Forests and Their Management
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Module – 09
Logging and Yield
Lecture – 25
Logging and Processing

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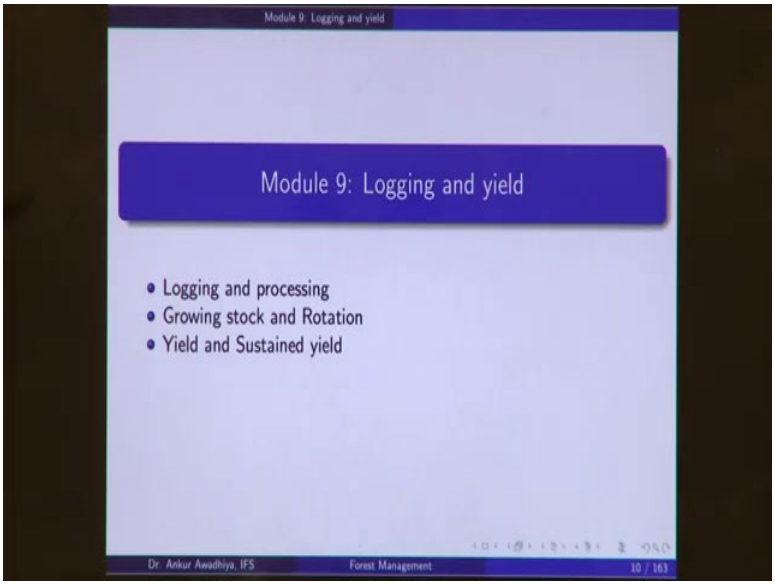

[FL]. Today we begin a new module which is Logging and yield. This module we will have 3 lectures, the first one is Logging and Processing, followed by growth stock and rotation, followed by yield and sustained yield.

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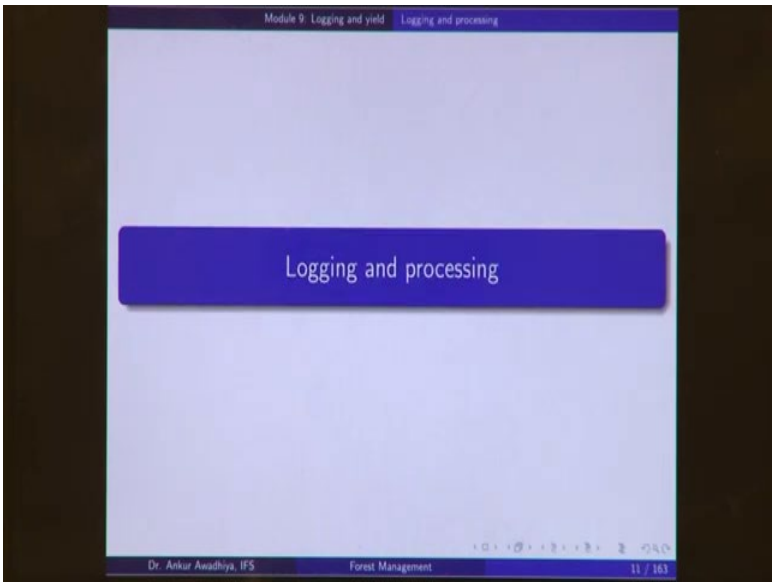

So, we begin with logging and processing. Now, we have seen in the previous modules that, in the case of forest management, we need to regenerate the stand. And, when we say regeneration, we also fell some trees that are there on the stand to make way for the new growth of the young plants. Now, when you have decided following any Silvicultural management prescription that certain number of trees are to be removed from the forest or from a stand how do you remove them? What is the procedure?

What are the things that you need to be careful about when you are removing these plants is what we are going to see in this lecture.

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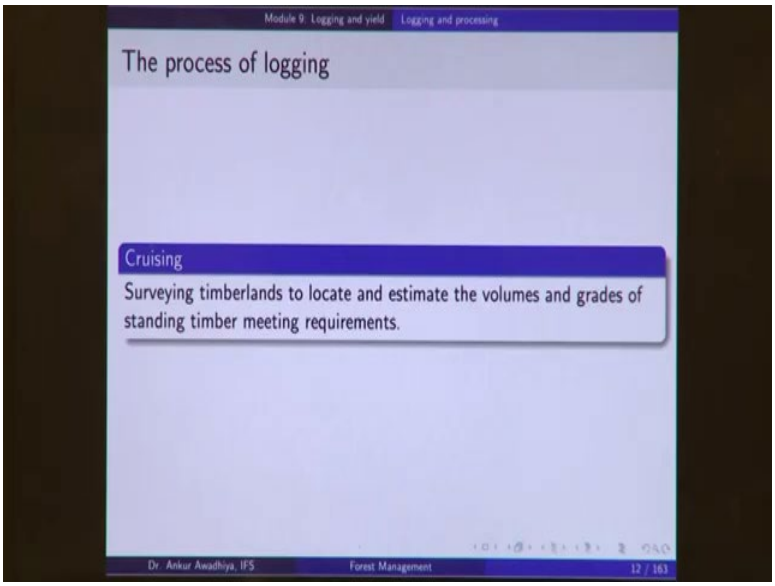

Now, the process of logging begins with a stage that is known as cruising. Now, cruising is a stage in which the forester surveys the timberlands. So, this is essentially a process of surveying to locate and estimate the volumes and grades of standing timber meeting the requirements. Now what does that mean? We have seen in one of the earlier lectures that when you are when you want to remove certain trees, the first thing the first trees that we remove are the dead, dying and diseased trees.

But then the question is, where are those trees?

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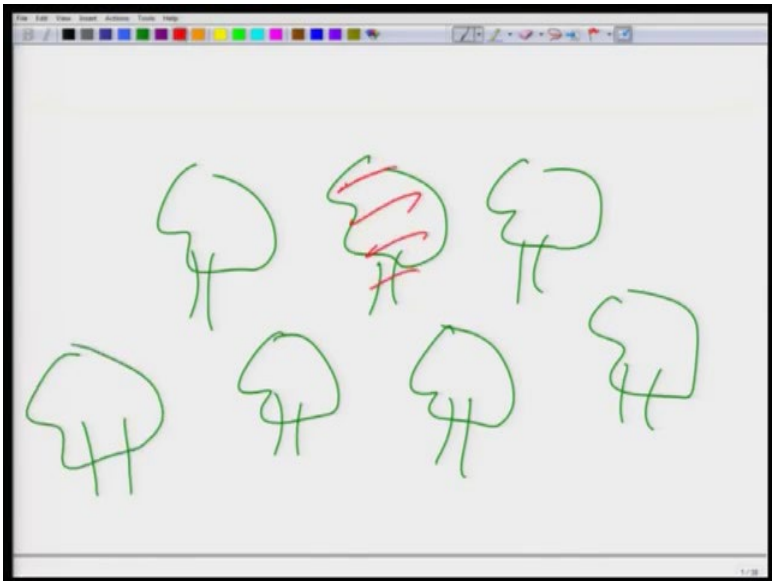

Because, if we consider a forest; so, if this is a forest, then all the dead, dying, diseased trees will not be at the same location.

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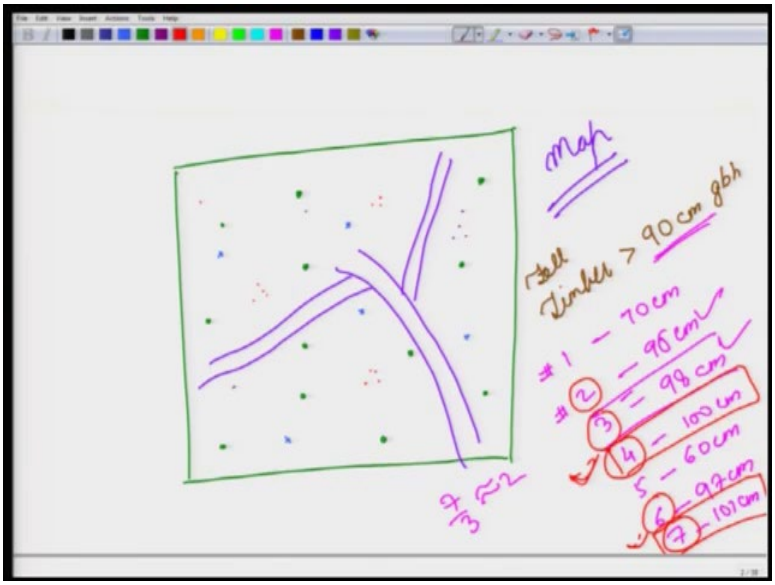

Probably, this tree is a diseased tree. But then, if we look at a complete stand probably, you will have a diseased tree here, a few here, a few here, probably a few here, then a few dead trees in this location, a few here and there, and a few dying trees that are spread here. Now the question is, this is a stand in which you are having these dead, dying and diseased trees. Now, your forester needs to know where exactly each of these trees are located, so that he when these trees have to be removed, the forester can go to that location or a contractor can go to that location and fell these trees. So, the first stage is surveying. So, you survey for the different kinds of trees. Next, you also do a surveying of which are the trees that are silviculturally available to be removed, which means that we should be having certain trees that are past the their felling age.

So, they are large sized trees; they have sufficient diameter; they have sufficient girth; and so now, these trees have to be felled. Now when you want to do felling, then invariably, you will want to remove these trees or these timber. Now when you have to remove this timber, you need to make a plan. So, the plan would be, for instance, where should you make the roads for your vehicles to get inside? How many vehicles do you need? How many workers do you need? And, how are you going to arrange for these logistics?

Because, in the case of any forest, we prefer not to perform any of these felling operations in the rainy season. Because, if there is a rainy season, then probably the roads will not be in a serviceable condition, and the vehicles when they are when you are trying to get the vehicles into the forest, they might get stuck, because of which the whole the whole operation would stall.

Now, if you want to remove this timber before the onset of the monsoons, then you need to make a very detailed preparation about on what day, which vehicle and how many laborers would be at which location? So, for that, you need to have a map that is showing you the locations of different trees that have to be felled and also the volumes of those different trees that have to be felled.

Because suppose there is suppose you have vehicles that can only carry say 20 cubic meters of timber; now, if there is a location that is having say 25 cubic meters of timber, then probably you will have to plan your routes in such a manner that your trucks are able to move out with a full load.

So, you need to create this map. So, the first process in logging is cruising, in which the foresters service the timberlands to locate and estimate the volumes and grades of standing timber. Grades of standing timber meaning whether it is with it whether this is a class 1 or a grade 1 timber, grade 2 timber, grade 3 timber and so on.

Why? Because, if you are having a location where you are having grade 1 timber and you are felling that timber, then probably it is much more economical to harvest that timber even at the cost of certain other timbers; probably having a larger volume, because this is a more expensive timber.

So, the forester is surveying to estimate the volume and the grades of standing timber which meet your requirements. Now, once this cruising has been done, the forester will come out with a map. So, this is a map that has been created and this map is now telling you that apart from these trees that are dead, dying and diseased trees, there are these trees that are large in size that have to be felled.

So, suppose, this is a map that the forester has come up with. Now, this map or this information needs to be translated back to the field because your forester has done this or this paperwork he has identified, which trees have to be felled. But now he or she needs

to go back to the forest and paint those trees in different colors, so that the contractor who will go later on to cut these trees, knows that these are the trees that need to be felled.

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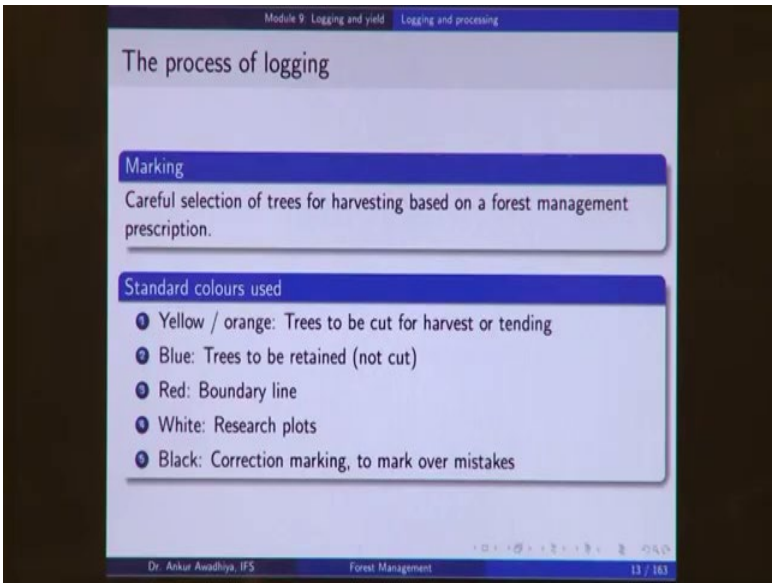

So, this is in the next process which is known as marking. Marking is the careful selection of trees for harvesting based on a forest management prescription. So, this is a selection of trees. Now how do we do this selection? So, in the first stage, when the forester went into the forest, he or she made a list of what all species are there, in which locations, what is their height, what is their girth.

And suppose, you have decided that you are going to fell all timber. So, you fell timber that is greater than say 90 centimeter girth at breast height. Now, when you are making a list of different trees, so suppose you have tree number 1, which is having say 70 centimeter girth; tree number 2 which is having say 95 centimeter girth; tree number 3 which is having 98 centimeters; tree number 4 which is having 100 centimeters; tree number 5 which is having 60 centimeters; tree number 6 which is having 97 centimeters, and say tree number 7 which is having 101 centimeter.

Now suppose, your forest felling prescription has come out in such a manner that you have to remove one-third of the trees. So out of every 3 trees, you are going to remove 1 tree. So, in this case, because you have these 7 trees, probably you will remove 7 by 3 which is a approximately 2 trees.

So, you are, in this case, you want to remove 2 trees. Now when you are removing 2 trees, which are having the girth of more than 90 centimeters, then you could say go for the first 2 trees; these 2. So, this one is having 95 centimeter; this one is having 98 centimeter. But then, when you are doing these operations, then probably it will make much more sense, if for instance in place of going with these 2 trees, you went with this tree and this tree because these are meeting all your prescriptions; but at the same time, these are the more larger size trees.

So, in that case, you will be able to extract much more volume of timber. So, if that needs to be done, then this is a process of the selection of the trees. So, even though you were having so many different trees; so, tree 2 could be selected, 3 could be selected, 4 could be selected, 6 could be selected, 7 could be selected. So, you had all these different trees, but out of these 5 trees, you only selected these 2 trees which were number 4 and number 7.

Now, when you do this and when you translate this information to the ground, then this is marking. So, this is careful selection of trees for harvesting based on a forest management prescription. So, in at all times, you are ensuring that the forest management prescriptions are being followed. So, you are only removing one-third of the trees, but while following the management prescriptions; you are also removing those trees that are much more profitable.

Now, when this information has to be put back to the ground, we typically make use of colored rings. So, these are the standard colors that are used. So, if there is a tree that has been colored with a yellow or orange colored strip; so, what is this color? What are we talking about?

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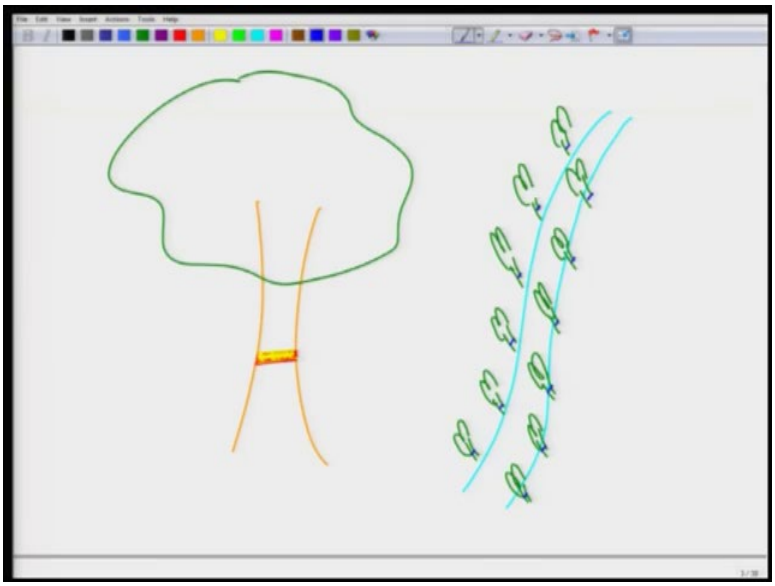

So, here you have a tree. So, when we say that this tree will be marked it means that we will remove certain amount of bark from this area and we will paint a strip all around this tree. So, this is a red colored marking and this red colored marking would tell us that this is a boundary tree.

If suppose, in place of a red colored marking, we went with a yellow colored marking, it would give a signal to the contractor that this is a tree that has to be felled. So, these are the strips that we put around these trees by using paint and all of these different colors will give different meanings. So, a yellow or orange color marking will tell the contractor that this is a tree that has to be cut or for harvesting or for tending operation.

If it is a blue colored strip, it means that this is a tree that is not to be cut. This is a tree that needs to be retained and typically these are trees that are on the banks of rivers. So, if this is a river, and these are the trees on the bank of the river, what will happen if we do a felling in this area? Well, if we do a felling, then probably there will be much more amount of soil erosion; the banks will get eroded and the river will change its course.

So, in that situation, what we do is that we paint these trees with a blue colored paint and this will tell the contractor that this is a tree that is not to be felled. Now, typically there are also certain other trees. So, suppose there was there is a tree that was say, planted by some emperor, or say some viceroy, and you need to you need to preserve this tree for

say, cultural reasons or for historical reasons. In that cases, were you will paint this tree with a blue colored ring.

So, a blue color will tell the contractor that this is a tree that needs to be retained and not to be cut a red tree is a boundary line tree.

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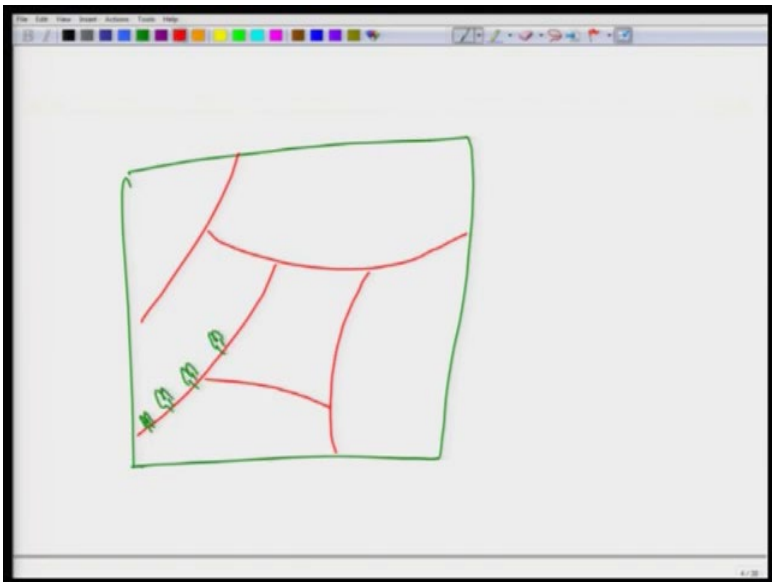

What that means is, suppose this is your forest and this forest is divided into different compartments; so, the trees that are falling on these boundaries will be given a red colored band. So that people know that this is a boundary. A white colored line will tell that this is a tree that belongs to a research plot. So, this is not for silvicultural purposes, this is just for research purposes. So, nothing needs to be done in this area.

A black colored marking is a correction marking, it is to mark over mistakes. So, suppose there was a tree that had to be reserved; so, you have to paint it with blue color but for some reason in place of blue, you painted it with an orange color. So, an orange color would tell that this tree should be cut, but then you realize your mistake. So, what will you do? You will go back to that area and paint it and over; paint it with a black colored strip. So, a black color will tell you that will tell the contractor that there was a mistake that was done and the other color is the correct color.

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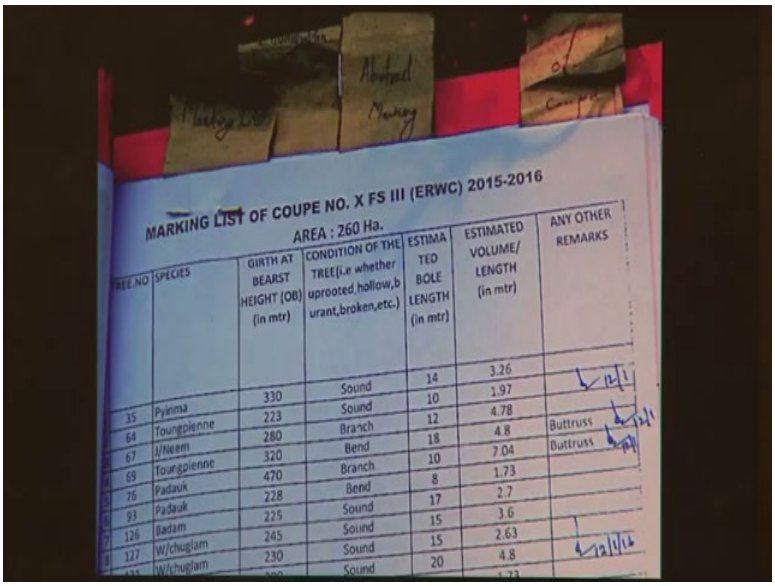

Now, this marking is done with the use of a marking register. Now, this is an example of a marking register. If we look at it in more detail, this says marking list of coupe number X FS III ERWC 2015-16. The area is 260 hectares, and here you see that you have a tree number. So, all the trees in your stand are numbered and for each tree, you have the name of the species; you have the girth at breast height; you have the condition of the tree whether it is uprooted, hollow, burant, broken, etcetera.

Then, you have the estimated pool length that you will get when you cut this tree, estimated volume or length and any other remarks. So, for instance, this tree this padauk tree is having a buttruss.

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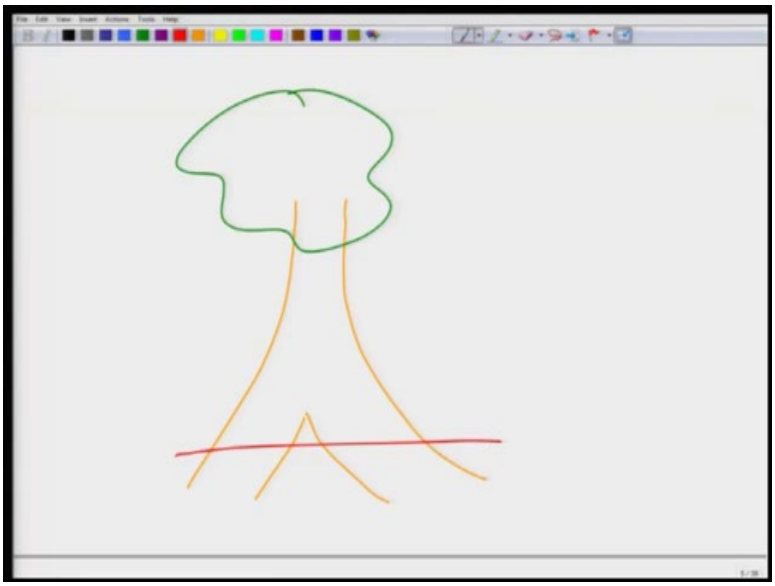

Now, a buttruss means that your tree is like this. So, this is your tree, but then it has roots that are coming out and they are supporting the weight of this tree, but then, in this case, it will be difficult to fell this tree at say the breast height. So, these are the remarks that we also put into the marking register.

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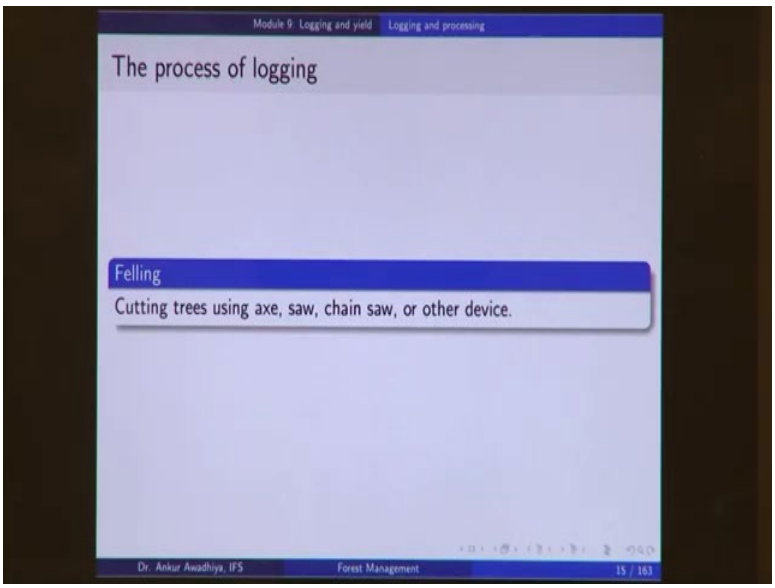

Now once you have marked your trees the next operation is felling. Now felling is cutting trees using axe, saw, chainsaw or other device. So felling is the actual process in which you are cutting or harvesting the trees.

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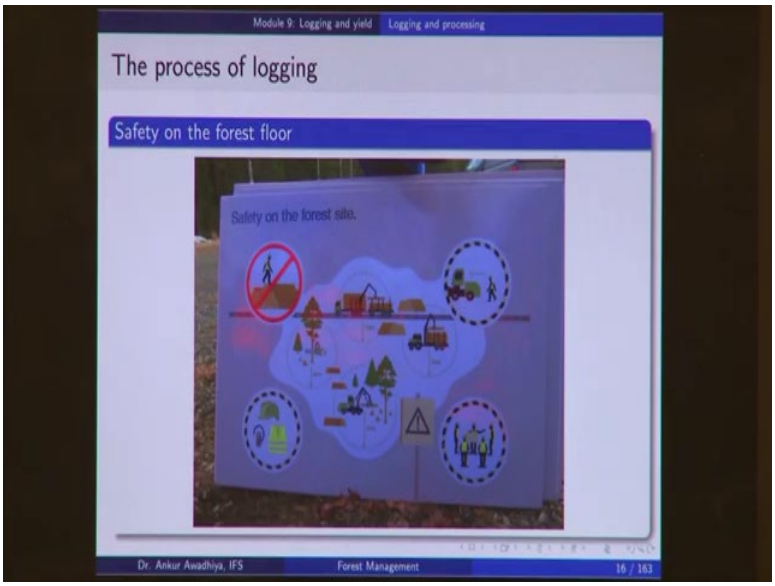

Now, whenever we are doing felling, the foremost thing - the most important thing - is safety on the forest floor, because a tree is a very tall organism; now so and, forestry happens to be one of the very accident-prone professions. So, if you have a tree, and you are felling it, then if you are not careful, this tree may fall over the person. And, if that happens, it may result in say an injury or even death.

So, whenever you are whenever any forestry operation is being done, the foremost thing to be kept in mind is safety on the forest floor. Now, what kinds of safety operations we need to be aware of?

One, if there is a stack of timber, people should not walk over this stack. Because timber is typically a cylindrical object and if you try to walk over it, there is a good chance that it will roll and you topple down. I mean it's just common sense, but you need to be aware of it. If there is any machine that is working, then for each and every different machine, there is a minimum distance that you need to maintain so that there is no chance of injury.

Then, when a tree is being felled, then also you need to maintain certain distance from the tree. Then, you need to use certain protective equipment such as helmets or such as goggles. So that when somebody is say, using a chainsaw, then there will be some amount of powder from the operation that comes out. Now, that powder might get into

the eyes. So, if you are doing; if you are using a chainsaw, it is better to make use of goggles.

Similarly, if there is a machine that is making a very large sound, then probably it is good or it is much more prudent to go within earmuff. And, whenever you are doing anything, you should have a planning meeting in which case you should talk with your come with your colleagues about what is it that you are going to do, so that nobody is caught unaware. All of these are very common sense things, but they need to be ensured.

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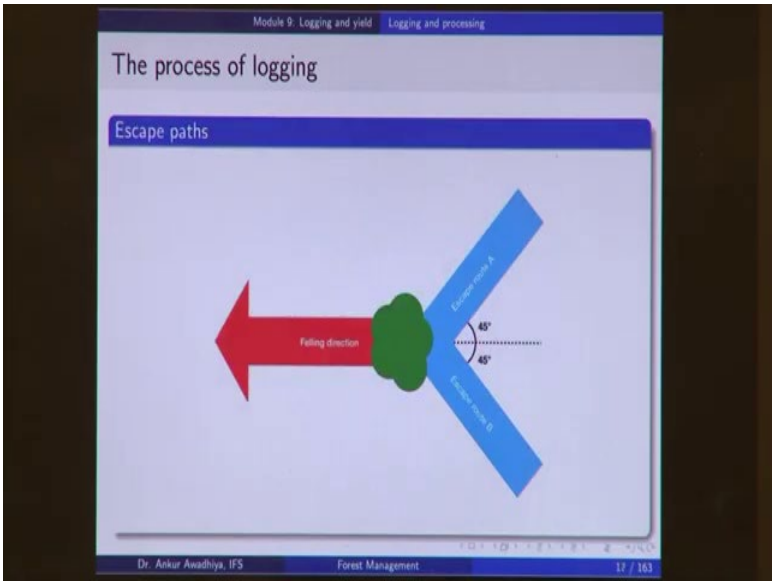

And similarly, whenever any tree is being felled then the escape paths need to be decided from the beginning.

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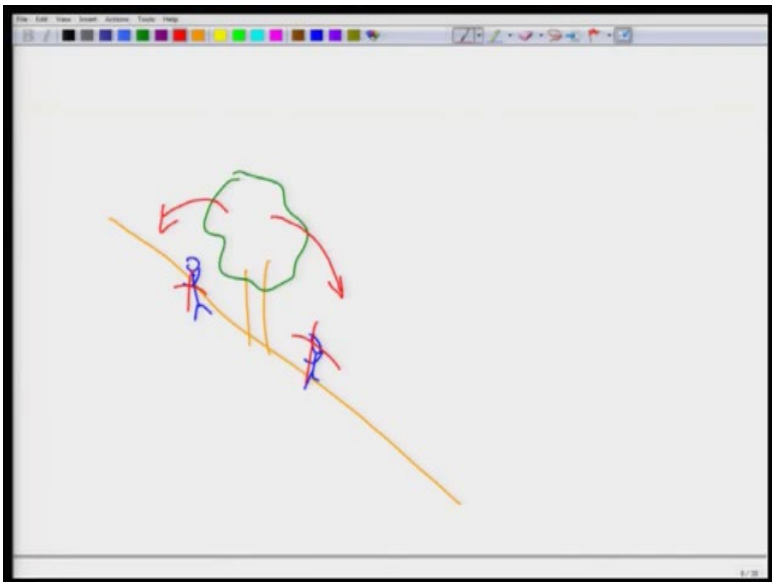

So, suppose you have a tree, so here you have a sloppy ground, and there is a tree that is standing here, and you are trying to fell this tree. Now, if you are felling it in such a way that it falls in this direction, then you should not be standing in this place. Because, in this case, that it may fall over you. But then, if you are trying to make your tree fall in this direction, there is also a chance that it will fall in the opposite direction.

So here again, you should not be right behind the felling direction because this is a more accident-prone area. So, typically, whenever we do a felling operation, if the felling direction is here, then this is a no-go-area and right behind also is a no-go-area. And, these are 2 escape paths that we decide which are at 45 degrees to this line.

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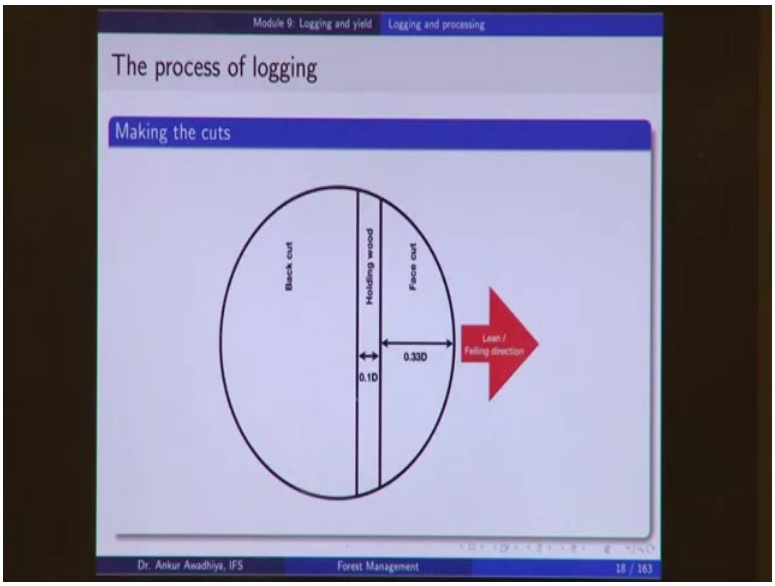

Now whenever, the felling operation is done, typically it is done using three different cuts.

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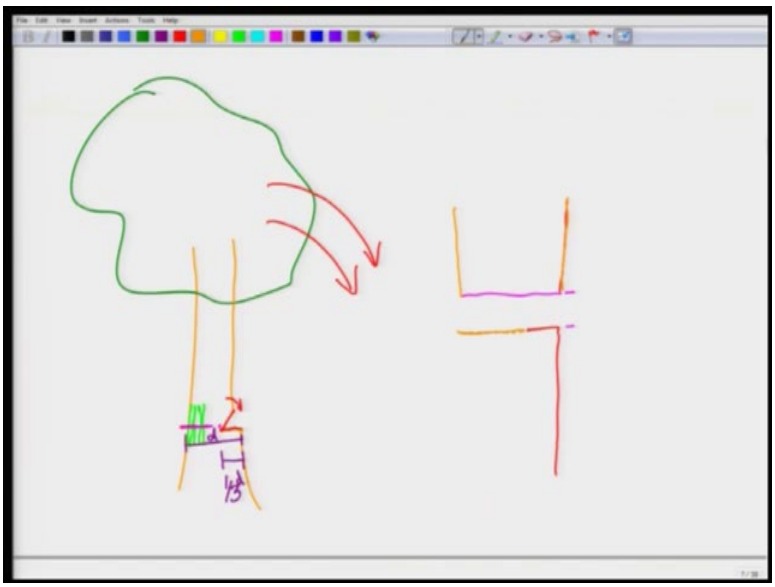

So here, you have a tree and you want this tree to fall in this direction. So how can you ensure that? So, we do this by first making a cut here, a cut here and then we remove this portion of the log. So, after this, this section would look like this.

Now, in this case, you have created a hole or a notch to the right of the tree. So now, if and right after that, you start giving it a felling cut or a back cut from this side. So, you

will use your axe or a chainsaw to start cutting the tree from this side. Now, because in this area, you have created this gap, this hinge; so, your tree will start falling in this direction. And, when it starts falling, the fibers in this side, they get more and more stretched.

When they get stretched and you use your chainsaw; so, one after the other the fibers are getting cut and then your tree is now giving a more and more greater lean. And, slowly and steadily, it will topple to the right side. So typically, what we do is that, suppose this is the trunk; so, you will give it a face cut. So, this is the lean or the felling direction. So, in the lean or the felling direction, you will give it a face cut.

Typically, this face cut is given to a depth of 1 by 3 of d, which means that this depth is one-third of d. If this is d, then this is one-third of d. So, this is the face cut. Then, you give a back cut from the backside. So, this cut will move in this direction and there will be certain amount of wood that will be left out. So, what we are saying here is that when you are doing this operation, this cut does not completely go to this point, because before it reaches this point your tree will have already toppled down.

And, this section which is known as the holding wood, this would act as a hinge and this will hold the tree together till it falls to the ground. So, these are the cuts that we make - the face cut and the base and the back cut.

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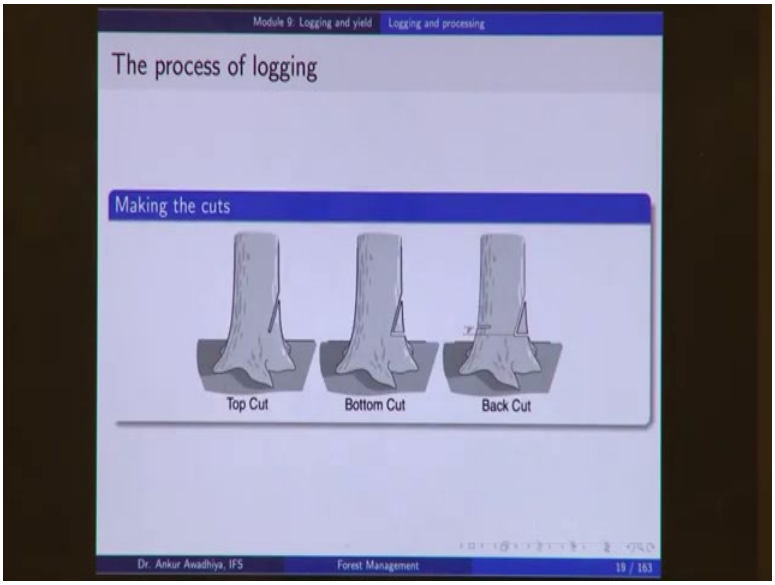

And, the face cut is comprised of the top cut, the bottom cut, and then you have the back cut. So, when you begin your felling operation, the first cut is this one. So, you make use of your chainsaw or your axe to give it a cut like this. So, this is the first cut; this is the second cut, and then you start giving at it a cut from the back, and then your tree will topple to this direction.

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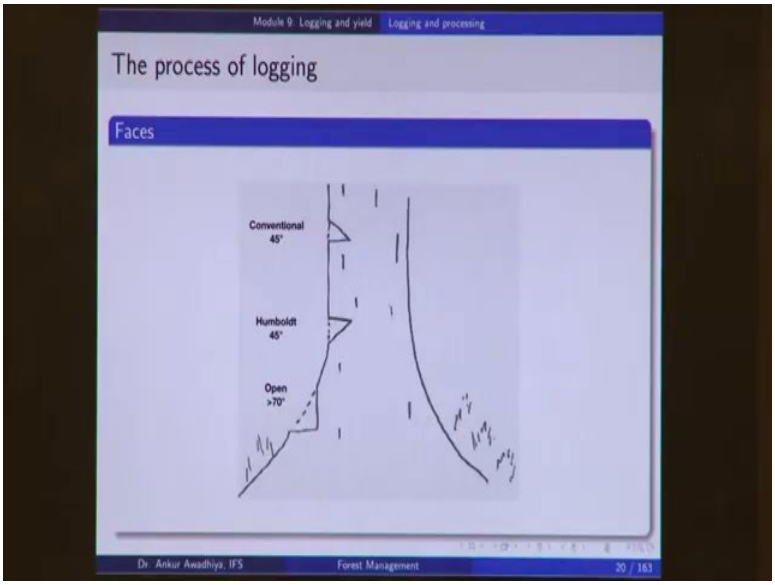

Now when you are making these cuts, you create faces, which is why we call it the face cut. And typically, we use 3 different kinds of faces. The first one is a conventional face. Now in the conventional face, the first cut or the top cut is at 45 degrees to this line or to the vertical. So, you have a 45 degrees cut which is the top cut, then the bottom cut is parallel to the ground. In the case of a Humboldt cut, you or a Humboldt face, your top cut is parallel to the ground, the bottom cut is at 45 degrees, and in the case of an open cut, you make an angle which is greater than 70 degrees.

So, these are 3 typical faces that we make use of. And all these 3 different faces have different utilities.

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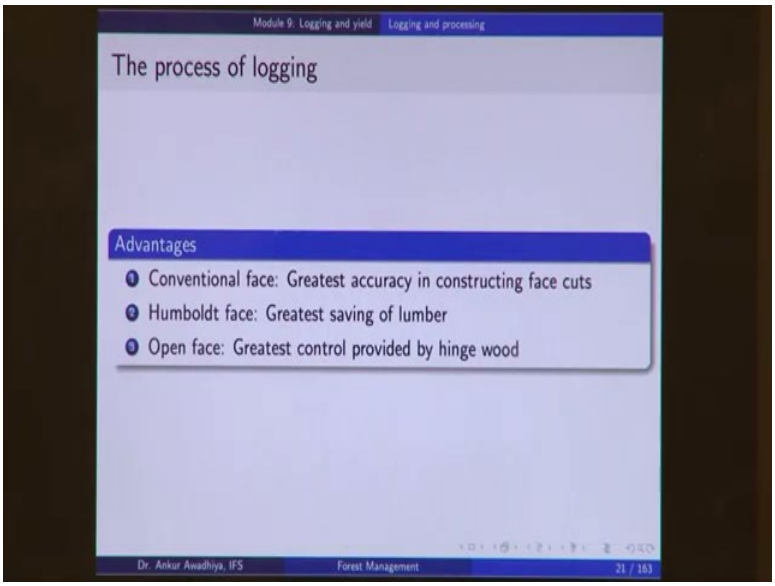

The conventional face gives the greatest accuracy in constructing the face cuts. Because in this case, this angle is very easy to construct because we are seeing it from the top. So, from the top this cut and this cut both of them are easy to make. In the case of a Humboldt face, there is a greatest saving of lumber because, in this case, you have lost in the case of conventional cut, you have lost to this much timber.

What we are saying here is that, when you give it a conventional cut, then when the tree falls down then typically, you will get a section that is looking like this. Now, but in this section, because this portion is hollowed out or is having a smaller size; so typically, you will have to cut this log from this location and this portion is now no longer available. So, there is a loss of timber that happens in the case of a conventional cut.

But, in the case of a Humboldt cut, because that your top cut is parallel to the ground, so in this case, there is a seaming of timber. Now, in the case of an open face, there is the greatest amount of control that is provided by the hinge wood because you can make these cuts very easily, and at the same time. you can have different angles for different tree species because of which you will have much more control over the way in which your tree is falling.

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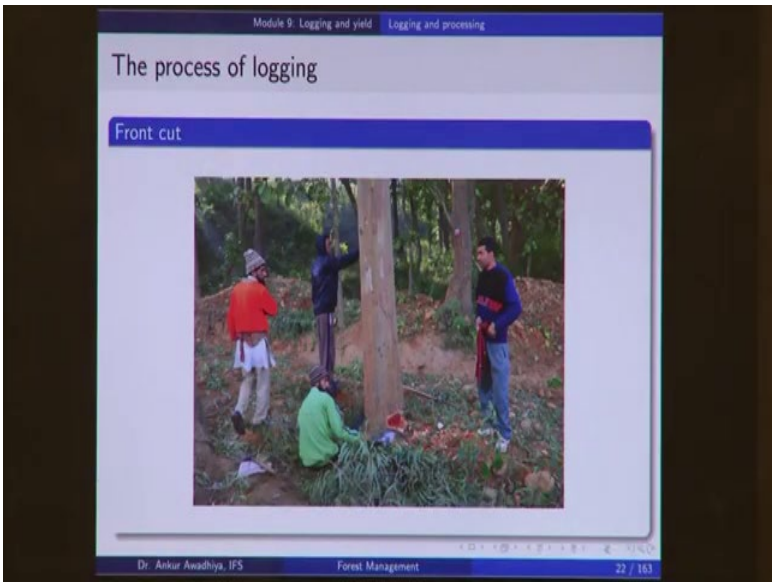

So, in this picture, we are seeing a front cut that is being made. So, the these people are trying to topple this tree or cut this tree; so, that it falls in this direction. Because of which they have given it a face cut in or a front cut like this

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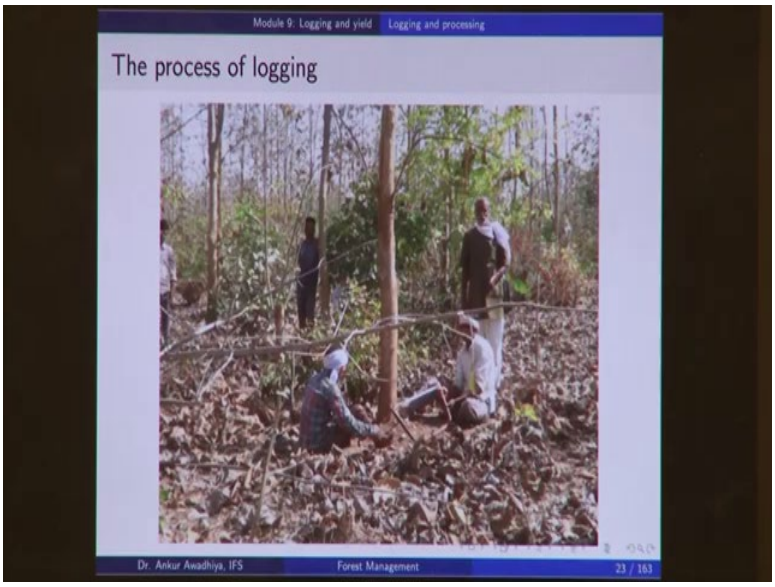

Then, you have the back cut that is being made here. So, in the case of this tree, the front cut is on this side, and now these people are trying to make the back cut. And when they are doing this back cut, they are making use of saw, and in this case, 2 people sit at the base of this tree and then they saw this tree to give it a back cut.

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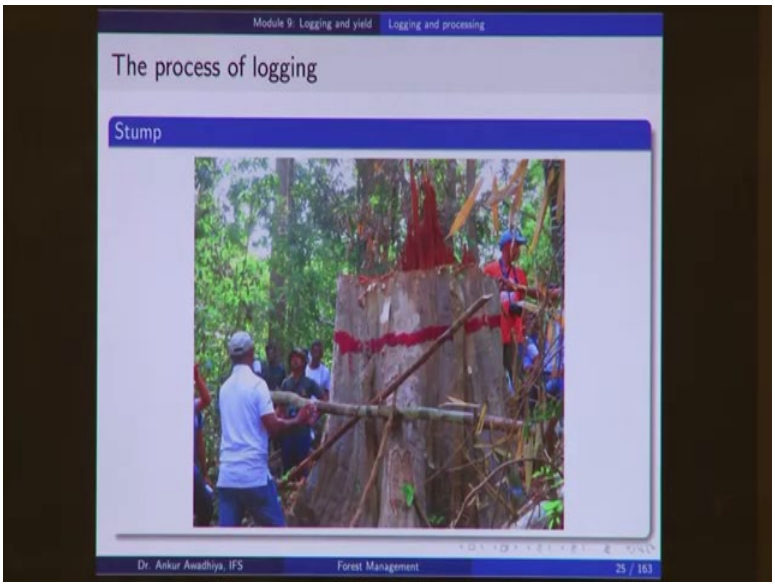

Now whenever this these cuts are made, then the holding wood would form a hinge and this hinge wood typically be seen also in the stump. So, in this case, when this tree was felled then the then this was the holding wood, and the fibers have gotten stretched and this holding wood was serving as a hinge till the tree fell to the ground.

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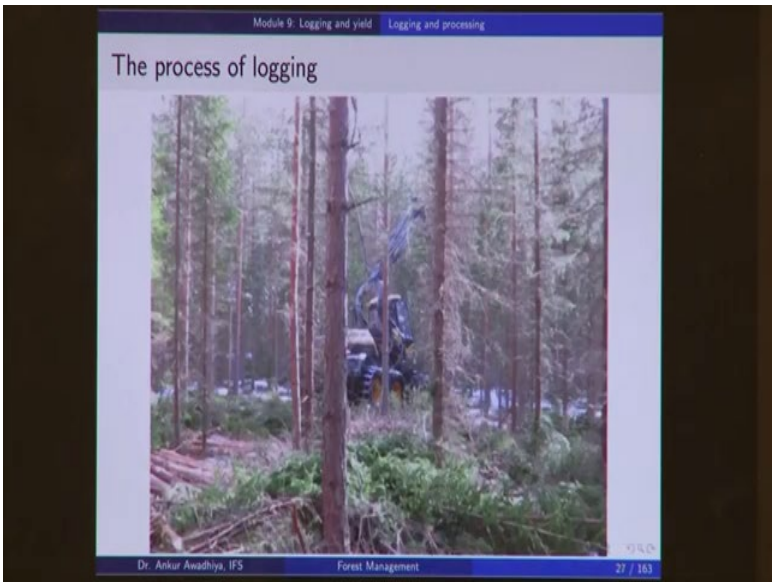

And, this is where we are seeing certain felled logs that are there right next to the door to the road. Now, in more advanced countries, we typically make use of automated machines, and this machine is a combined logger machine. So what it does is that here, you can see that it has an arm and this arm will typically grab a tree near its base, then it will cut it at the base, then it will turn it, and then there are rollers that are moving, this log like this and then it is cutting it at specified distances.

So, let us have a look at this video once again. So here what we are seeing is that, this is the automated machine, it has cut a tree. And then, the log has now come down and it is now. See, this is the log, and then this is the tree. And, it is now rolling this tree and it is cutting it into different smaller size sections. Now, once you tree has come down on the ground, the next process is that of delimbing. So, delimbing is cutting off of the branches and these branches are typically left on the site.

Now, why are they left on the site? For 2 or 3 reasons. One; it is not very economical or not very financially lucrative to cut the to carry these small branches which typically have lesser diameters out of the forest. Because there are transportation costs involved, there is certain logistic cost involved, and because they do not fetch a large value so it does not make much sense to carry them away from the forest. Second; when you leave these branches out there on the forest, typically these branches also have a number of

leaves. And, these branches and these leaves form a layer on the ground which then protects the young crop against grazing. So, this is another benefit.

The third benefit is that these leaves will form a mulching layer on the forest floor and will typically moderate the conditions which will help the next generation.

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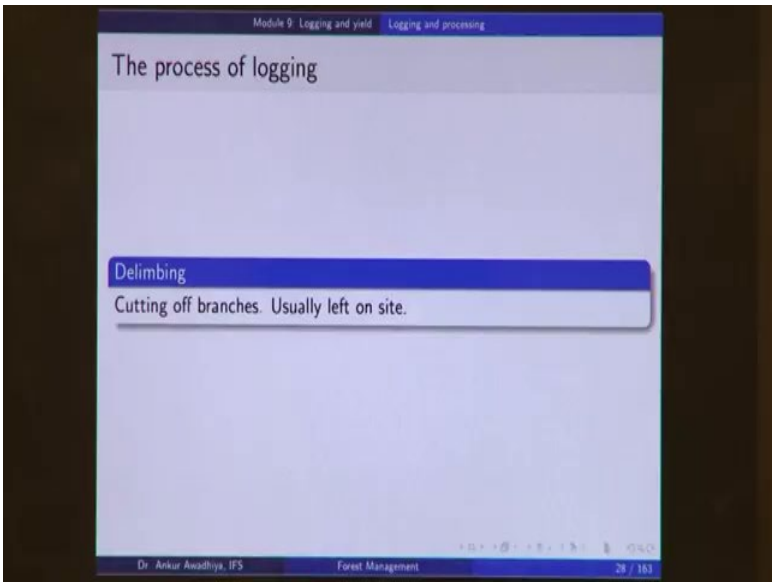

So, this is the process of delimbing where you are cutting off the branches and typically leaving them on the site.

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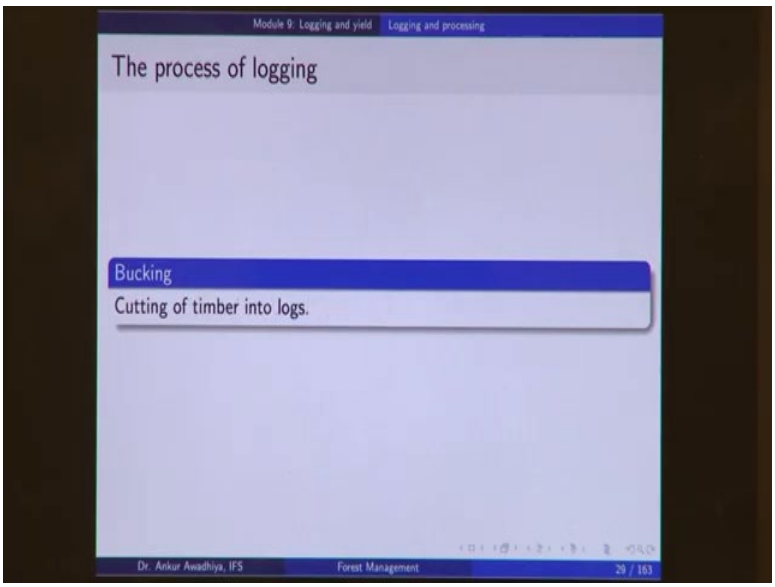

The next process is that of bucking. A bucking is cutting off timber into logs.

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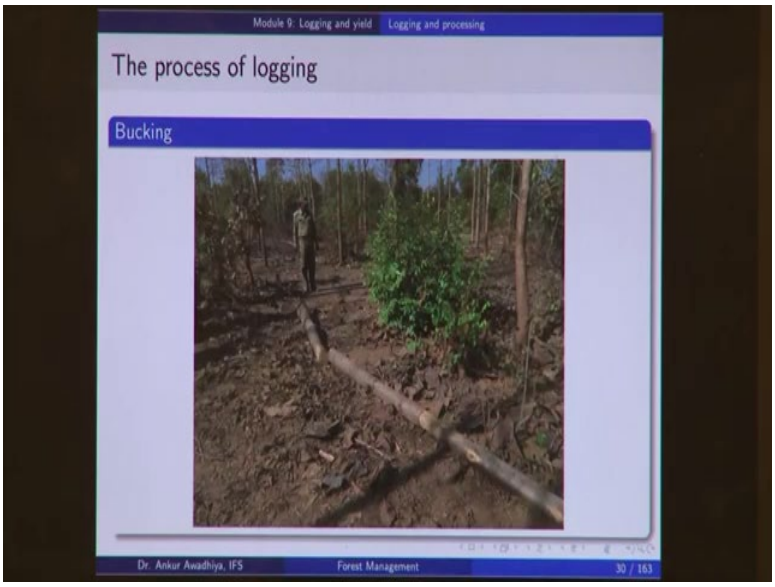

So, for instance, here you have a very large sized tree and it is difficult to carry this tree in two-two and in this case the foresters are cutting these tree this tree into smaller sections. So, like this section, it is easier to carry it into the to the market.

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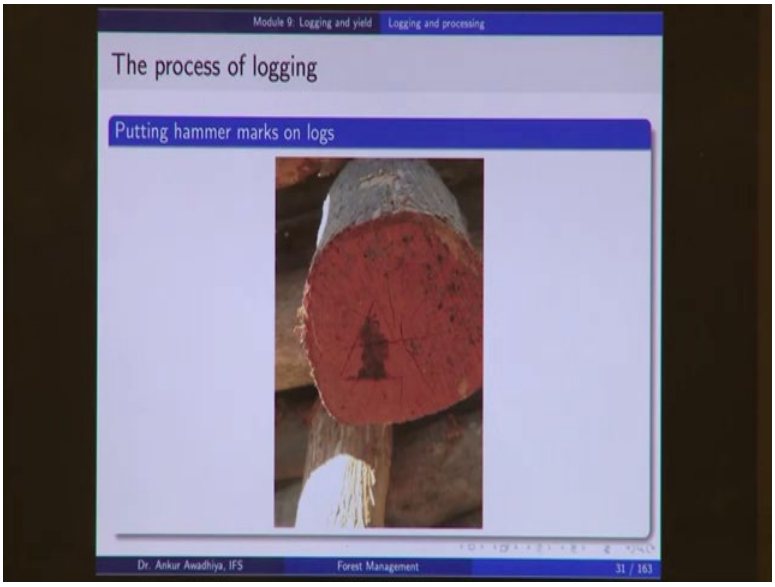

Now, when the when this felling is done, in India, we also make use of hammer marks. Now, if we look at this face here, we are seeing that there is a triangular mark and it is having certain numbers. So, this is telling us whether this tree is legally cut or whether it

was illegally cut. So typically, the foresters are issued different hammers for different purposes.

These hammers are taken on record and whenever there is a felling operation, all the trees that have been felled in that area will be marked with this hammer, so that whenever you have any log that is seized from somewhere, and if you have a hammer mark, you can always trace it back to men and where this particular log was felled.

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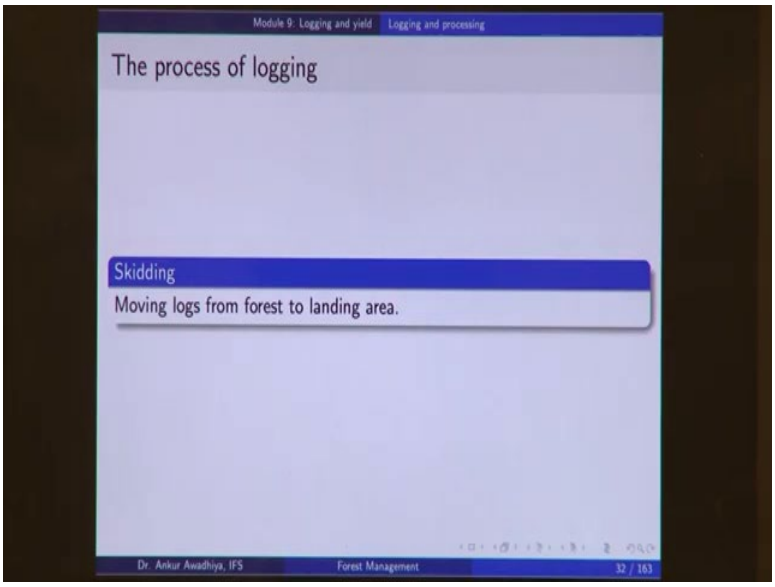

Next operation is that of skidding. Now, skidding is the process of movement of logs from the forest to a landing area. Now, landing area is an area where your vehicles can get inside and you can put the logs onto the vehicle for transportation. Now why is a landing area important? Because if you go inside a forest there will be so, many different trees that it will be difficult to bring a large-sized truck or other vehicle into the forest area.

So typically, that the trees that are cut in the forest are brought to a location that is closer to the road and this is known as the landing area. And, from the landing area, it will be picked up by a truck. Now, the process of taking your timber from the forest to the landing area is known as skidding. Now, from the landing area you can make use of a truck very easily because you have access to the road.

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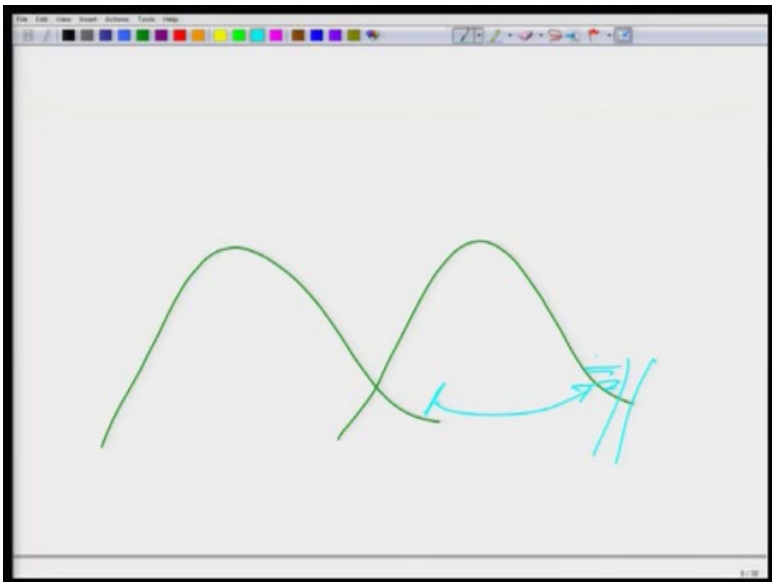

But from the forest, and typically if you have a forest in a hilly area and suppose this is your road, and this is the landing site, so how do you carry a lumber from this place to this place? That is the question. So typically, this is done using say elephants.

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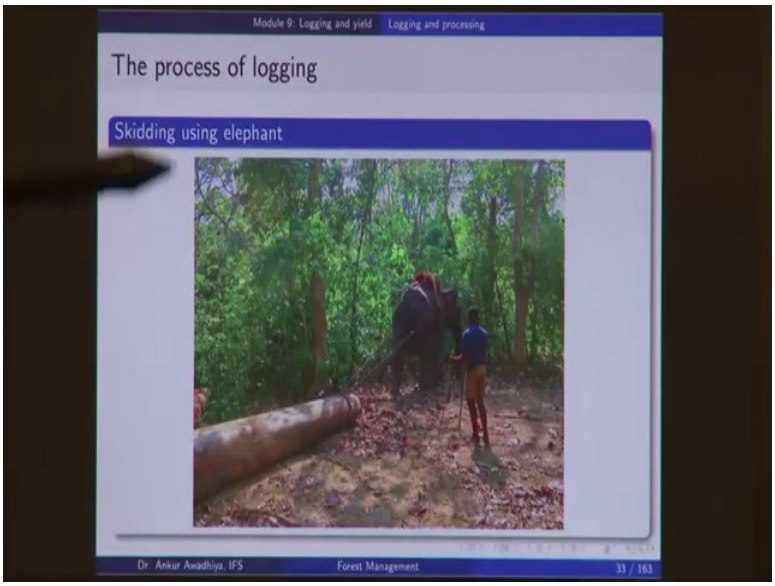

So, here is this picture from the Andamans, and here we have this elephant; here you have a log that has been felled. So, notches are made at the end, then we tie an iron chain; and this chain is then attached to the elephant, and the elephant carries these logs to the landing site from where we will make use of a truck.

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In certain areas, we do skidding using tractors. Now here again, the this lumber is not on the tractor; the lumber is tied with a rope and this rope is tied to the tractor. So, it is essentially skidding it over the ground

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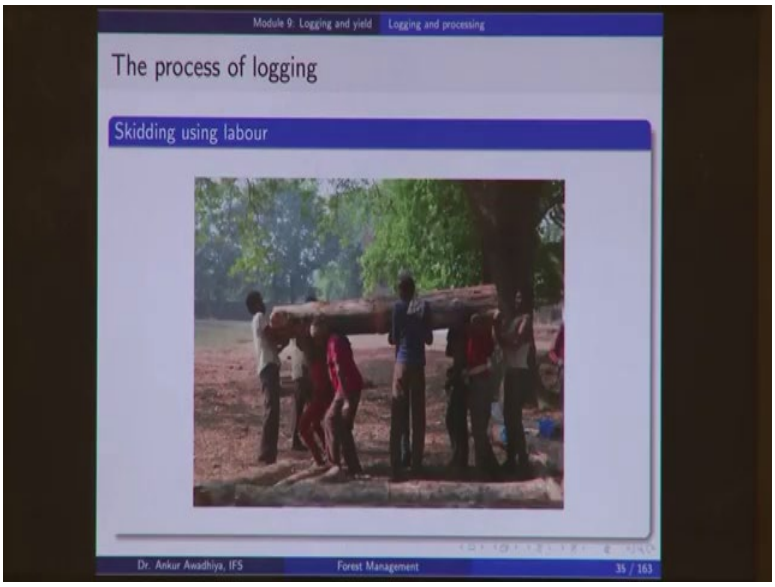

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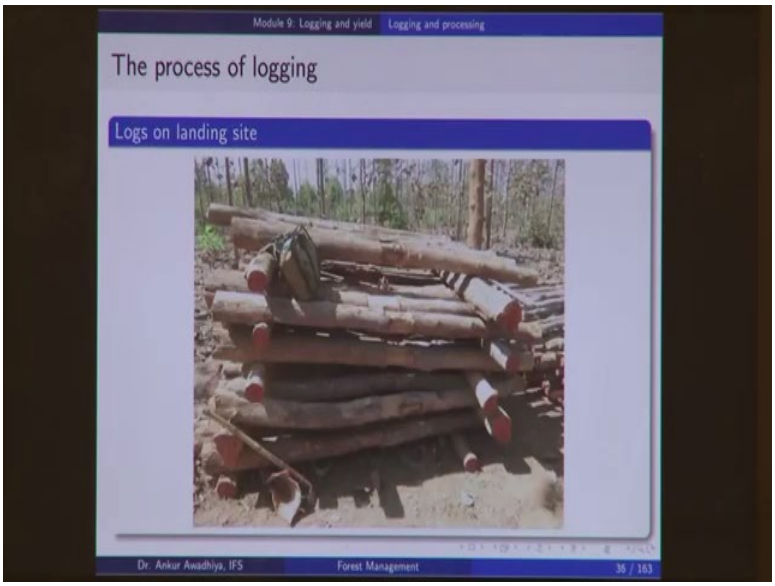

In certain areas, we also make use of manual labour, and using all of these, we bring the timber to the landing site. So here you have the logs that are there on the landing site. In certain cases, we differentiate these logs based on the diameters, and in which case, we make clumps so that we have a vehicle full of load for each of these stacks.

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So, we will have these sorts of stacking. So, everywhere like, this images from Finland, this image is from Harda, and in both these cases, the process is one and the same.

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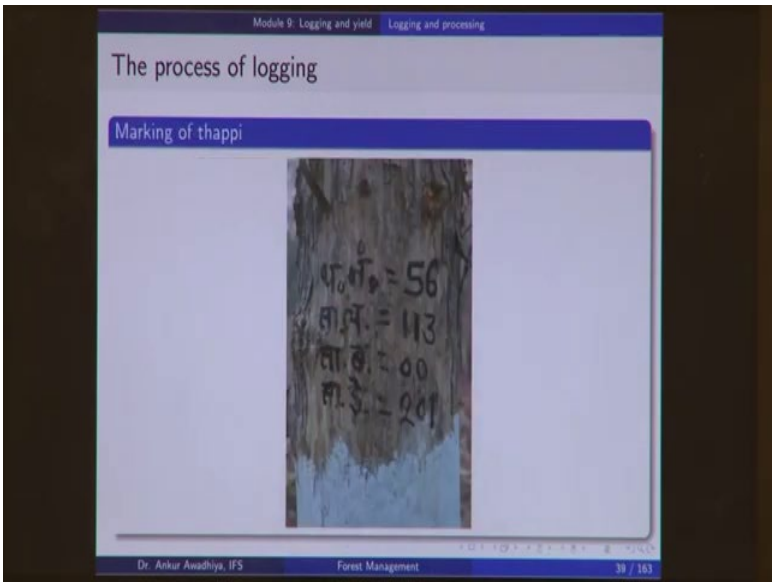

Now, here we are seeing a marking of this stack. Now, this stack in Madhya Pradesh is known as a thappi. So, this record is now telling you that this is a thappi number 56, the Sars stands for Sagwan or Teak.

So, here you have Sagwan, Latta, Balli and Dingre. Latta is a log that has a very large size a large diameter, Balli is a log with a smaller diameter, and Dingre is typically the smaller branches that you can either leave on the forest floor, or in the case of our Indian forest, the villages might also take them for use in say, for uses say firewood.

So, this record is telling us that in this thappi number 56, we have 113 latta which is large-sized logs, we did not get any Balli in this stack and there are 201 Dingre which is the smaller branches.

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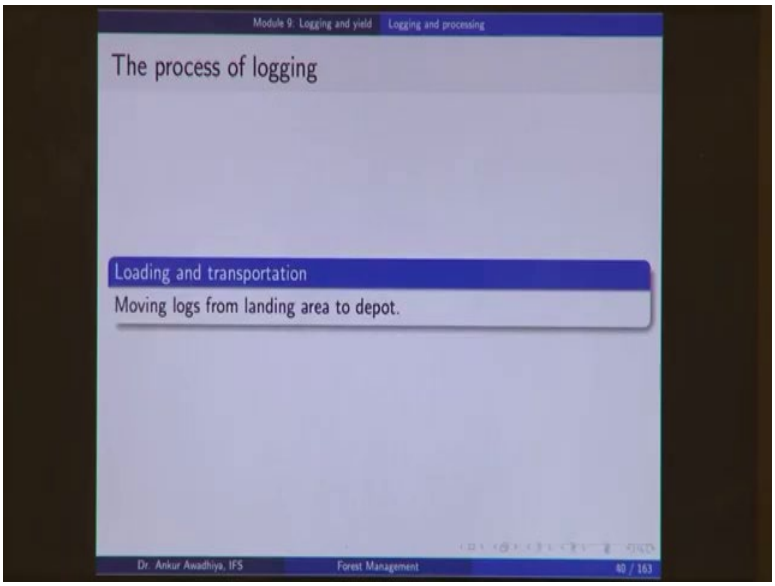

Next, we do the loading and transportation. So, loading and transportation is movement of logs from the landing area to the depot.

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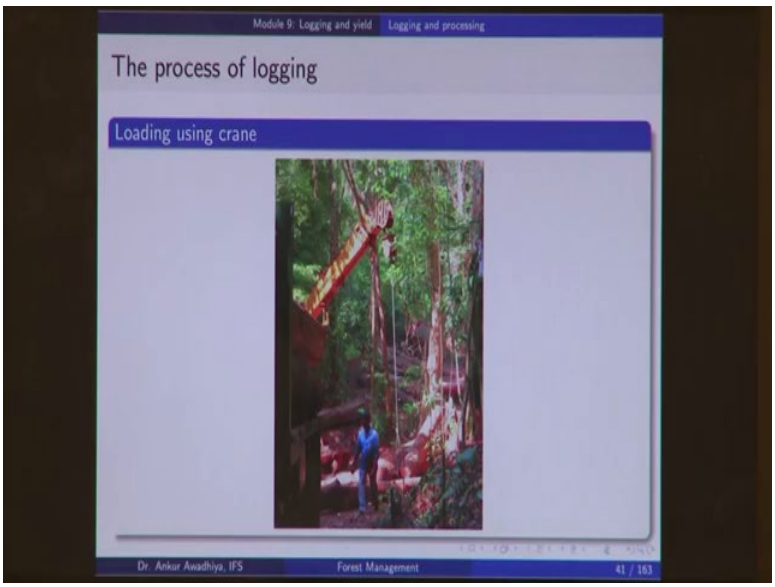

And, this loading can be done using a crane. So, in here we are seeing that this is a landing site and here we have the road, here you are using a crane to carry to move these logs onto a truck.

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It can also be done using a forwarder. Now a forwarder is a machine in which you have a truck combined with a crane. So, in this case, this is a landing site and this forwarder is taking these logs and putting them in on itself now. This is how a forwarder works. Now, in this case, this forwarder is taking the logs and depositing them on the depot. So, here it is taking it out and it is dumping them on this stack.

So here you have a crane; here you have a stack of logs that are there in the truck, and with this machine we are taking these logs. And then, using the crane we are taking them out and dumping them. So, this is how a forwarder works.

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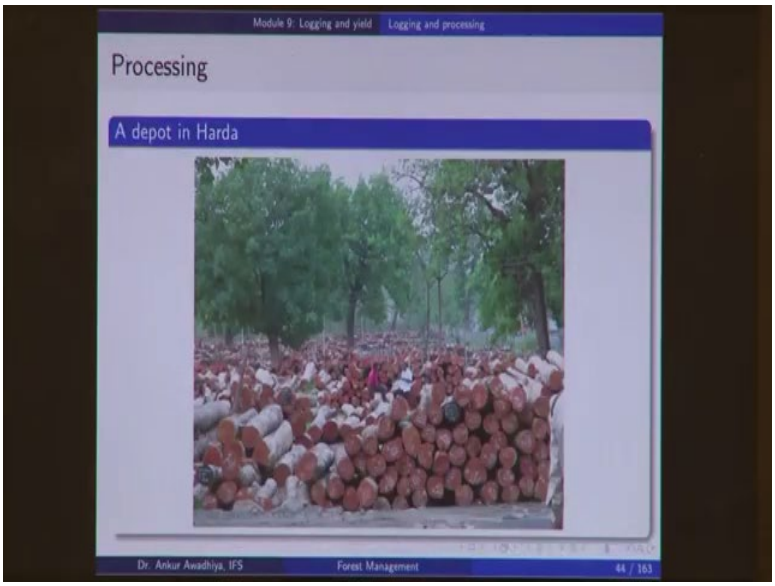

Now, when we have taken these logs to the depot, typically we get a huge quantity of logs. So, this is a timber depot in Harda the district of Madhya Pradesh, and here you can see that you have so many logs that are there in this depot. Now what do we do next? Now, the first process that is required is that of seasoning.

Now, what is seasoning? Consider a green tree. So, when this tree is felled, it will be having huge quantities of water inside it. Even our bodies are roughly 70 percent water. Similarly, with plants they are roughly 40 to 50 percent of their weight is made out of water.

Now, if you have a log that is having a very large quantity of water and then once this tree has been felled, and this log is kept out. If this log is exposed to say the sun, then what will happen is that there will be a very rapid loss of water from this log. And when that happens then typically, we will start seeing certain deformities in the timber.

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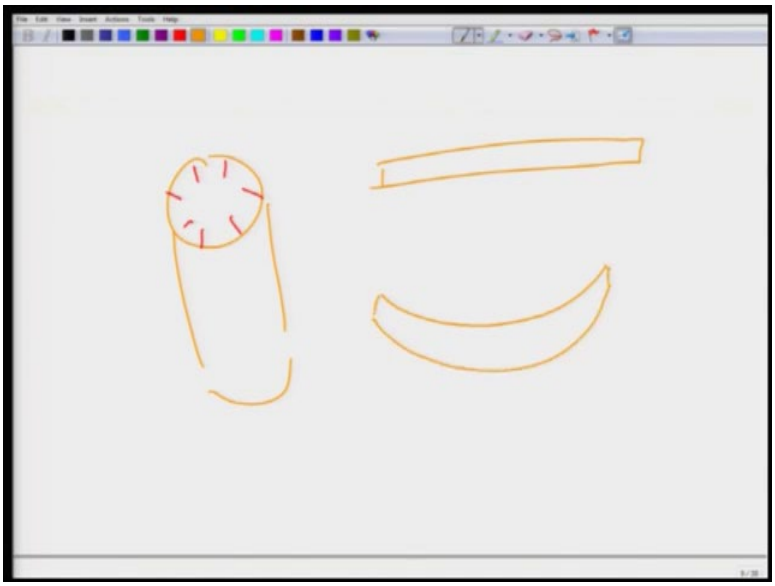

So, for instance, your timber may get cracks; it may get split, or in place of a flat timber; it may start showing bends or warps or kinks and so on.

Now to reduce this possibility, we make use of the process of seasoning. Now, seasoning is the process in which we reduce the amount of moisture that is there in the timber in a controlled manner. So, in lower temperatures and in such a phased controlled manner that there is not that we do not have a rapid loss of moisture which would result in certain deformities in this timber.

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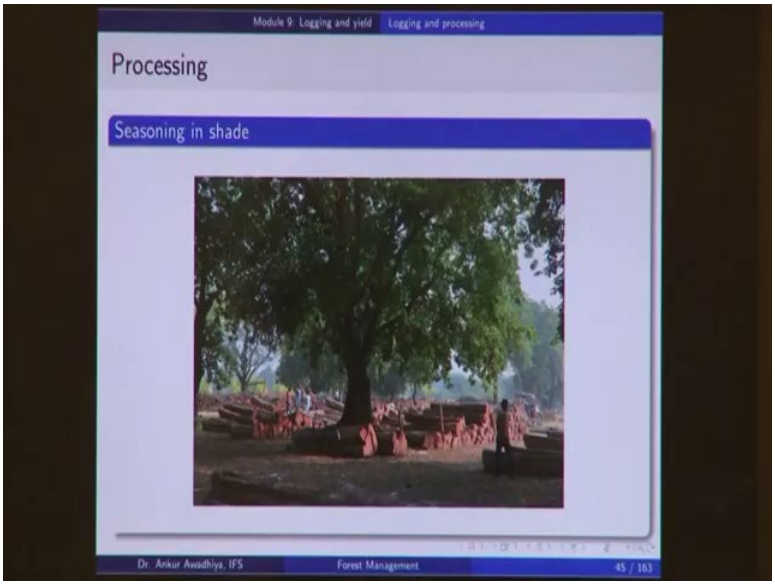

Now here what we are saying is that, these logs are kept in the shade of this tree so that they are not exposed to the sunlight. And so, under this tree, the logs will slowly get seasoned; they will slowly and slowly the moisture will get out and these will become seasoned logs.

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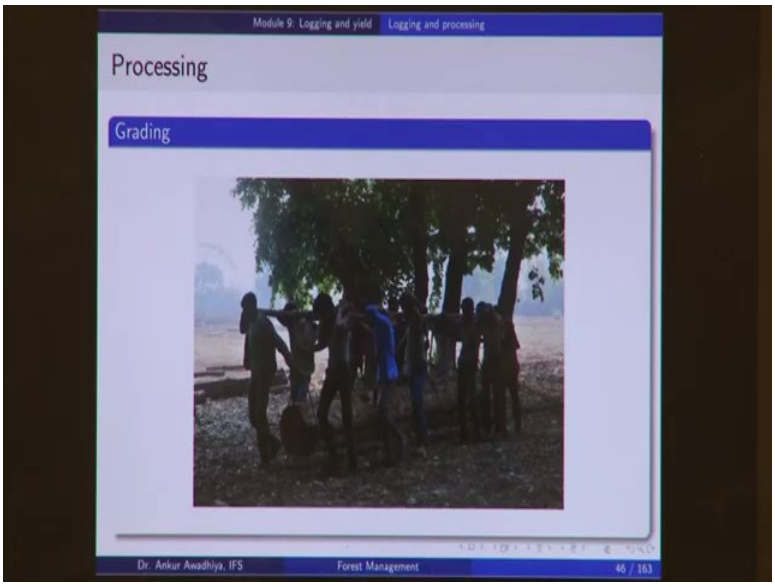

Now, another thing that happens in the depot is grading. Now, in the case of grading, you classify these logs so that the logs of similar diameter, similar girth and similar soundness are grouped together. When we say similar soundness, it means that those logs that are not having any holes, that are not having any splits, that are not having any warps, they are the best quality of timber. So, all those logs will be grouped together.

Now, within that group, those logs that are having the largest diameter and the largest length will be grouped together and so on.

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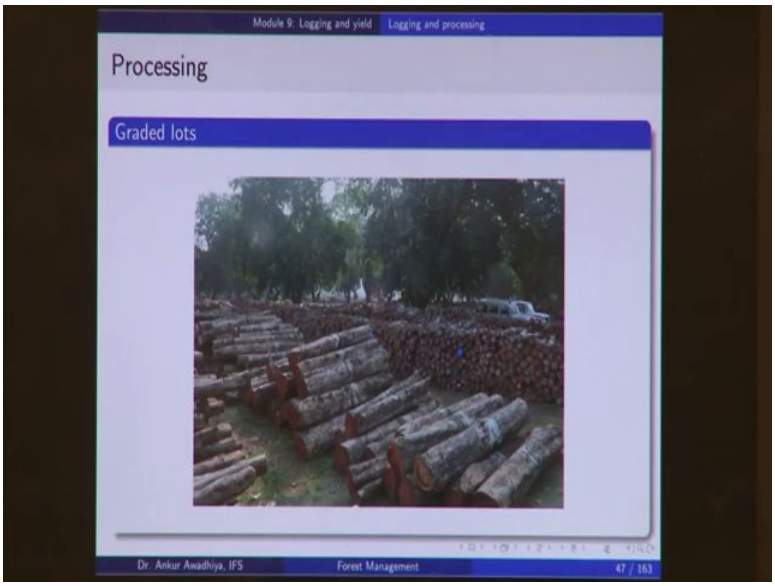

So typically, a grading operation is also done in a depot which will result in the formation of these graded lots. So, here you have all this timber; they are looking similar. All of these are looking similar. So, for instance, these ones are having larger diameters, these ones are having smaller diameters. So, this is the process of grading.

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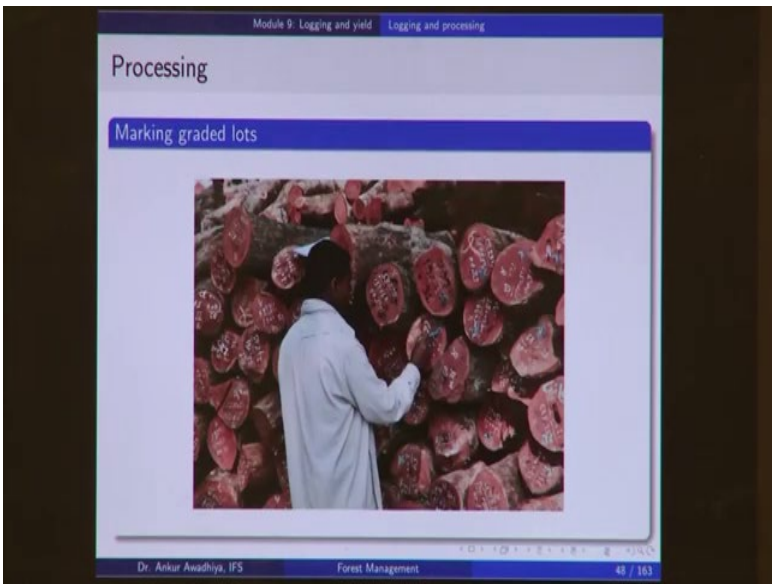

Now, once the grading is done, the next process is graded lots. So, what this person is doing here is that he is taking the measurements of each and every log, writing them on the face of the log, noting them down in the depot register. And at the same time, he is

making lots. Now typically, we make lots in such a manner that one lot will fit in one truck.

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So, it is one truck full of load that we make in the form of a lot, and then these graded lots are then put up for auctioning. So, this is the whole process of logging till disposal of the wood. Now, once you have disposed off your wood, what happens next? So, there is a merchant that who has procured your woods, who has purchased your wood. Now, what does he going to do with that?

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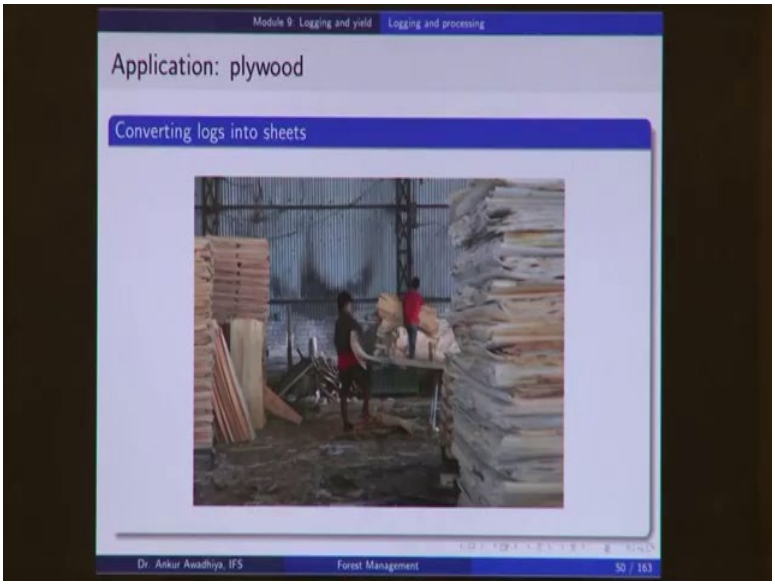

Merchants can make furniture out of the wood, he can make door or window frames, he can make doors or windows or he can use it to make certain other artificial products such as plywoods or particle boards. Now what is plywood? Now, these days, to reduce the consumption of wood, plywood is advertised as a good option. Now the best thing about plywood is that it comes in the form of a flat sheet. So, it is very easy to work with.

So how do we make plywood? A plywood is made by converting your log into very thin sheets. The process is very similar to sharpening of a pencil. So, you take a pencil and you put it through a sharpener, and what we get here is these flat sheets of the wood. Now plywood is the process of making plywood begins with this stage. So, there is a sharpener, there is a wood or a log that is put with the sharpener and it is converted into very thin sheets.

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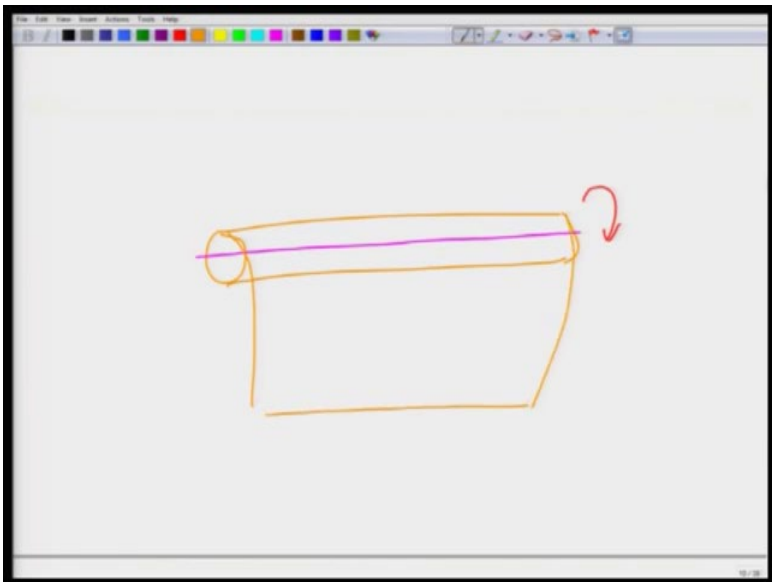

Now typically, how this works is that you have a log and this log is rotated on a machine and you have a blade which touches the surface of this log and this log comes out in the form of sheets. So, here we are seeing this process. So, there is a machine and this person is collecting the sheets that are coming out of the machine.

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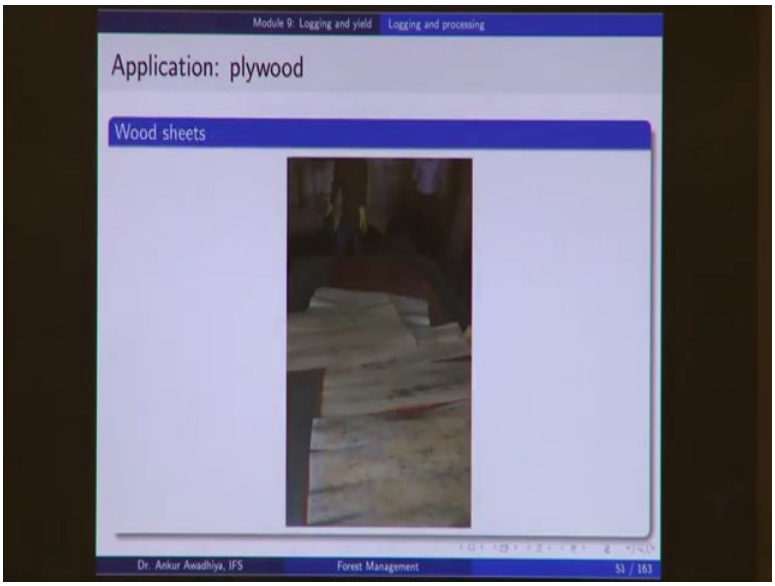

This is how the sheets look like So in so using a single log now we are able to get very large number of very thin sheets.

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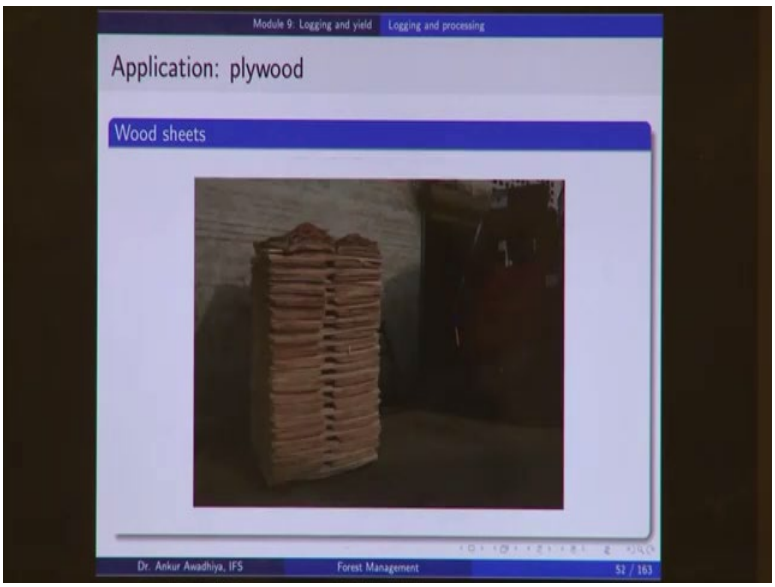

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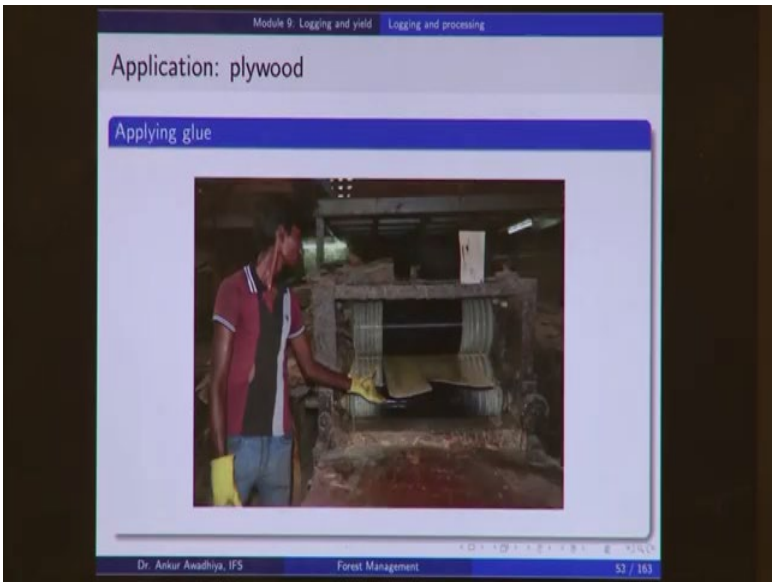

Now these sheets are then kept together in the inventory, and to convert these sheets into plywood, workers apply glue to this to these sheets. So here you have a machine which has 2 rollers and there is glue that is which is moving across these rollers.

So, there will be a person on the back side who will be; who will be putting these sheets one after the other, through these rollers and on both the faces of these rollers, the glue will get applied. And, this next worker is now collecting these sheets which have glue on both the sides

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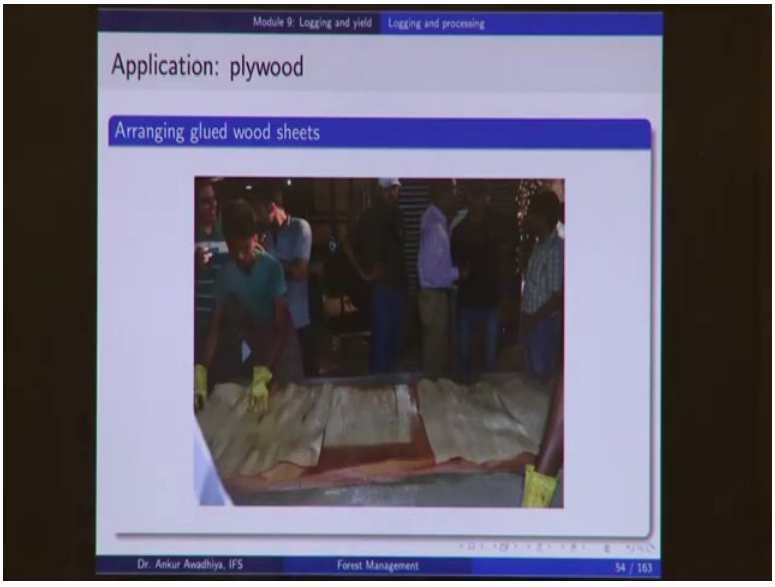

Now these sheets with the glue they are now arranged on a table in such a manner that we alternate the arrangement.

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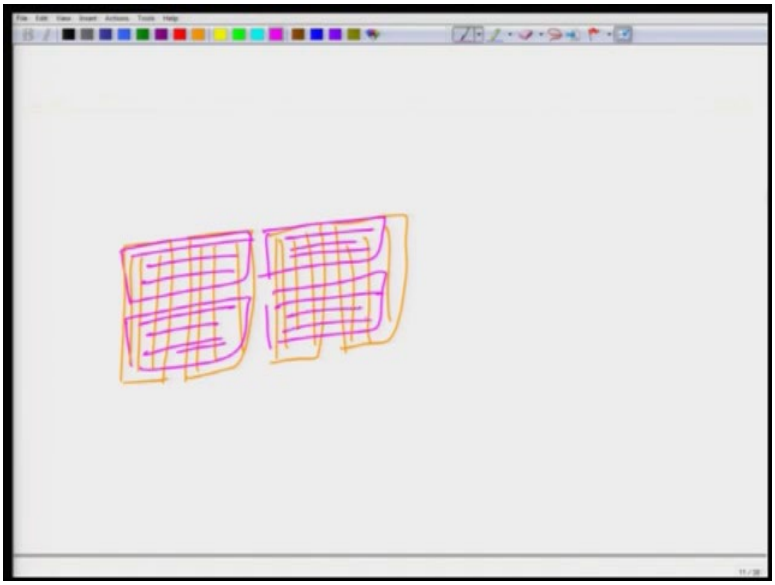

So typically, if you have the sheets that are like this in the first layer, then in the second layer the sheets will be kept like this. So, the direction of the fibers is interchanged with each layer, so that it is having so that it so that, the final product gets a more uniform property and it's having a sufficient strength in all the directions. So, this is what this person is doing. So, you have one sheet that is below then the next layer of sheet is being put on the top.

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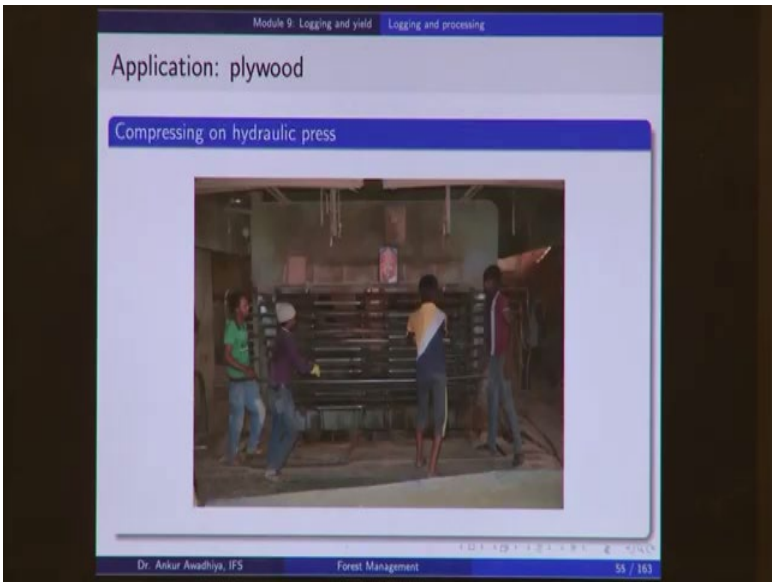

Then, all these sheets are put into a hydraulic press, which then presses these sheets together. Typically, the ends of these presses are also heated up. So, this press will now apply great amount of pressure to these sheets and this will ultimately get converted into a plywood.

Now, when these sheets have been glued together, the pressure has been applied, all that remains is to cut these conjoined sheets into standardized shapes which are known as plywood. So, in this lecture, we began by looking at the logging operation.

So, the first stage in the case of logging operation is cruising. In the case of cruising, a forester will move through the forest, will note down, will mark each and will enumerate each and every tree and note down what is the species? What is the girth? What is the height? What is the soundness of each and every tree? What is the amount of branching that is there in different trees?

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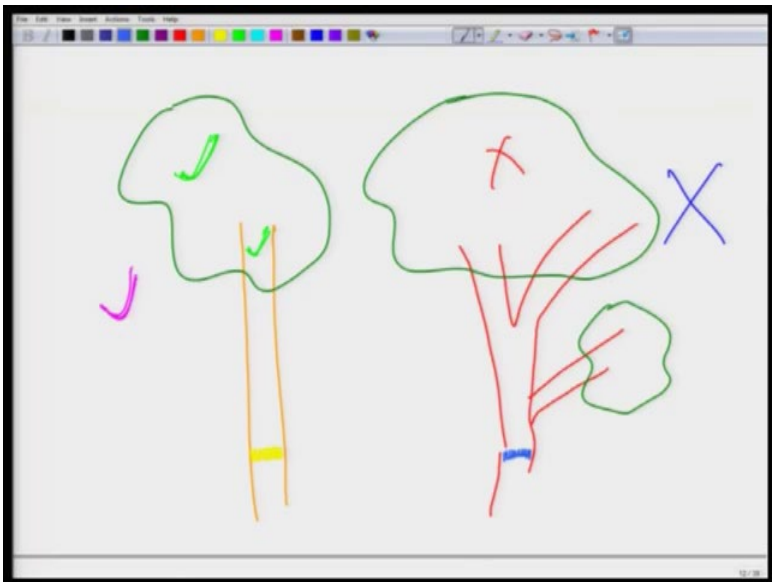

So, for instance, if you have 2 trees, the first one is having a straight bole and the second one is having a branchy formation. Now, if both of these trees were silviculturally available, we would prefer this tree and not in this tree, because it is easier to work with this straight bole. So, all these different kinds of information where is each and every tree located, what is the species? What are the dimensions? What is the soundness? What is the branchesness? Does it have a buttress or not? All of these are noted down, they are enumerated.

Once that is done, the next process is that of marking. So, in the process of marking, we choose between these different trees to ascertain what which are the trees that will be felled. So, once you have noted down these trees, you say you say that we are going to cut down this tree, and we are not going to cut down this tree. Now, this process will be known as marking of trees. Now this is done not only on pen and paper, but is also reflected on the ground. How is it reflected on the ground? By the use of marking paint.

So, this tree will be given a yellow colored paint on its trunk whereas, this tree will either not be given any color or will probably be given a blue color. Blue color will say that this tree is not to be felled; the orange or yellow color will say that this tree is to be felled; that we also have different other standard colors. Red color is for a boundary line, white color is for a research plot, black color is for overwriting.

So, the forester will after enumeration, he has marked these trees and he has gone to the field and he has painted these trees with different colored strips. Now once that happens, then typically it is now given up to a contractor, or in the case of Madhya Pradesh, we give it to a production division. Now, the people in the production division will now go to the forest and will start cutting these trees. Now how is a tree cut? The first stage is to ensure that you have sufficient amount of protection in that area.

So, the people are given training, they are given typically the protective equipments, you make a plan about the leaning of different trees. So, for instance, suppose there is a tree that is leaning like this. So, it is better to make it fall in this direction than in the other direction. If you wanted to make a tree fall to the other side, that is also possible.

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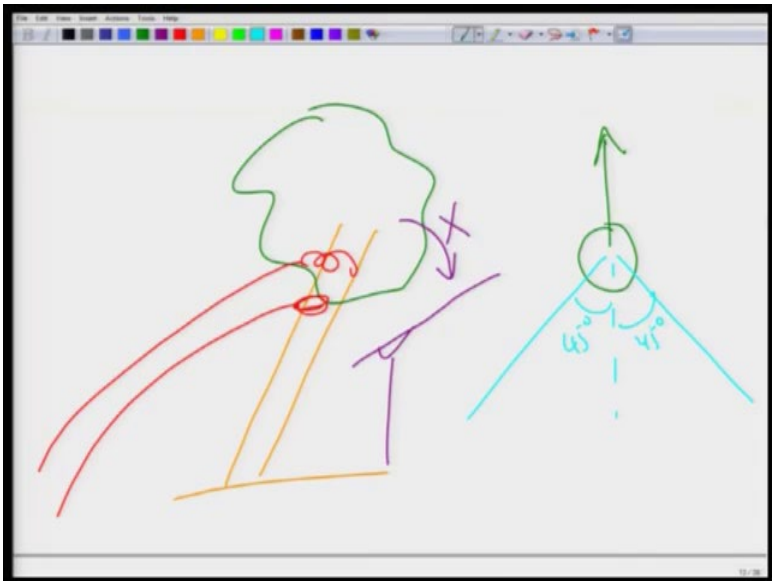

So, you have this tree that is leaning to this direction. But then typically, but then probably you are having an electrical line in this side. So, you do not want this tree to fall to this side. This is to be avoided. So, what you will do is, you will attach ropes to this tree and you will start pulling it in the other direction, and then you will make your cuts so that it does not fall in its leaning direction. But typically, we prefer a tree to fall to its leaning direction.

Now, certain modifications have to be made to the leaning to the direction of felling so that your tree does not fall on another tree. Because, if that happens, then both these trees will get damaged. Then, we also ensure that it does not fall on any other establishment; it

does not fall on any other infrastructure, such as road or say a powerline or say a water line and so on.

Now, once we have decided of what is the direction what is the direction in which you are going to fell your tree, the next thing is to plan an escape route. Now, escape route is if you have this tree and is it is going to be felled in this direction; so, there are these 2 escape routes and so, the person who is cutting or filling this tree, if anything if any mishap happens, he or she should use these escape routes which are typically at 45 degrees, and there is a very low chance that your tree will fall on this line.

So once that has been done, and people have been made aware of, next, we start to fell the tree. Now in the case of felling, we begin by creating a face.

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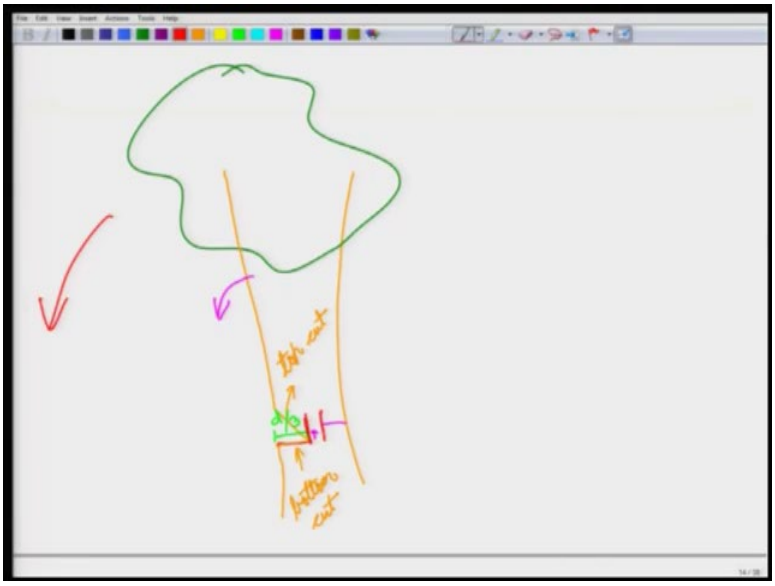

A face is created on a tree by giving it a top cut. So, if the tree has to be felled in this direction, you will give it a top cut like this then a bottom cut, and when you have created these cuts, and you have removed this wood then it creates a face. So, this is how the face will look like.

So, this is now a face in the tree. So, this face was built using a top cut, a bottom cut. Both of which together are known as the front cut, and this depth is typically d by 3 where d is the diameter at this spot. Then, you start giving it a back cut. So, you start cutting it. Typically, it is done at a slightly higher location.

So, you will start cutting it from here and you will probably make use of a saw to make the back cut. Typically, we avoid the use of axes. We basically use saws because you have to cut down the fibers one by one and these fibers are already in a stretched position. So, consider that you have a very large number of strings that are kept tight, and you are slowly and slowly you are cutting the strings one by one. So that this tree will now lose its rigid its rigidity and it will start falling.

So, as soon as you start making these cuts, this a back face will get created and your tree will start to topple to this side. And typically, by the time you have reached roughly half of this portion, this tree would have already fallen down, and this would have fallen down through the construction of a hinge at this location. So, hinge is the amount of wood that has not been cut. So, it was neither a part of the front cut it was not the part of the back cut.

But because your tree was falling apart, so this portion the fibers in this portion they get stretched and it forms a hinge, which helps you which helps us to make this tree fall in a more gentle manner, which will in turn help us to protect this timber from damage. So, these are the cuts that we make to the tree. Now, once your tree has come down to the ground, the next operation is that of delimbing. Now, delimbing is the process in which the branches of the tree are gotten removed off, are gotten rid off.

So, the branches are removed, the leaves are typically left on the forest floor and once that is done, the next process is that of bucking. Now, in the case of bucking, in place of canning, the whole timber together you cut it into smaller portions and these smaller portions are then skidded to the landing site. In the case of skidding, you are not lifting this timber and putting it into a truck, instead what you are doing is that you are attaching it with say a vehicle or say an elephant or in certain cases, we even make use of helicopters or even make use of cable cars.

So, in this case, the wood will be attached, it will be skidded. So, when this is skidded, it is you are trying to move it across or between different trees, so that it comes to the landing site. Now, landing site is that location where your vehicle can come and at the landing site, you pick up these logs and put them into a truck. Typically, we make use of cranes or forwarders to move, to lift these logs and put them onto the truck from this truck it is it will now go to a depot.

Now in all this process, it is very important to keep records. The typical records are the enumeration record which was done during the cruising face. Also, the marking record which was done during the marking face. Once your tree has been cut down, then it will be hammered and different pieces will get their own numbers which will then be noted down into the felling register, and when these logs are being transported, they will be again records generated.

Now, once these logs have reached into your depot, then they will be taken down from the truck typically, again either using forwarders or by using cranes. Now, once they have reached into the depot, then again we will make certain records, we will go for the seasoning process, in which case the amount of moisture in the timber is gradually reduced to avoid the to avoid any warping or any defects that could have crept inside.

Then, we make and then we grade these logs ah, so that all the logs which are of the same quality, the same diameter and the same length are put together in the form of a lot and then these lots are typically auctioned off. And after auctioning, people can make use of these logs to create furniture or they can go with more modern products such as plywood, plyboard, particle board and so on. So, this is the process of logging and processing of timber. So that is all for today.

Thank you for your attention [FL].