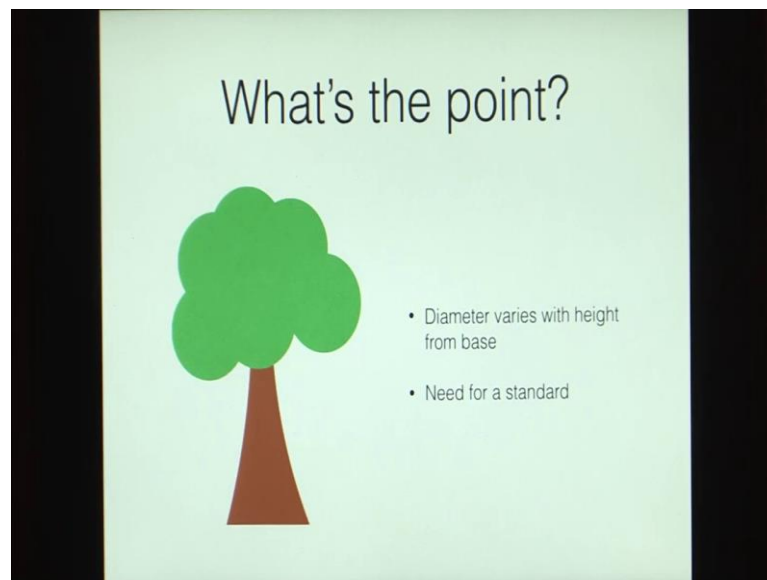


Forest Biometry
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Lecture – 12
Where to measure the diameter?

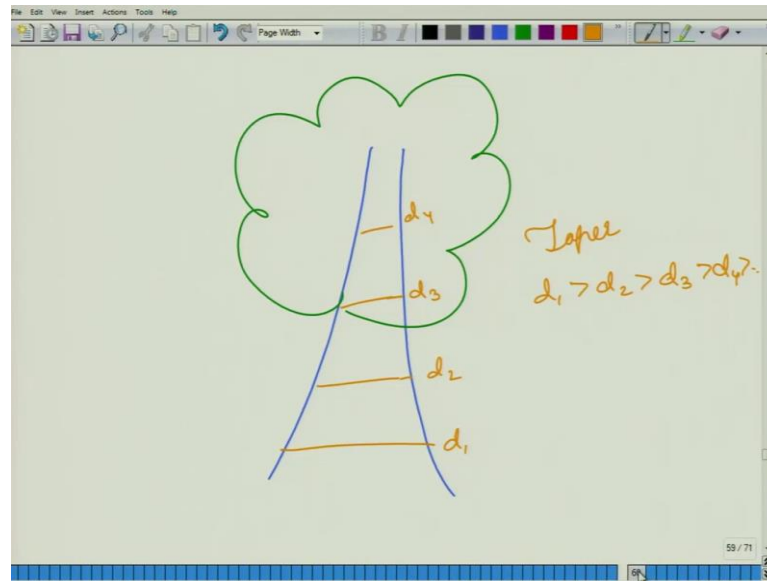
[FL]. In this week we are looking at the measurements of tree diameters. In the last class, we looked at the cross-section of a tree and we looked at its bark. How do we calculate the thickness of a bark, how do we calculate the bark volume and the bark percentage?

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In this class we shall look at how to measure the diameter. So, what is the point? Well we know that diameter varies with height from the base.

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So, we know that our trees have a taper. So, if we measure the diameter at this location say d_1 , at this location d_2 , this location d_3 and so on, we would have that d_1 is greater than d_2 is greater than d_3 is greater than d_4 is greater than so on and this is because of the taper of the tree.

So, if we know that our trees taper, we need to find out a standard at which we are going to measure the diameter, so that the diameter that you measure and the diameter that I measure for the same tree should remain the same. So, what is that standard? That standard is called dbh or diameter at breast height.

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Artificial form-factor

$dbh = 49 \text{ cm}$

$H = 29 \text{ m}$

$V = 3.26 \text{ cum.}$

$AFF = \frac{\text{vol. tree}}{\text{vol. cyl}} = \frac{3.26 \text{ cum.}}{5.47 \text{ cum.}} = 0.60$

$V_{\text{cyl}} = \frac{\pi}{4} (d^2) h = \frac{\pi}{4} \times (0.49)^2 \times 29 = 5.47 \text{ cum.}$

$f = 0.60$

The diagram shows a tree with a green outline. A blue cylinder is drawn around the lower part of the tree, representing the bole. The diameter of the cylinder is labeled ϕ (dbh) and the height is labeled h .

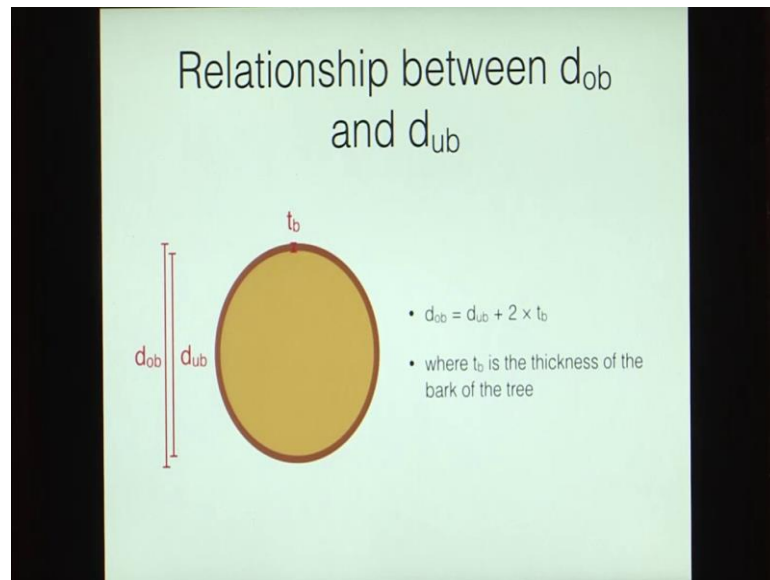
So, diameter at breast height means that if we had a tree and if a person stood in front of the tree, it would be a diameter that is very close to the height of his or hers chest, so that the measurement of the diameter is easy.

So, this dbh is chosen for ease of measurement. However, even if we choose this dbh, its meaning would be different in different countries. So, for instance db edges 1.3 meters or 1.37 meters or 1.2 meters depending on which country you are in. For instance, Japan and Korea take the value of 1.2 meters; our country takes the value of 1.37 meters as the breast height. Most of the countries in the world take the measure of 1.3 meters and us still using the fps system. It takes 4.5 feet as dbh.

Now, the International Union of Forestry Research Organizations or IUFRO, International Union of Forestry Research Organizations, it recommends that we use the term d in pace of dbh. However, in our force will be using d or dbh interchangeably because it means the same thing.

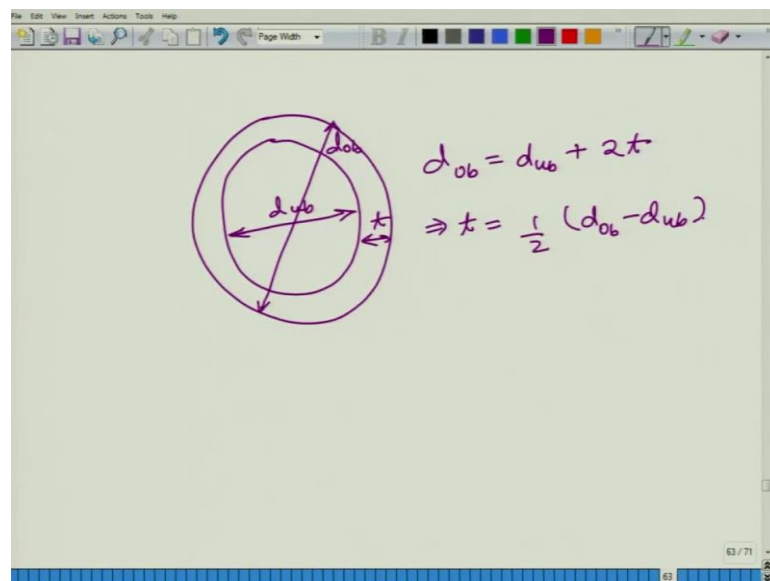
When we use this term d , we define two things i.e. d_{ob} and d_{ub} . As we saw in the previous slide, this is the diameter over bark and this is the diameter under bark. So, not only do we need to tell at what height are we measuring our dbh, we also need to tell whether we are measuring the d_{ob} or the d_{ub} .

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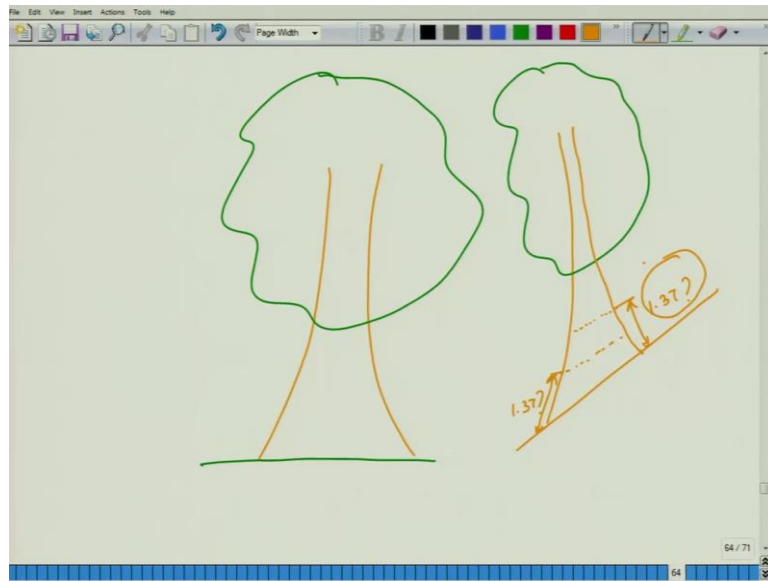
So, as we saw in the previous lectures, d_{ub} and d_{ob} are related.

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So, if your d_{ub} and this is your d_{ob} and this is your bark thickness t ; then the relationship is d_{ob} is equal to d_{ub} plus twice the thickness or the bark thickness is half of d_{ob} minus d_{ub} .

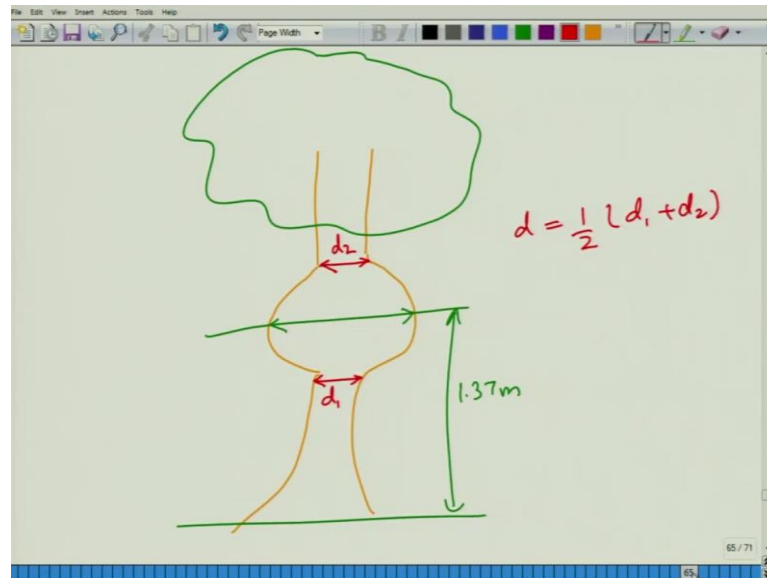
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So, now we can say that for any tree we are going to measure its diameter at the breast height, but what would you do if this tree was standing on a sloping ground. So, this is for a straight ground. Suppose this tree were standing on a sloping ground like this. These were your tree. Now, how do you calculate your 1.37 meters? Is it these 1.37 meters or is it these 1.37 meters because if you measure it at this point, you would have a greater diameter and at this point, you would be having a lesser diameter. Now, to solve such problems, we have some formal rules.

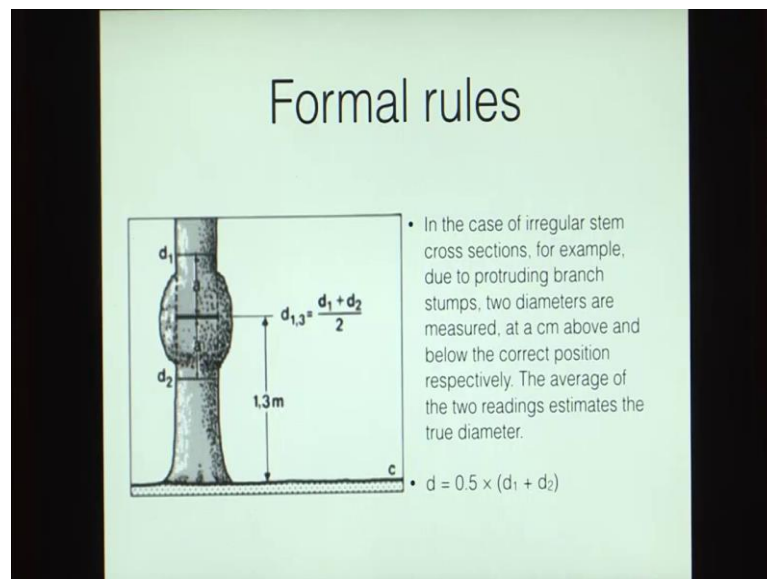
So, in the case of slope we would only be taking the upper slope diameters. So, you would be measuring it here similarly, if your tree had a bulge in between.

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Now, this bulge could be an irregular stem cross-section.

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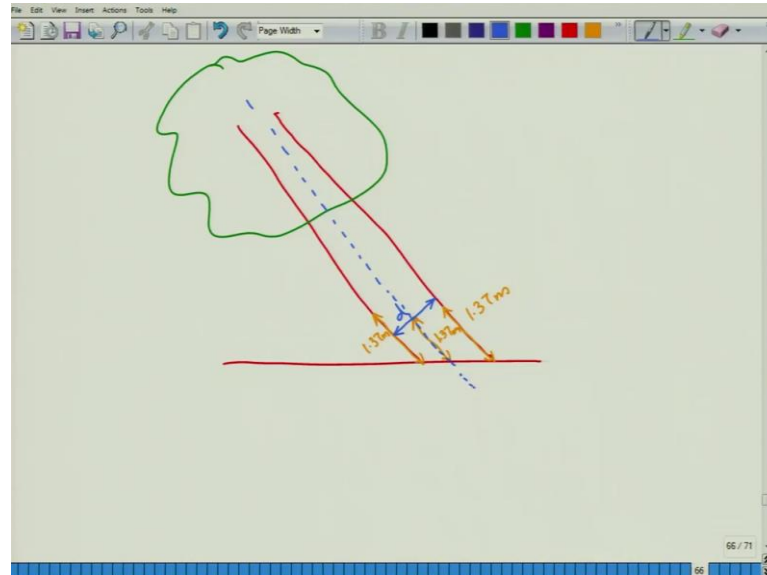


You could be having a branch that is protruding or you could be having a bulge that is caused by some insects. So, in such cases, suppose your 1.37 meters comes here, now this would not be your representative diameter at breast height. So, what would you do? You would measure a diameter right below your bulge and you would measure a diameter right above your bulge. So, suppose this one was your d_1 , this one was your d_2

2. So, you would write d is equal to the average of d_1 and d_2 . So, it becomes the most representative diameter at breast height.

Now, if you had a tree that was sloping.

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Suppose you ground it straight, but your tree is sloping, so how do you measure your dbh? Do you measure it from this point? So, is it this 1.37 meters or is it this 1.37 meters? What is a central portion of 1.37 meters? So, here the rule state that you take measurements at the right angle to the tree axis.

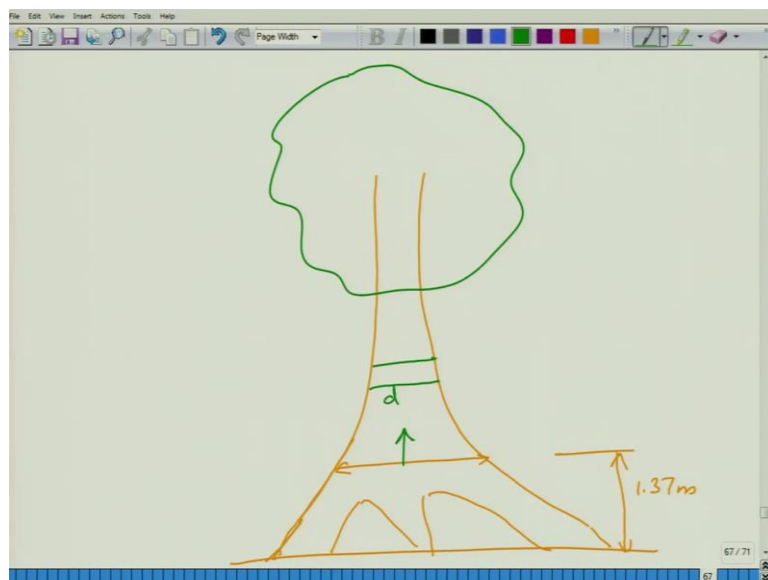
So, in this case our tree axis is this. So, we need to take measurements at right angle to this. So, we take 1.37 meters here and we take the right angle and this becomes our dbh or small d .

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So, if you can look at the slide here, we are seeing a tree that is sloping on a flat ground. So, this is what we were referring to. Now, suppose your tree had a big buttress. Now, what is a buttress?

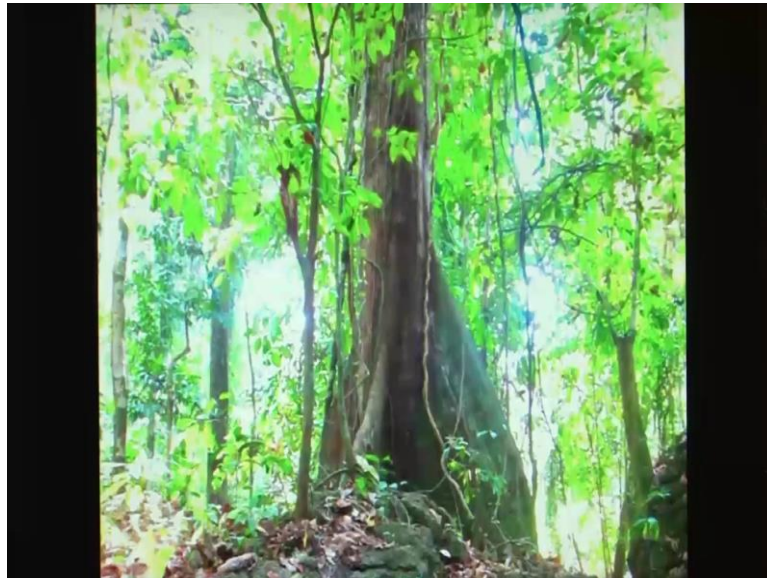
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A buttress means that in some areas you have the roots that are extremely protruding. So, this is your ground level and here you have very thick roots. So, because these roots are extremely protruding, this diameter, it becomes very large. So, suppose this was your 1.37 meters. So, in the case of a buttress, how do you measure it?

So, here the rules state that if you have a tree with a buttress, you take your dbh at some point above the buttress at which the diameters have become nearly equal. So, where you are, your buttress is gone. So, here you will measure your diameter at this point.

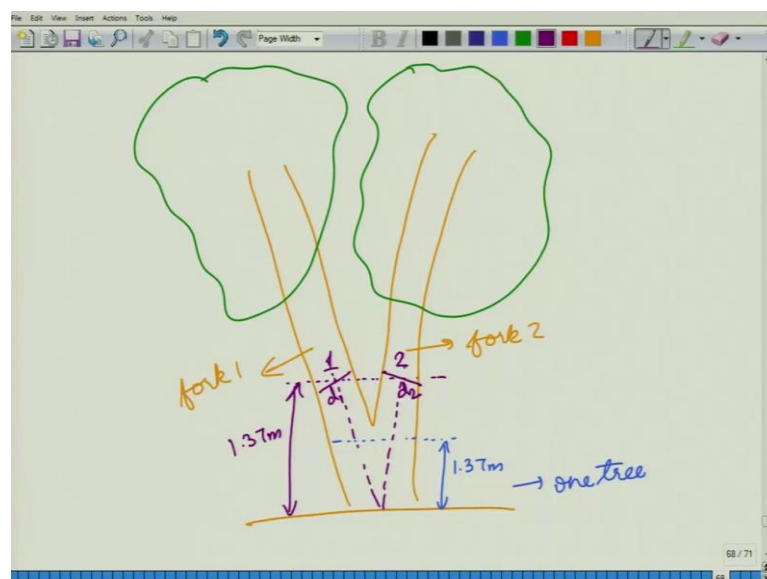
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So, here in this slide, we can see a tree with a huge buttress. It was found in Andamans. So, now you understand what our buttress is. So, here this buttress is giving it support.

Now, another rule tells us what to do in the case of forking.

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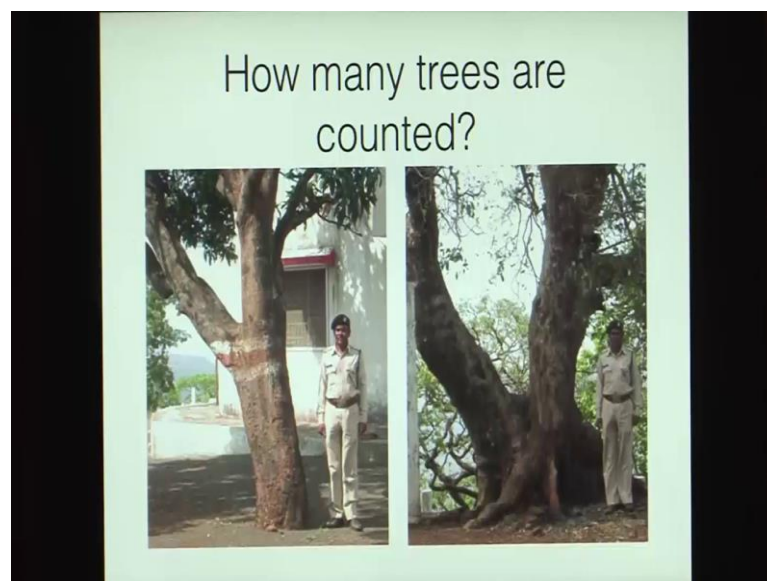


So, as we saw in a previous slide, forking means that if you have a tree and its main stem bifurcated into two parts to give you these two forks. So, this is your fork 1 and this is your fork 2. So, in this case how do we measure the dbh. So, the rules state that suppose in the first situation, this forking occurred above your 1.37 meters. So, suppose this one, this was your 1.37 meters and the forking has occurred about this point. So, in this case you will consider this as one tree and you will measure dbh at this point, but suppose your 1.37 meters came at this site.

Suppose this is 1.37 meters. So, in this case, we will consider both these trees as two different trees. So, this is your first tree and this is your second tree. You would not consider this as 1 tree and now you will measure your dbh perpendicular to the tree axis. So, this would be your dbh for the first tree and this would be your dbh for this secondary tree. So, this is d_1 and d_2 .

So, now let us look at some examples on these slides.

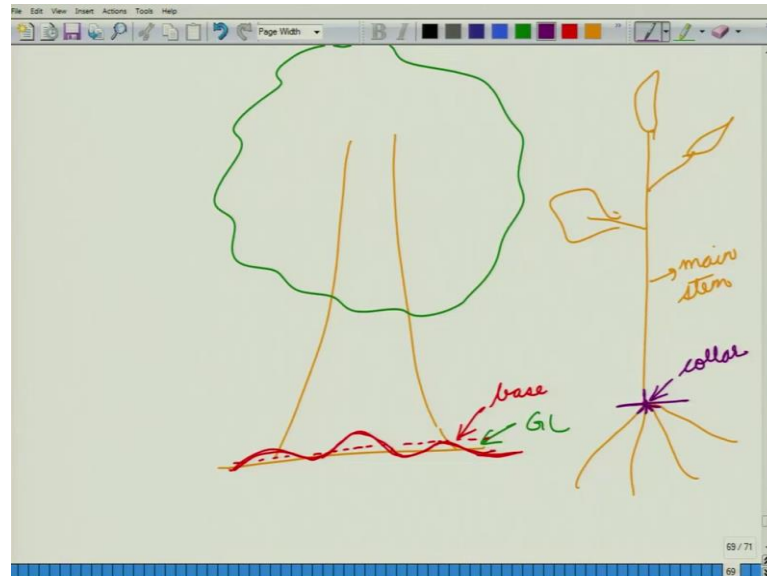
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Here you are seeing a forest guard standing right next to a tree. On the left side, you can see that the forking has occurred above the breast height. So, the breast height could be taken as the chest height of the forest guard. So, as you can see though the forking has occurred above the breast height, so in this case we will consider this tree as one tree. In the right picture, we can see that the forking has occurred below the breast height. So, in

this case will consider it as two different trees however, the next question is where do we have the base.

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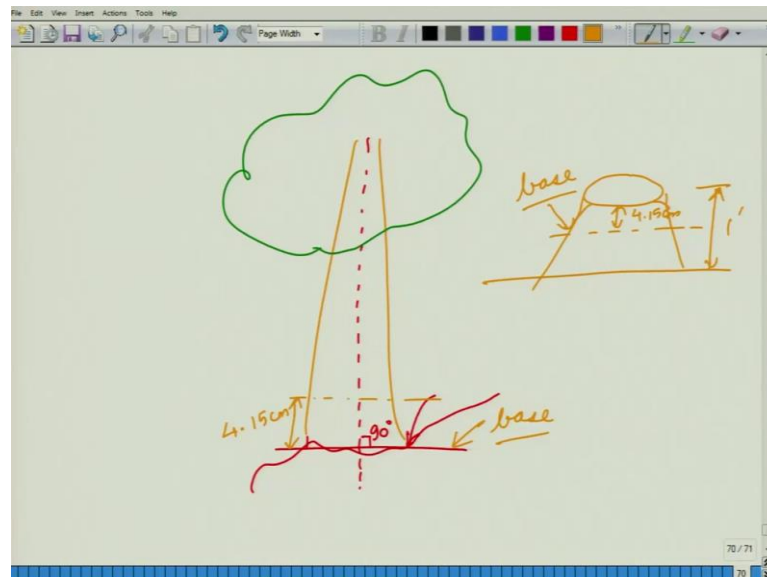
So, when we draw a tree, we take a base. So, in this case we are taking a base. Now, we take this base as the ground level. However, can we uniquely define this base? What if this base was not a straight line, but it was something like this then what would be the base.

Now, here the rules are a bit ambiguous. We do not have a proper definition of the base. The base could be an average derived from measurements at different points around the tree. So, basically if you took this, if you measured these heights for your base, you could draw an average. So, the average would be somewhere here in which case you will take that as the base, otherwise what you could do is, you could use the route collar. Now, what is the route collar?

So, if we drew any stem. So, here you have a main stem, you have branches and leafs and then, you have the roots. Now, this point where the root system and the shoot system meet together is called the collar. So, we could even disregard the ground level and we could take this collar as the base. So, that is the second definition of base. The base of the tree is synonymous with its root collar.

So, we can figure out the root collar because the cross-sections of the stem are very different from the cross-sections of the root. So, they are completely different issues. So, it is easy to identify the collar. We could take that collar as the base or we could take the measuring position on the uphill side. So, that is we had this free.

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Suppose the ground level was something like this. So, we could take on the uphill side, the measuring position. So, this could be taken as the base. We could then draw an axis or the tree and then, draw a line that is perpendicular to the axis and going through this point. So, this is 90 degrees and we could define this to be the base. So, that is another definition of base or otherwise when you chop a tree, you could take up any position that is 4.15 centimeters below your stump as the base.

So, suppose you have a stump that is left. So, a stump is generally 1 foot or 1 foot, but then we do some stump dressings. So, we could take any point that is 4.15 centimeters below the top of the stump and we could define that as the base. So, that is another definition of base. So, as we can see there are different definitions of base and base is something that has not been uniquely defined by IUFRO.

So, there is one point where we could have some ambiguity, but in any case in the case of forestry are measurements considering one tree that is say around 20 meters or 30 meters in height. A small difference in the calculation of the base is not going to bring

about a substantial difference in our computed values which is why this definition of base has not been gone into very great depth, but the other rules are quite clear.

Thank you for your attention. [FL].