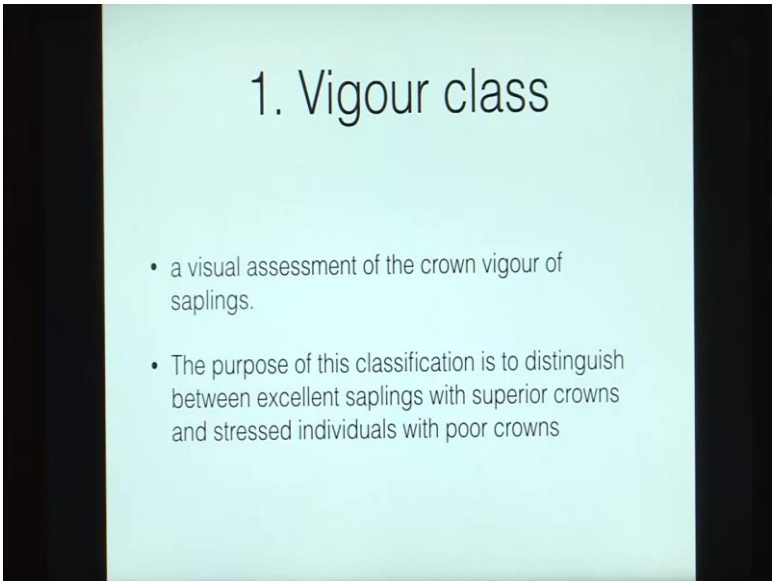

So, the first attribute for the crown is known as the vigour class. Now, a vigour class is a visual assessment of the crown vigour of saplings. Now, what is vigour? Vigour refers to the amount of energy that a sapling has will allow it to grow. So, if a sapling has a lot of vigour, it will be able to grow at a very fast rate. It will be a healthy sapling, whereas a sapling with a low vigour would not be able to grow at a very fast rate.

So, vigour class is a visual assessment of the crown vigour of saplings. So, it is used for the case of saplings. So, this is not for whole trees; it is for the small plants. The purpose of this classification is to distinguish between excellent saplings with superior crowns and stress individuals with poor crowns. So, as we said, as we discussed before if a sapling has a good crown, then it will be called an excellent sapling. Why? It is because consider a small plant and suppose it has a good crown. So, a good crown will tell us that it has abundant rate of photosynthesis.

Now, photosynthesis is the reaction by which sunlight gets converted into biomass. So, this is the process of photosynthesis. So, when it is converted into biomass, this biomass is in the form of sugars or carbohydrates and these carbohydrates are then used for getting energy through the process of respiration and for growth because these sugars will then be distributed to the various parts of the plant which would allow it to grow to a greater height or may be taken its stem.

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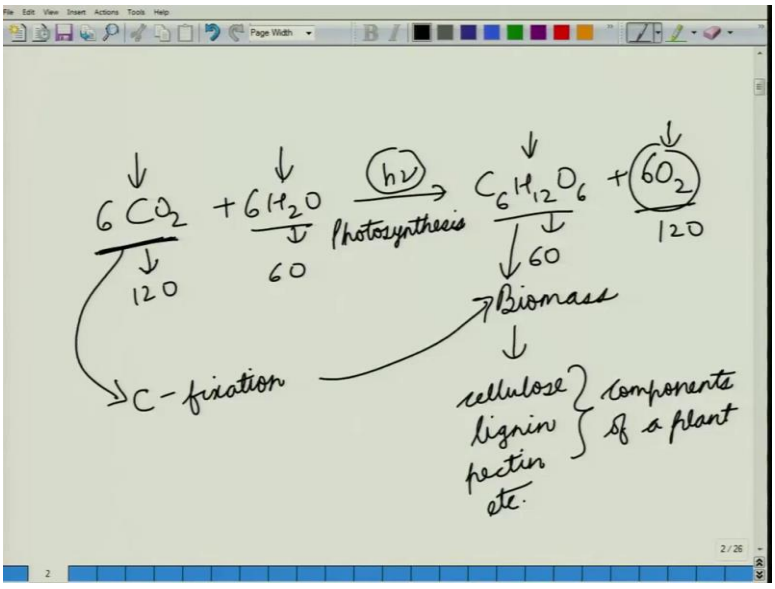

A very simple reaction of photosynthesis could be carbon dioxide which is taken from the air plus water that is taken from the ground through using the sunlight and through the process of photosynthesis, it gets converted into sugar. For instance, glucose plus oxygen has given out.

Now, if you balance this equation, it is C6. So, we have 6 CO2 H2 F. So, 6H 2O here we have 12 oxygens, here we have 6 oxygens, here we have 6 oxygen. So, here we need to have 12 oxygens. So, it will give you 6O2, that is 6 moles of carbon dioxide plus 6 moles of water. Utilising the sunlight and through the process of photosynthesis will make 1 mole of glucose and will give out 6 moles of oxygen which is why trees are able to to take carbon dioxide from the atmosphere and release oxygen

Now, taking this carbon dioxide is also important in the case of carbon fixation. So, carbon fixation is in which this carbon dioxide from the atmosphere is fixed into biomass. So, for instance this sugar is a biomass. It might later be polymerized or maybe converted into other biomass. For instance, it can make cellulose, it can make lignin, it can make pectin and a number of other components of the plant cell, components of a plant and a number of other such molecules.

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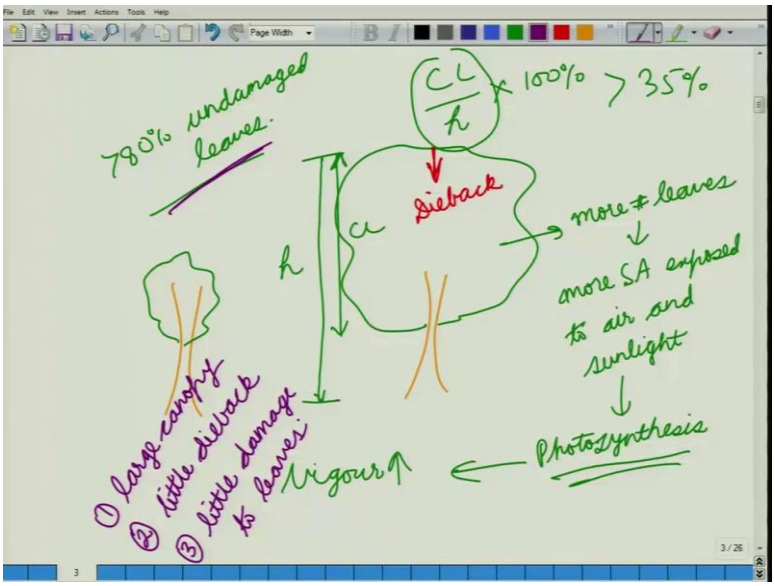

Now, when we talk about vigour, we have seen that if we have a plant that has a small crown and if we compare it with another plant maybe of the same size, but with a much bigger crown, so in this case this will be able to because it has more number of leaves or

more surface area exposed to air and sunlight. So, the amount of photosynthesis because remember that in the process of photosynthesis, you need carbon dioxide from the air. So, you need lots of areas that are exposed and you require sunlight which also means that you should have more and more area exposed to the sunlight. So, it will have more photosynthesis. So, this will give you a greater vigour.

Now, coming back to the slide; so the vigour class, the purpose of this classification is to distinguish between excellent saplings with superior crowns and stressed individuals with poor crowns.

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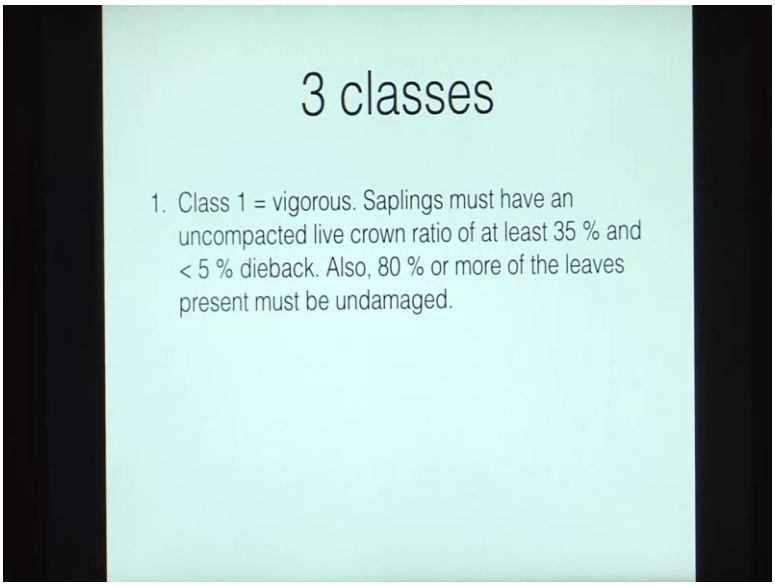

So, we divide the sapling into three classes. The first class is called the vigorous class. Here the saplings must have an uncompacted live crown ratio of at least 35 percent and less than 5 percent dieback. Also 80 percent or more of the leaves present must be undamaged.

So, now we can see here that it is vigorous when the uncompacted live crown ratio is at least 35 percent which means now coming back to the tablet, it means that if we have this as the total length and if we take the crown length and take the ratio crown length upon or may be let us call it the height of the tree, then it will have crown length by H into 100 percent. That should be greater than 35 percent. In the case of class I saplings also, it should have less than 5 percent dieback.

Now, dieback is a condition in which the leaves of the plant or the plant itself start to die from the top of its canopy towards its base. So, it is dying in a backward direction which is why it is called a dieback. It should have less than 5 percent. Also 80 percent or more of the leaves present must be undamaged. So, we have greater than 80 percent undamaged leaves.

Now, what does this tell us? One, by using this live crown ratio, we can say that it has a large canopy. So, we have a large canopy plus two, the canopy is not suffering in a dieback. So, there is little dieback. So, these canopies are healthy plus even the tree, even the leaves that are there are healthy. So, we have little damage to leaves. So, it is a large canopy, it is a healthy canopy and even the leaves are healthy.

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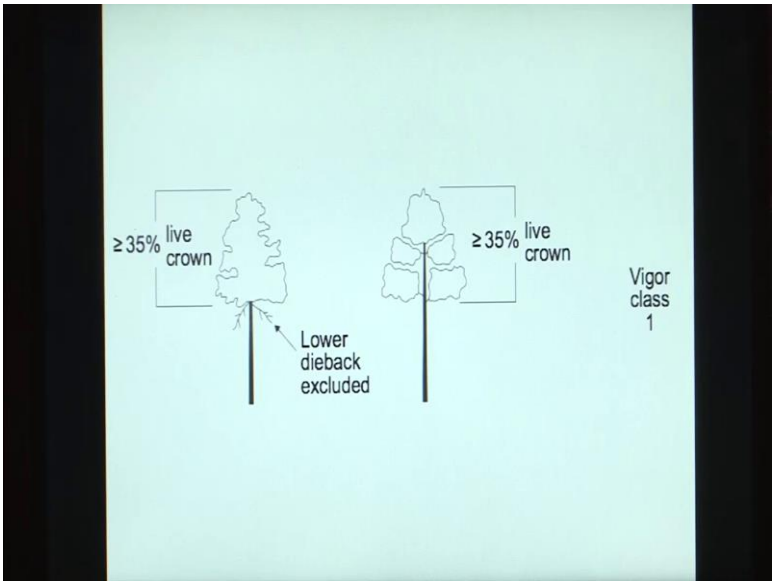

So, we look back at the slides. So, here we are seeing saplings of vigour class I. So, we can see that the live crown is greater than or equal to 35 percent of the length and in a dieback. So, in this case we do not include any lower diebacks, but we include diebacks that are there in the crown.

The second class is the class III. Now, we have skipped class II. We will come to class II in a short while. So, the second class that will consider is class with poor vigour, so in the case of poor vigour less than 20 percent of the leaves are undamaged or to put it in other words, for class III, we have greater than 80 percent leaves that are damaged.

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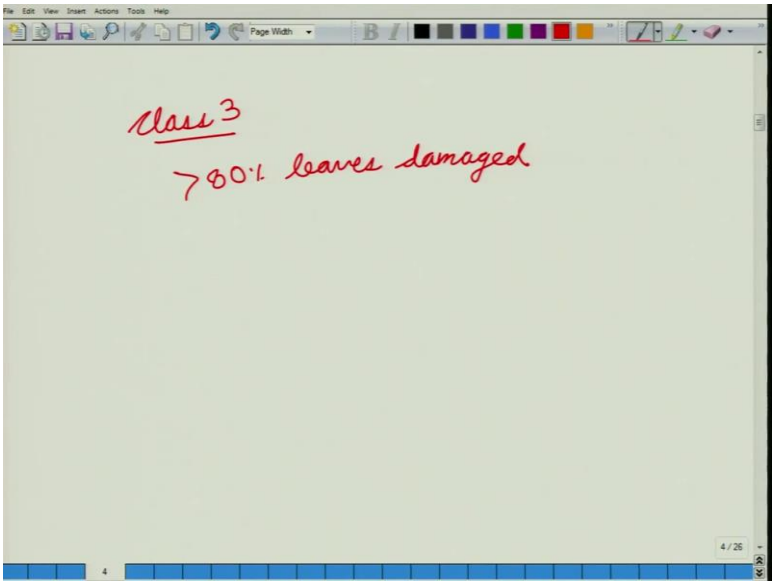

Now if the leaves are damaged, then this plant will not be able to perform photosynthesis properly; so if we look at figures now, so coming back to the slides.

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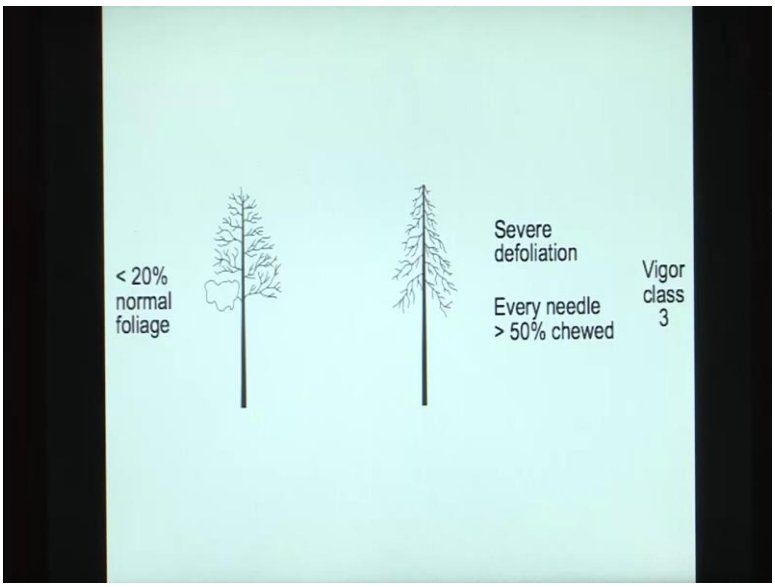

So, here we are seeing less than 20 percent normal foliage or maybe the sapling has a severe defoliation or maybe every needle on or greater than 50 percent of the needles are chewed. So, this will be called a vigour class III. So, this could be because this plant has not received proper nutrients or maybe this plant has not received proper amount of sunlight or maybe it was infested by some fest or insects or maybe it was damaged by

some diseases. So, in all these cases, it would have lost its vigour. So, this sapling will not be able to grow properly when we planted into the field.

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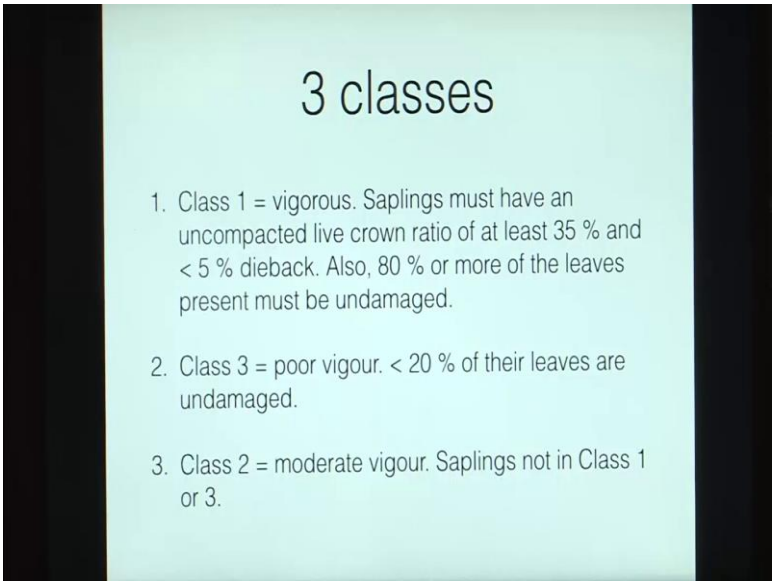

Now, the third class as we can see on the slides, now is the class II that we had left before. This is the moderate vigour class. So, any sapling that are not in class I or class III are put in to class II. Why is that so? Because it is easier to distinguish class I saplings in class III samplings. So, anything that does not form class I or class III gets into class II. So, here we have some examples of class II.

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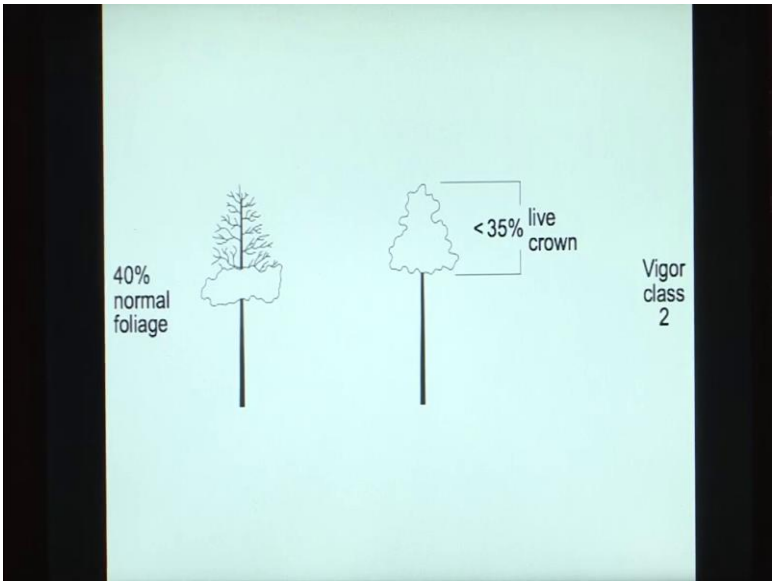

In this case, we have suppose 40 percent normal foliage. Now, in the case of class I, we would have, so coming back to our class I, we would have had this crown length upon height is greater than 35 percent. Now, coming back to the figure; so here we are saying that 40 percent of the foliage is normal and with 35 percent live less than 35 percent crown length, so we either have less than 80 percent undamaged leaves. So, in the case of class I, we had greater than 80 percent undamaged leaves.

So, in the case of the first plant, here we have just 40 percent normal foliage. So, it will not come under class I. Similarly, in the case of the second figure, it has less than 35 percent live crown. So, that is why it is not part of class I. However, it is also not part of class III because in the case of class III, we would have had greater than 80 percent of the leaves that are damaged, but here we have 40 percent normal foliage in the case of the first one. In the case of the second one, we have all the normal foliage, but just because its live height ratio is less than 34 percent, it is not forming part of class I or class III which is why these are class II.

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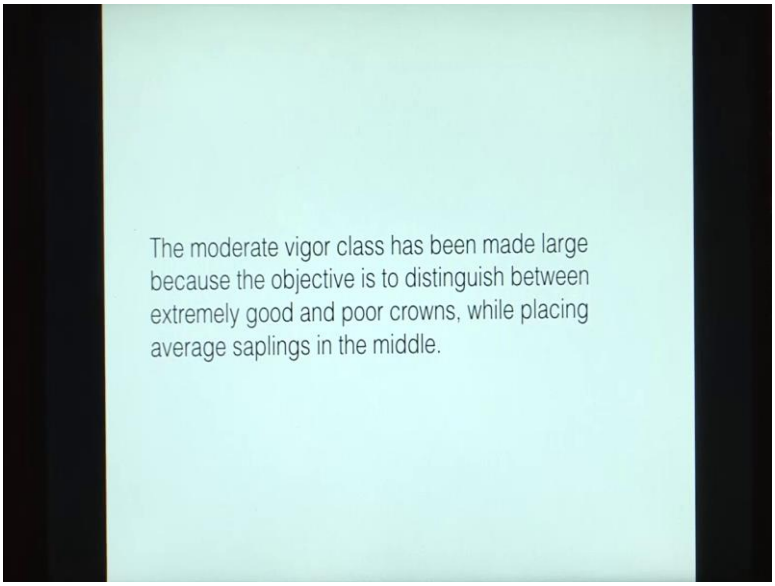

Now, the moderate vigour class has been made large because the objectives to distinguish between extremely good and poor crowns. So, in the case of poor crowns, we are not going to plant them in the field. In the case of extremely good crowns, they will be the first options when we want to plant these saplings into the field and anything that

is not extremely good that is class I and are not extremely poor that is class III comes in the middle.

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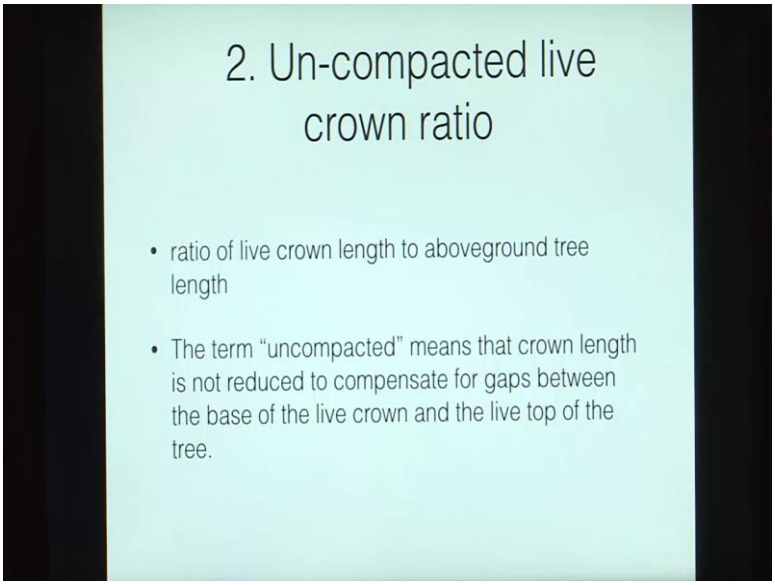

Now, the next thing that we can measure is called the uncompacted live crown ratio. So, it is the ratio of live crown to above ground tree length which is what we had calculated earlier. Now, why is it called uncompacted? The term uncompacted means that the crown length is not reduced to compensate for gaps between the base of the live crown and the live top of the tree.

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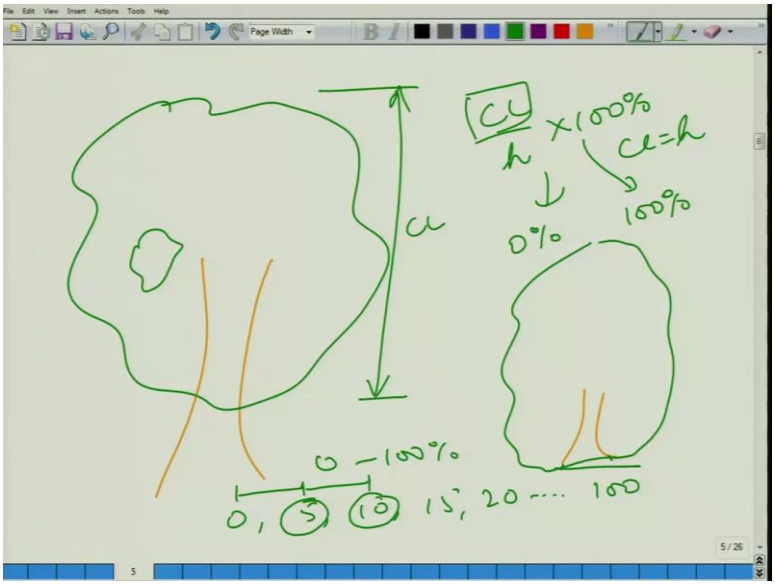

So, essentially if we have a tree and maybe we do not have anything here. So, this is a gap, but we are not going to subtract it from this length from the canopy length which is why it is called the uncompacted live ratio. Now, coming back to the slides, how is it measured? The uncompacted live crown ratio is recorded in 5 percent classes and coded as 0 5 10 15 so on up till 100. So, because this is a ratio of crown length upon height into 100 percent, so if there is no crown, it will be 0 percent. If you have say a theoretical condition where you have a tree and you have a crown that completely covers it, so essentially this crown cannot go breath the ground level.

So, in this case you will have the crown length is equal to height which will give a ratio of 100 percent. So, this ratio can vary from 0 to 100 percent and we divide it into classes which are 0 5 10 15 20 up till 100 percent. So, when we write it as classes, we do not write this percentage here, but anything that forms between 1 to 5 percent. So, anything that comes here between 1 to 5 percent will be called a class 0 5. Anything that comes from here till here will be called class 10 and so on.

So, how do we measure this ratio?

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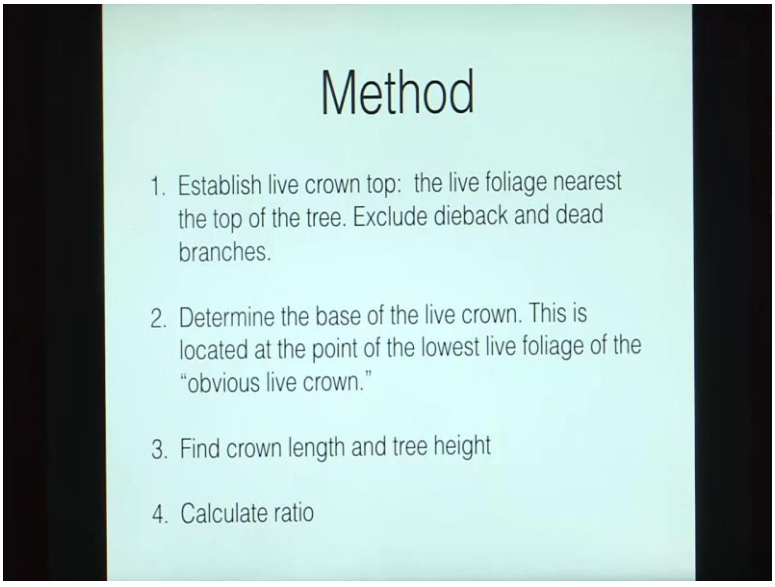

First of all, we establish the live crown top which is the live foliage nearest to the top of the tree and here we do not include any dieback or dead branches. So, the first thing that we need to figure out is in the case of a tree which is the live crown top which is the position that will call the top.

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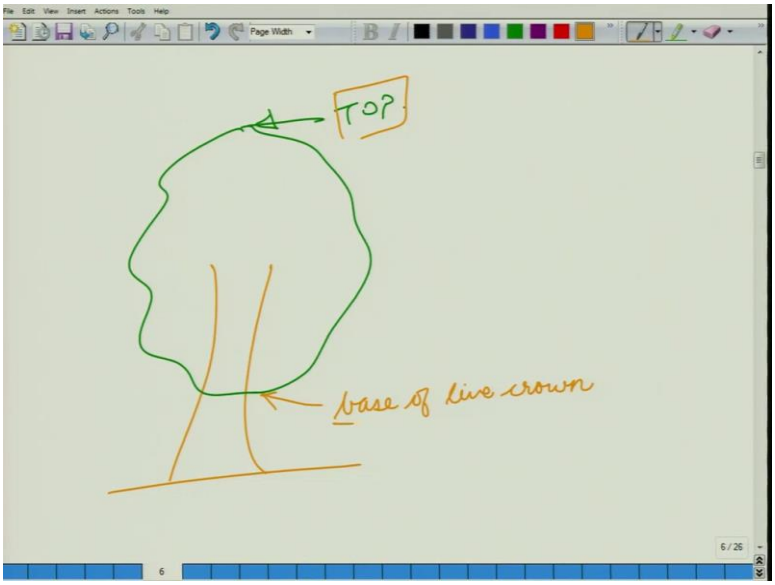

Next coming back to the slides, the next step determines the base of the live crown. Now, base of the live crown is located at the point of the lowest live foliage of the obvious live crown. So, coming back to the tablet, now this point will be called the base of live crown. So, we need to figure out where is the top and where is the base.

Next we need to find out the crown length and the tree height. Now, we have already dealt with tree height and crown length is this distance. So, this is the crown length and then, we can calculate the ratio. So, let us now look at some figures on how we do that.

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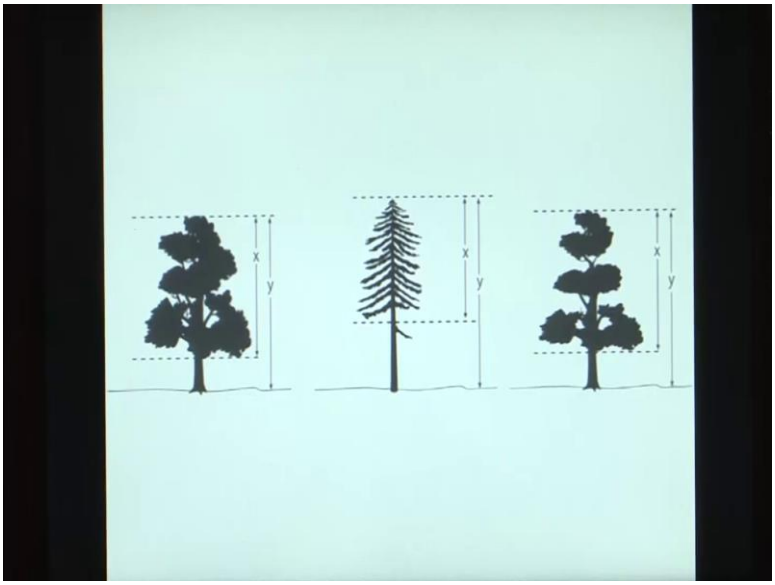

So, in the first case here we have the top of the crown, this one is the base of the crown and this is the ground level. So, this is the crown length, this is the total height of the tree and this ratio x by y will give us the live crown ratio.

Now, in the case of the second figure, we have removed this branch. So, this is removed by making use of 5 feet rule. So, in the case of 5 feet rule if there is any branch that is beneath 5 feet of your main crown, then you will call it as another crown. So, in this case also, we can figure out x y and then, calculate x by y.

In this case, we have a crown that is divided into three parts, but because these are less than 5 feet, then we would call it one crown. So, here also we can find out x and y. Here in the top, we can see that these branches do not have any leaves. So, these are not live branches which are why when we are trying to figure out this top, it is the top of the highest live branch.

Similarly, in this figure we will remove this portion, but in both these situations, in the case of this tree height, these live branches on the top are also considered. Now, the third figure is obvious.

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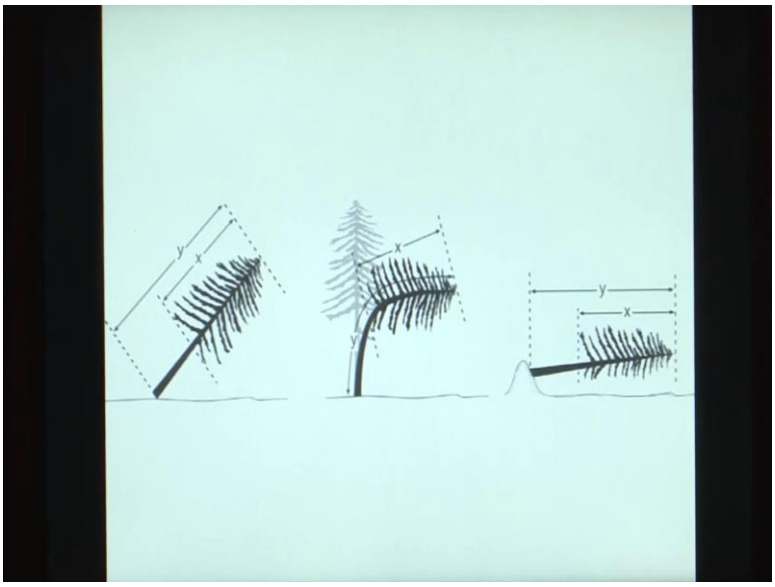

Now, what do we do in the case of trees that are bent? Here also the height and this length of your crown is measured parallel to the stem axis. So, here your height of this tree or the stem length to use a more technical term, this is why here you have x which is

the length of the crown. Similarly, here this stem length and this one is the length of the crown and by getting this ratio of x by y, we can calculate the live height ratio.

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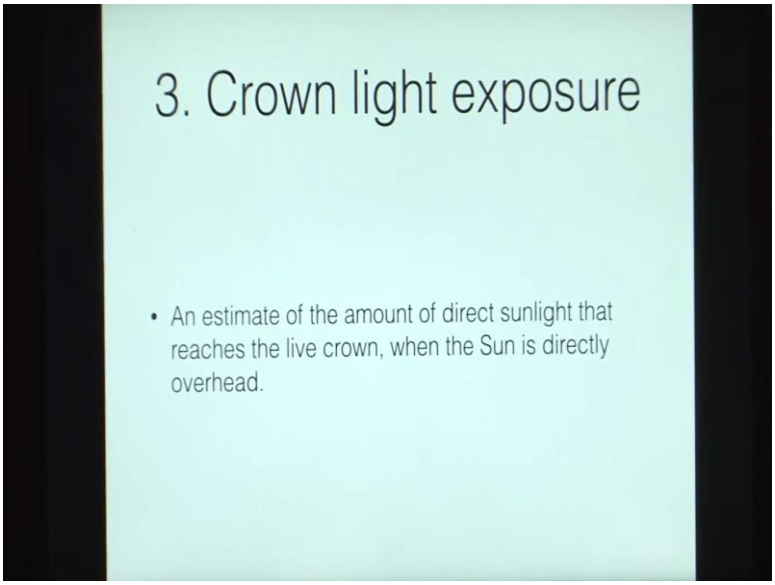

The next thing is crown light exposure. Crown light exposure is an estimate of the amount of direct sunlight that reaches the live crown when the sun is directly overhead. So, what do you mean by this?

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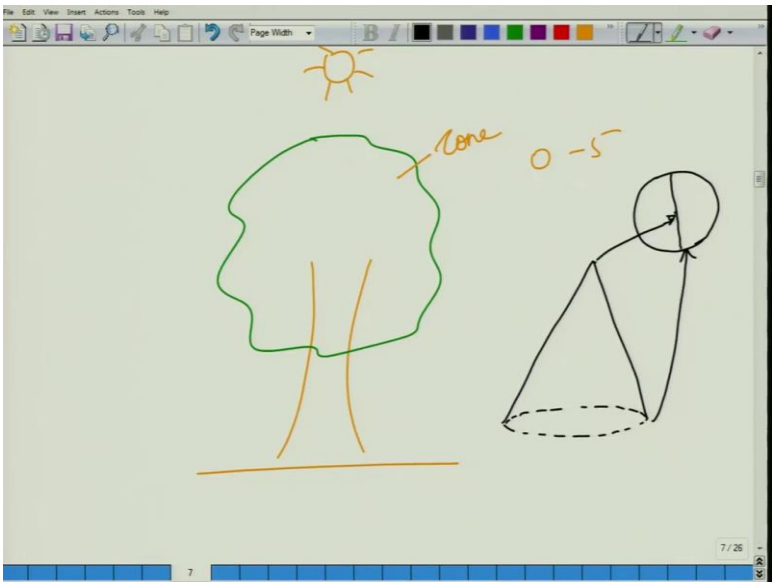

So, let us consider a tree. So, when the sun is completely overhead, at that point how much amount of direct sunlight reaches the live crown is the crown light exposure measure rating units of 0 to 5. So, how do we measure it?

We consider this crown as a cone. So, if you draw a cone, we consider the crown to be a cone in this part and we divide it into five parts. So, if we took a top view, it would look like this. So, this is the vertex and this is the base. So, now we divide it into five parts. So, these are the four parts and the fifth part is this vertex.

So, now coming back to the slides.

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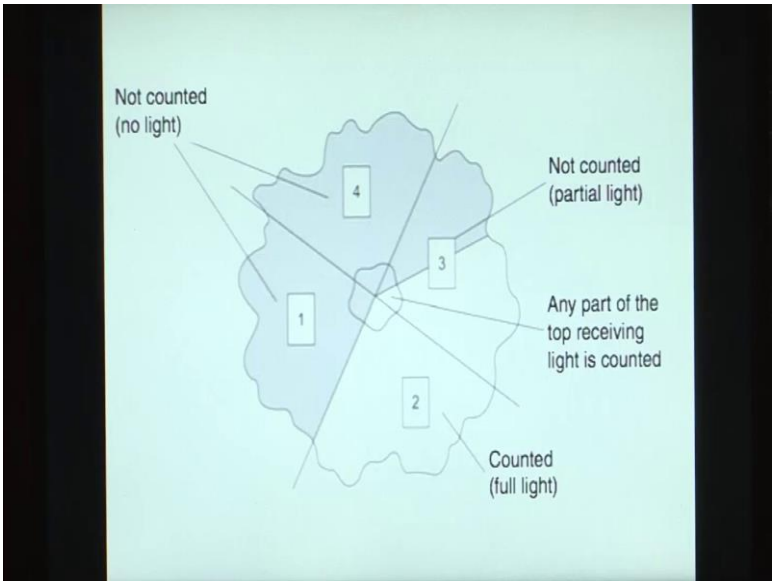

So, here when this tree, when the sun is overhead, we have divided it into five parts; 1 2 3 4 and this is the fifth part. Now, any portion that does not receive light is not counted. So, like 1 and 4 here are not counted. 2 is counted because it is receiving full light.

In the case of 3, now consider this portion from here to here. So, in this portion, it is not receiving light completely. So, when the sun is overhead, this portion that is shown in the darker colour is receiving a shadow and this portion of section 3 is receiving light. So, if it is not receiving light completely, it will not be counted, but in the case of this top portion if it is receiving any amount of light, it will be counted. So, this top portion will be counted in this case because it is receiving the light in this part and this part.

So, here we can say that out of the 5 parts, part 2 is receiving light and the top part is receiving light. So, only two parts are receiving light. So, in this case, its value will be 0 to 5. It will be a value of 2. So, what is the use of this crown light exposure?

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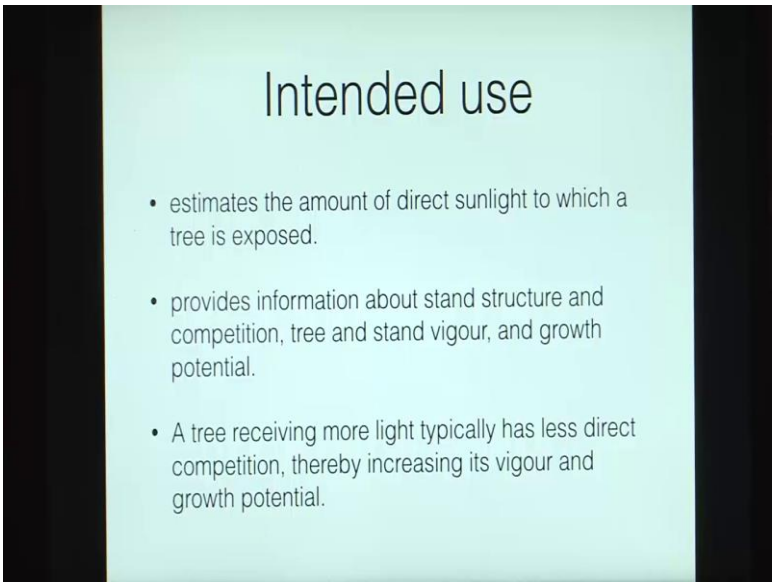

The intended use is that it estimates the amount of direct sunlight to which a tree is exposed. It provides information about the stand structure in competition tree and stand vigour and growth potential. Why is that so? It is because let us consider a stand in which your tress are far apart.

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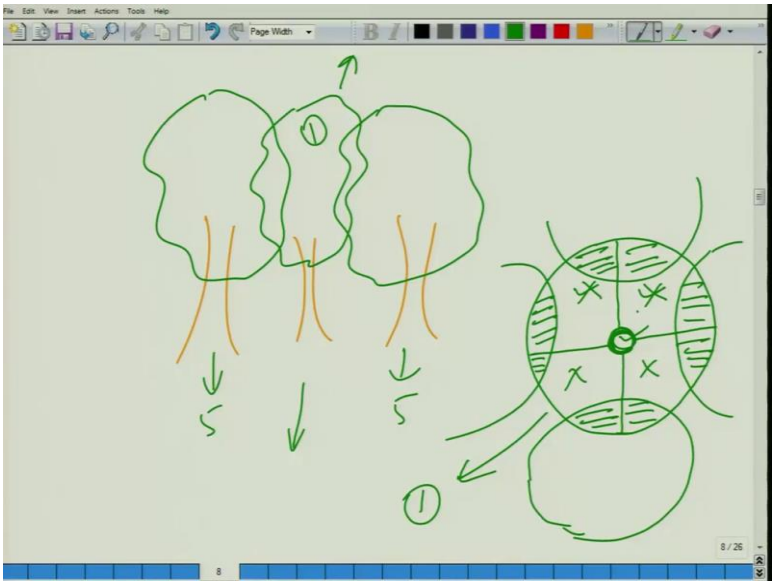

So, in this case the first tree will be having a value of 5, the second tree will also be having a value of 5 whereas, if you now include a few other trees in between, so suppose your stand is very dense. So, it grows like this and similarly on this part and on this part also, we are having trees.

So, what would happen if you look at the top view of this tree? It would look something like this. So, this is the canopy and it is covered on the right, it is covered on the left, it is covered on the top and it is covered on the bottom by the other canopies. So, what would be this crown light ratio for this? Tree will be divided into four parts and the fifth part is the top portion.

So, now is this part receiving light completely? No, because this part is shaded, this part is shaded, this one also. Similarly, this one is also not counted and this one is also not counted. Only this part will be counted. So, this is not receiving complete light; only this portion is receiving complete light. So, in this case, the ratio will be 1.

So, if you have a lower ratio, then your stand is more dense. There is a lot of competition and the growth of these trees and the growth of the stand will suffer in this case. Now, coming back to the slide, a tree receiving more light typically has less direct competition thereby increasing its vigour and growth potential. So, that is obvious.

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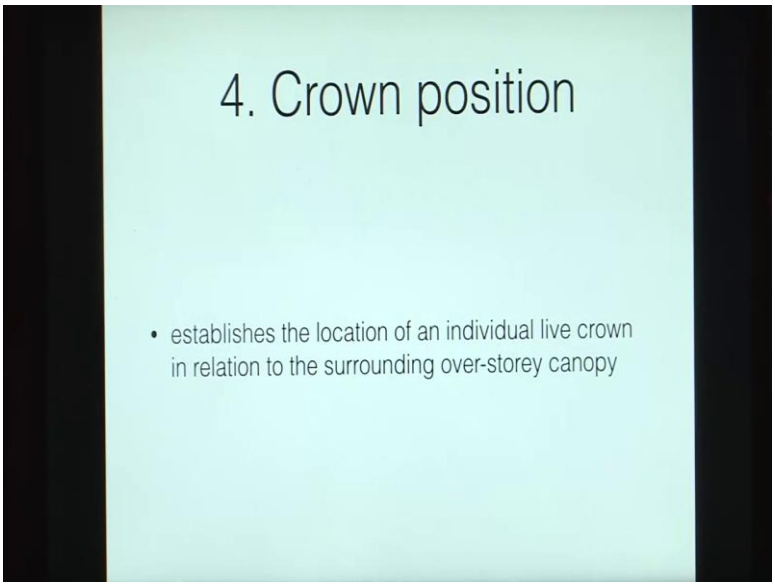

So, the next thing we can figure out is the crown position. Crown position establishes the location of an individual live crown in relation to its surrounding over story canopy. So, you want to establish the location of an individual live crown for every tree, you can figure out a crown position in relation to its surroundings over storey canopy.

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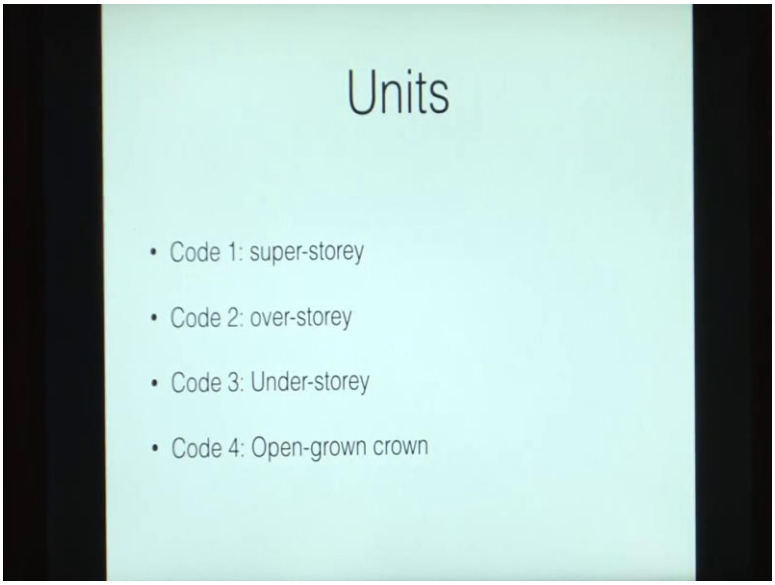

Here we divide it into four codes. So, code 1 is called super storey, code 2 is over storey, code 3 is under storey and code 4 is an open grown crown. So, how do we figure out this crown position?

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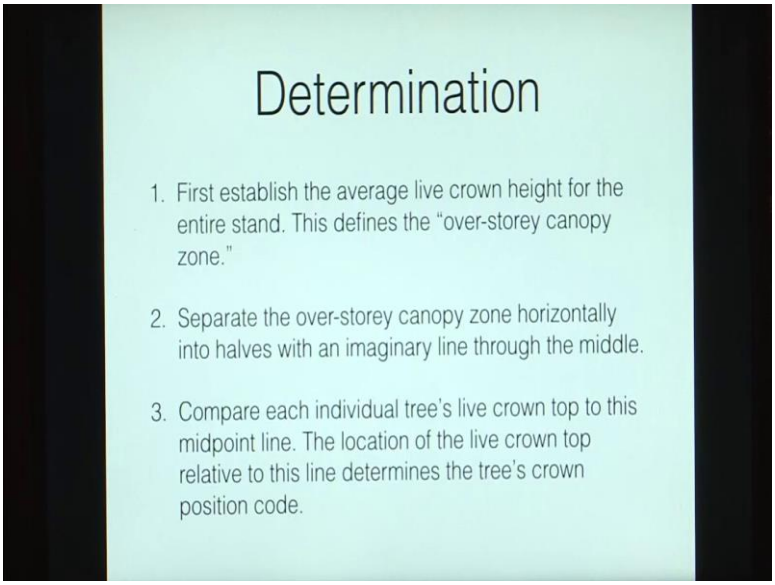

First of all, we establish the average live crown height for the entire stand which defines the over storey canopy zone.

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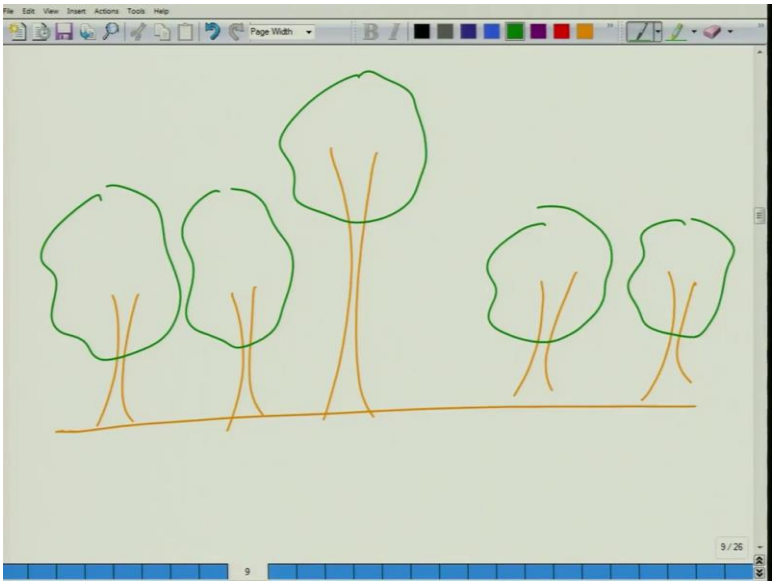

So, for instance if you had a tree here, maybe a tree here, another tree here, another tree here and maybe another tree here. So, all these trees are having different heights and their crowns are also at different heights. So, the first thing is to establish the average live crown height. So, what is the average height that you will figure out?

Step 2 in the slides shows that we separate the over storey canopy zone horizontally into halves with an imaginary line going through the middle. So, the average will be divided into two parts to halves. Next we compare each individual trees crown, live crown top to its midpoint line and the location of the live crown top related to this line determines the trees crown position code.

So, now we have two lines. One is the average line, one is the 50 percent of the average line and we are going to compare all the live crown tops with these two lines.

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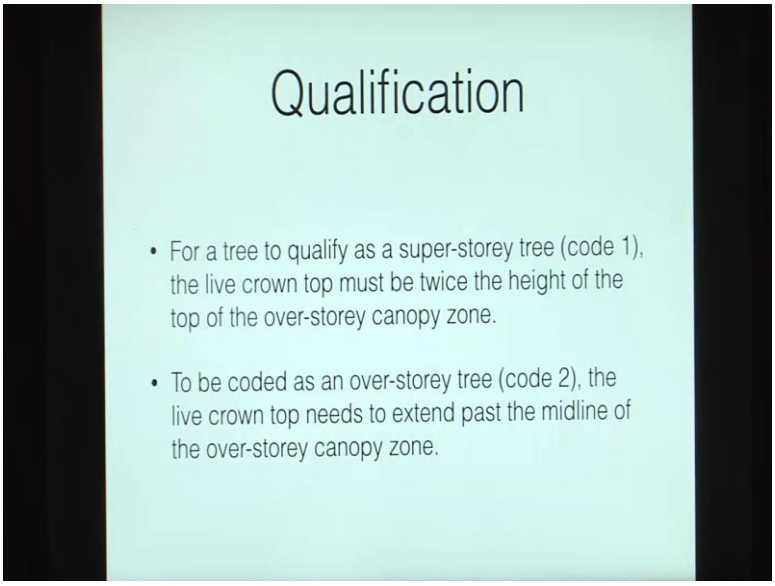

When do we call it a code 1? For a tree to qualify as a super storey tree or code 1, the live crown top must be twice the height of the top of the over storey canopy zone.

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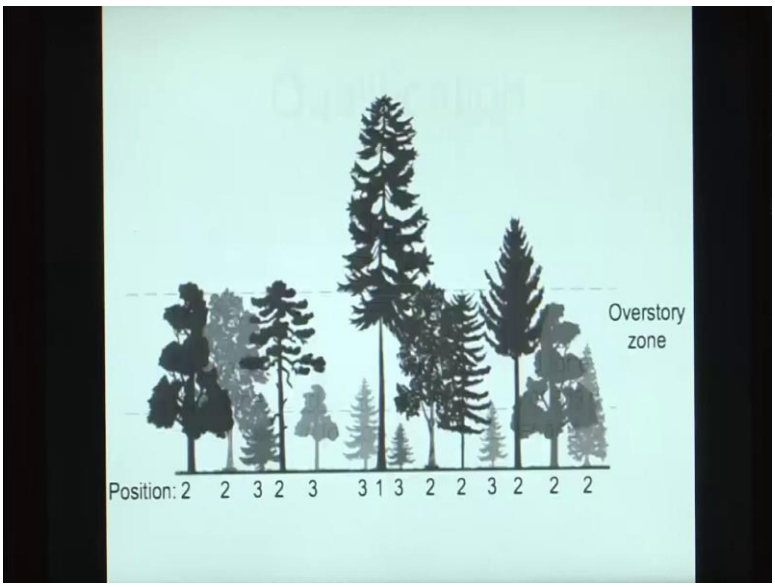

So, to show it in a figure, in this case we have calculated the average line. So, these are all different trees and this is the over storey zone that we have calculated by taking the average heights. Then, we have also figured out this line which is 50 percent line.

So, now this large tree with the code of 1 is given this code because its top of the crown is twice this height of the over storey zone. Then, we will call it a tree of code 1. The live

crown top must be twice the height of the top of the over storey canopy zone to be coded as an over storey tree or code to the live crown top needs to extend past the midline of the over storey canopy zone, that is if we have this 50 percent line from here till here, any tree that crosses this portion completely will be called a class 2 tree. These trees are class 2 trees.

In under storey crown or code three will have its top at or below the midline of the over storey canopy zone. So, the top is going to be at the midline or below the midline then we will call it a a code three tree or an under storey crown the open canopy code or code four is used for every tree in the stand wherein over storey zone is not discernible due to lack of canopy cover and competition.

So, for instance here we only we have trees 1 2 and 3. Here we have trees of position of code for as well because in this case, this canopy does not cover the whole bare ground which is why it is difficult to find out an average canopy height. So, this average over canopy zone because these trees are not facing any competition whatsoever, we will call them as open canopy trees or code 4 trees. So, by this we can figure out the canopy position.

Thank you for your attention. [FL].