Farm Machinery
Prof. V. K. Tewari
Department of Agriculture and Food Engineering
Indian Institute of Technology, Kharagpur

Lecture - 47
Machines for Harvesting Cereal Crops, Root and Fruit Crops

Well students, welcome to the lecture number 47. We discussed in previous lecture the details about harvesting equipment. Now, here will be slightly more specific and then talk of harvesting cereal crops, root and fruit crops. All though I had shown you some of the machines there just to introduce you to bring you to your mind set about these machines. Now, let us have a look at these and what are the principles and how they work even the in the field conditions? So, let us go through these slides and have a look at it.

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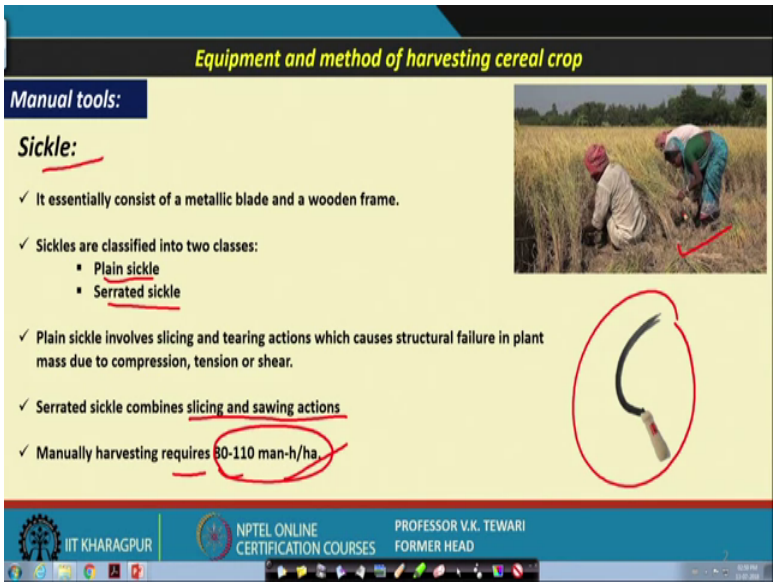

What are the basic equipments the manual tools; in fact, this is the tool which is known as sickle. And this tool has been used from ancient time this was the, in fact when there was nothing maybe people initial people might not have done any solution on this. And simply they might have had a piece of iron and then sharpened somehow and then used it for cutting etcetera, but then this your cutting came up and people became about knowledgeable about all these things so serration scheme in the blade.

And in fact now with this sickle various types of sickles are available in the country. It is worth knowing that in this country the sickles are known as Maharashtra sickles, then Bengal sickles and then UP sickles various types of sickles are available, various sizes of sickles are also available. Depending upon their affectivity and we had an opportunity to work on such a device as to which one is good for a group of persons.

Now, it actually depends on the location, where it has been developed and what is the liking of the people, they are used to a particular one. And if some modification has been done in that they that area people are liking, but if it is done in if it is used in some other area, we found that the acceptability of such a sickles were lesser.

So, as such then they can have a serrations and they can be plain as I told you. Then serrated sickle combines slicing and sawing actions, yes we are trying to see by holding this we are trying to sawing action, we are trying to move it like this and cut. And this requires actually manually and this is a very adverse job and you will find that most of the time, in fact, the women folk they are utilised to a for doing this job of course.

Now, this trend is that more and more women are being inducted into agricultural. They are coming up, because the male people from the house are going somewhere else for other greener pastures and getting more money for doing other operations and tasks and jobs. So, this in fact this number is increased. So, the total man over you can see here that 80 to 110. We have also founded about 30 to 35 mandates per hectare required depending on the growth of the crop the total (Refer Time: 03:28) crop that you have in the land. So, we have found that the harvesting takes so much.

Now, these are very important things, because, remember that the period between harvesting of one crop and then the shortening of another crop is very short. He has to harvest and he has to thresh also and then take the grains and then the keeping up the grains in the in ban or in the houses or wherever they can be safely kept is very essential. After that only he can think of taking off the next crop in the same plot and for that he has to prepare the field again accordingly and then show it.

So, the time period is very less so that is why so much man hours per hectare is not possible and very difficult during the peak season. During peak season such things have been a very big problem and the farmers did not get people for doing this task. So, as such, but they still remain so that is why it was worth showing you here and you can see

we have given a I mean it is not a video, but photograph how the ladies and gents all the people in what posture they are operating. So, these are very hard ware's postures, but they have used. And still they are being used in some other locations in the country and some other places.

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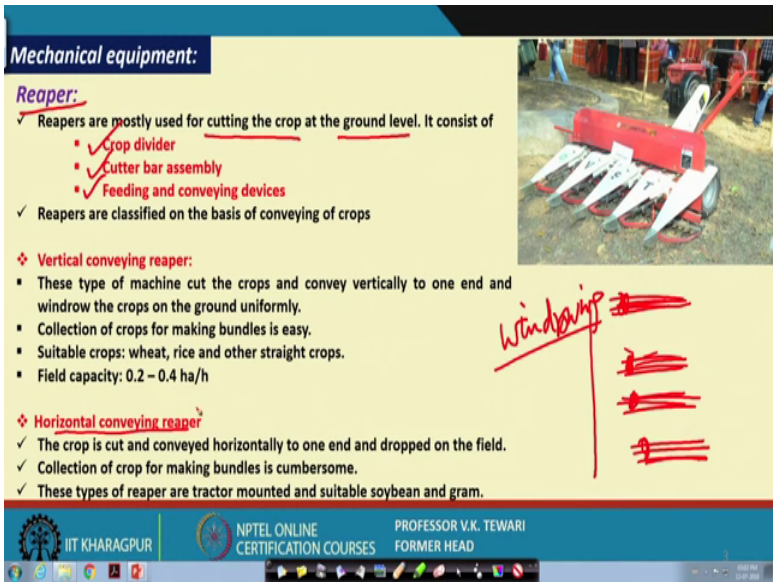

This is one where a mechanical equipment which I had shown you earlier that this is a device which is working. And it says lot of energy as I said that these require a very high energy. If they are manually done, so that is why we have such equipment, which are available. Now, these reapers are nothing but reaping the crop so as you sow, so you reap you must (Refer Time: 5:13).

So, if you have a good crop, you are going to reap a good crop so, that is why the name of this has come as a reaper. So, you can see that this reaper mostly it is cutting up the crop at the ground level and very close to the ground level. And what are the details of this there is a crop divider there is a cutter bar assembly then feeding and conveying devices which are there in these.

Now, these are classified into two types. Actually, when the crop is standing and it is cut what will happen, if generally manually what we do after cutting, small bundles are made and they are put in sites may be like this. So, like bundles are made and they are kept. Now, this job is done by the people so, here the vertical conveyor after cutting, they

move and they are windrow this thing is known as windrowing actually so, this is known as windrowing,

So, after cutting it through windrows the crops on one side of it. Now, the methodology this is called vertical conveyor, because the crop after cutting is conveyed in a vertical action and then it falls on one side. In some other situation this horizontal conveying is also done some of the crops where the crops are in bush type things.

For example in you can say in some of the crops where say soya been or gram. In these crops even they can be cut and they can be horizontally conveyed and that is why there are two types of such convey such reapers available. Now, we can have a look at the video of this.

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I have a look at the video how it works? You can see how it works here. Actually see the windrowing is going on properly as we have set. And if you can see there are 2 machines being operated, so the working is faster. They very fast they can cut these you can see here that the 2 persons are operating. And they have been used effectively for so long. Now, the other what is your problem with these is that they are just windrowing now there are devices where only windrowing will not do.

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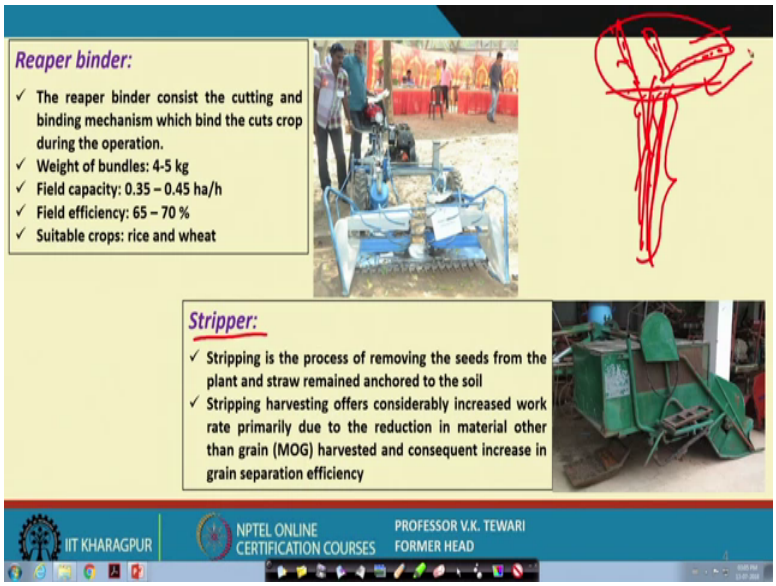

See, we would like that after as I showed you that windrowing after small bundles are made. Now, it will be easier for these to correct and then carry over to the farmyard so, that for that now the farmers expressed and then there another machine came up and this machine is known as this machine is known reaper binder.

So, exactly in the field of capacity field of efficiency all details given over here. And this machine does simply the job which was not done by the earlier machine. So, although there are some weaknesses of that, but still that machine is being used extensively, now this will do the job of binding also. So, the cost is slightly higher, but still if you have people, both the machines can be used, so have let us have a look at this as well.

Now, sometimes this is another one is a stripper harvest. Sometimes you must have seen that when the crop is here like this and it has the these are some of the this is this steam of that and these are the grains which are there into that. Now, sometimes then this sometime the stripper what is done is that this is a stripped this portion is simply stripped and a thrust so that it will simply take from top and these are taken. So, when they are taking like this, the whole this plant is left and this portion is taken.

Later on this these portions are cut and they are left in the field itself for conserving the moisture of that but they are not very popular now. But, as such this is another type of device which is available you might have seen some where we have at IIT Kharagpur we had one got from Philippines about 15 years back. This they are known as stripper

harvest that means they will strip the crop parts of the it where the grains are there. So, this is another one we will have a video of this reaper binder so that you can appreciate that after cutting in the earlier case it was simply windrowing and not putting the bundles small bundles this is done here.

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So, we will have a look at this actually how the whole thing is being perform. You can see the bundles being made see the bundles which are being made here. If see the back from this side the bundles are being, so it is easier for the farmer to collect these bundles and then transport.

So, this is one which is about that and of course, cost is slightly more than that one, but this is the availability of the it is available in the market. And one should if depending on this requirement, you should go for it. If you people are not a aware what will you do? You will have to go for this machine, because people are not aware of even for lifting. So, these are the machines, which I said particularly if the reaper binder and these strippers, so these are also available and they are being used.

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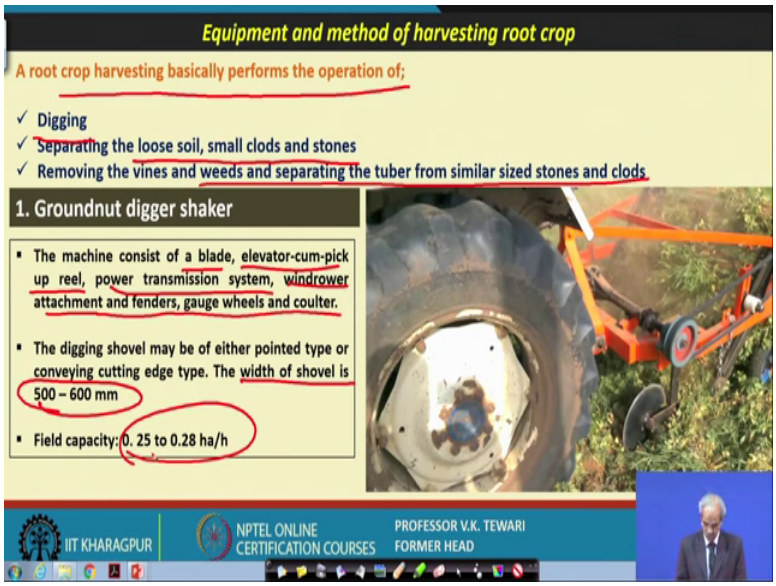

Now, for equipment for harvesting root crops so there we talked of in the earlier to once we said that the crop cereal crops are there. And generally, we had two types which are very important. Now, we are talking of root crops that means the crop which is they actually bulbs just like potato, just like groundnut. Now, these are the once which are there or sugar beet and things like that and even carrot these are all below the ground. So, you need to when you need to harvest them what are the things require see you will require so you will require digging.

The root crop harvesting basically perform the following operations. What are the operations digging will be there it has to be dug up to that level. You should you dug you should dig it to the extent that it should not cut, if it is in this posture supposing a carrot we are talking of carrot here and digging is there at this location then this much of material will be left inside. So, proper digging has to be such that the whole material comes out and the either in the potatoes are there then the it is must be below that so that every amount of potato which is there should be taken up.

So, this is important then separating the soil loose soil from the small clots and stones yes this is what I was saying that if you have done, this is the level at which the plant is there or the potatoes are there, then we have to cut from here. So, and all the soil which is there it should be removed from stones and all these, so that you get clear bulbs of

potatoes or sugar beet or whatever or weeds and separating them a in different size and all that..

Groundnut digger, now, these for groundnut see you have seen the machine consist of a blade the elevator cum picking a reel yes, there would be and then power transmission yes, power is taking from the tractor. We are taking the power from the tractor PTU and that power has to be utilised for the operations. So, windrowing operation which has attached and fenders which are there now, the fenders and that the attachments which will gauge which will maintain the depth operation and then the coulter which will try to cut some of the trusses which will be there on the top.

Now, the width of the shovel varies from 500 to 600 mm. Now, this depends on the type of the design you have and the power source that you have so on that this is, because you must try to match the requirement of the machine or the size of the machine as per the power. Maybe we have discussed earlier and we will in our subsequently lectures we will talk of how to match the power of the power source with the size of the equipment which is very important and so that you can utilise maximum power of the power source.

The field capacity varies from the 0.25 to 0.28 in hectare per hours. So, you can see that roughly within 4 hours or so 1hectare area you can do. And if you have to dig about 1hectare area, even you will require several times otherwise, so many people about 100 people you may require or so. And this is very (Refer Time 15:00) task so, the these are equipment which are already available we will have a video of this and see how it works.

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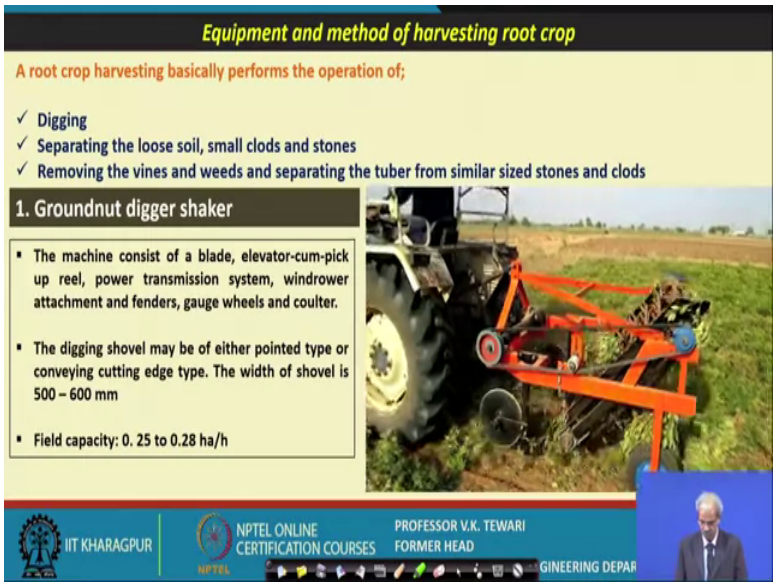

Now, you can see how it works here, the whole operation you seen this is in the ground you can see the bushes etcetera are there. And then the whole thing will be picked up and may be cleaned and then groundnut thresher are available we will talk of that in when we come to that place that in that lecture and those are then actually removed. So, this is you see the operation you should appreciate the point of view, yes.

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Now, potato we as I said earlier that you can think of the groundnut similarly for potatoes. Better you would see manual harvesting a potatoes are require (Refer Time:

16:42) man hour per hectare. Now, you see so much of this time is not possible that you get so many um people for doing this particular operation. And it has to be done at the right time otherwise you will lose the potatoes which are there. And many times we find that these potatoes if they are not harvested, they have to be thrown and even harvested potatoes. If they are not properly preserved, then after sometime they lose their value.

So, it is very important that they should be harvested properly. And they should be stored in the proper locations and places where they can be stored for some more duration of time. The field capacity of the so, we have a machine here which is and so, you the working of this as well. And you can see here that the potato the field capacity is 0.3 to 0.4 hectare roughly you can say that within 2 hours or so by 2 hours, so you will be in a position to complete 1 hectare of this you can see the very good operation of such a machine here.

Now, here I must tell you that depending upon the capability of the person see a poor farmer may not be in a position to purchase these big machines. They are not very big, but as such now the concept of custom hiring has come up. Some of the group of farmers can come together and purchase these machines and use for their own requirement. As well as they can also use give it on rent and earn some more money and field efficiency of such machines over 75 to 80 percent. So, these are some of these devices which are being used and they are worth having.

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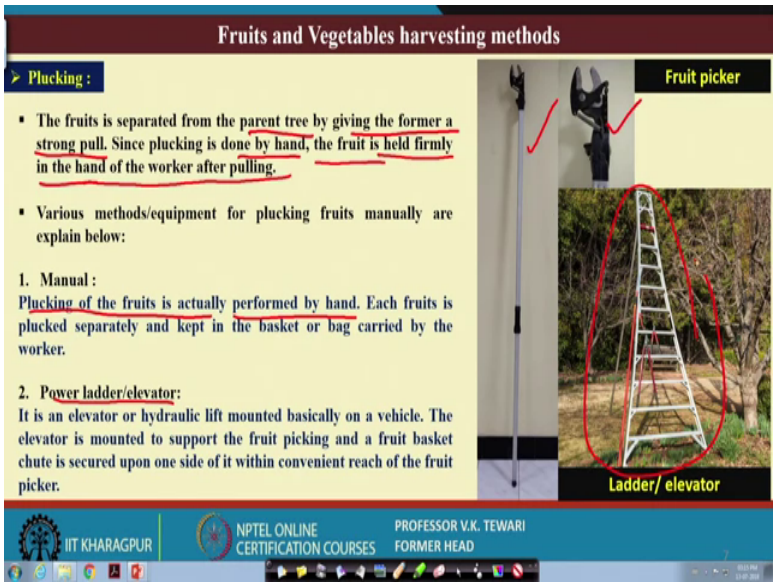

Fruits and vegetable harvesting mechanisms and methods; well, as I said that plucking is important here. And see the fruits are harvest from the parent tree by giving the former a strong pull generally try to pull it. So, the plucking is done by hand fruits are held from firmly hand of the worker after pulling. Now, you can say that the held the fruit is held firmly in the hand of the worker after pulling, otherwise what will happen is it will fall on the ground.

Once, it falls on the ground the fruit is totally spoil, because physically yet you may not see here at that point of time, but then the inside the tissues will get hurt. And after sometime when the temperature and other related humidity conditions are not favourable then it will start detonating. And then if you cut the fruit, after that it would not be in the position to be eaten, so this is difficult.

Similarly, manual plucking fruit is actually performed by hand. Manually, see you can pick up each and every mango if you talk people go into the tree free and then pick up the mangoes, they carry with in their small bags and all that. This is one way, but then how do you get so much people this is not possible.

So, the various types of ladders have been made you can see here. The various types of ladders have been made I showed here earlier I showed this is one way device, which is there. And you can see that this particular device which has been made so, the people can go onto on to it and then reach to that location. As I said in fact tractor drawn platform I have also been used and design you might have seen at some locations.

And these are available for plucking of these fruit sometimes in fact by shaking also we tried to take the fruits. What is done is that whole say suppose branch is the whole branch is held and then at certain frequency and amplitude this is you can say that vibrated. And this shacking is done and that through that shaking then net very big nets or spread at certain height above the ground and then fruits etcetera are collected.

Now, this one way of doing it, but still there has been found to be some damages, because when they fall, if they are not held properly very straight then they will fall and then they will become hips at various locations and that also the damages the plant. So, those are the different types of methods which are available and which people have used for this particularly when you go to hill regions, there it is very difficult even these apples and all that is difficult which are there on the hill region.

So, people go manually these are done, but where you have a larger plantation, when you are having so much of area to be harvested and the fruits are to be harvested well in time. So, that they are they are used and they are properly kept in the bags or in the proper places, so they can be transported properly so, this is very important.

And so when you are talking of harvesting of these, very you have to be careful. Same thing happens for vegetables also we will talk we have talked a fruits and vegetables. When you vegetables you have seen that vegetables are as fresh as possible, you would like to get the vegetables. So, maybe that you can have e carts where you can cut the vegetables or harvest the vegetables which were available and then put in e carts and then take to the market or store for a day or, so then take to the market or let we take it depending upon your requirement and depending upon the requirement on the market.

So, and many people have done this thing and if a people are good business out of the e carts which have been designed for fruits and vegetables people are making organic fruits and vegetables and then they are using this such devices which are available to them.

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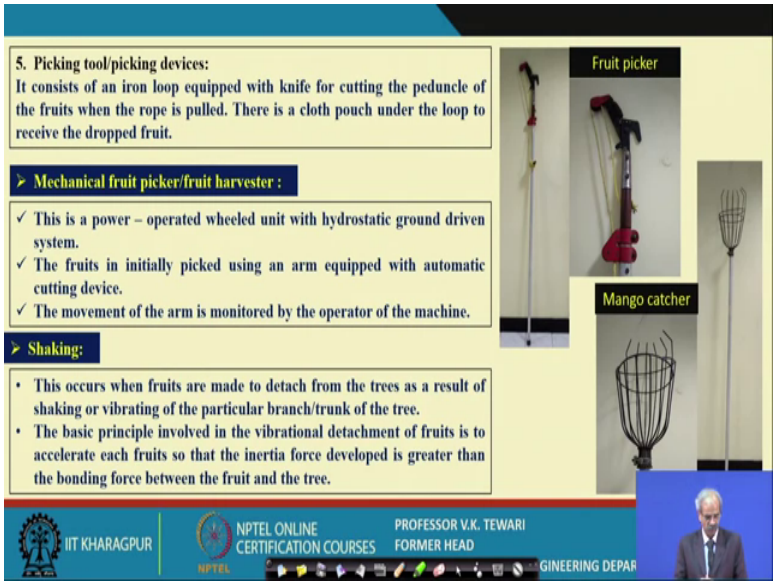

Well, these are the device which we are talking of their this for mango you can see here that a catcher is given and it is a fruit picker and this another device. Now, mechanical fruit picking fruit harvester shaking as I told you all these are the devices which I have already said. We have given you here some right up which will help you in

understanding them instead of hunting anywhere else. When you go through this video, you will have this material with you and you can see this and understand. If you require some more details when you can go to some of the books or rather literature and have more information about these.

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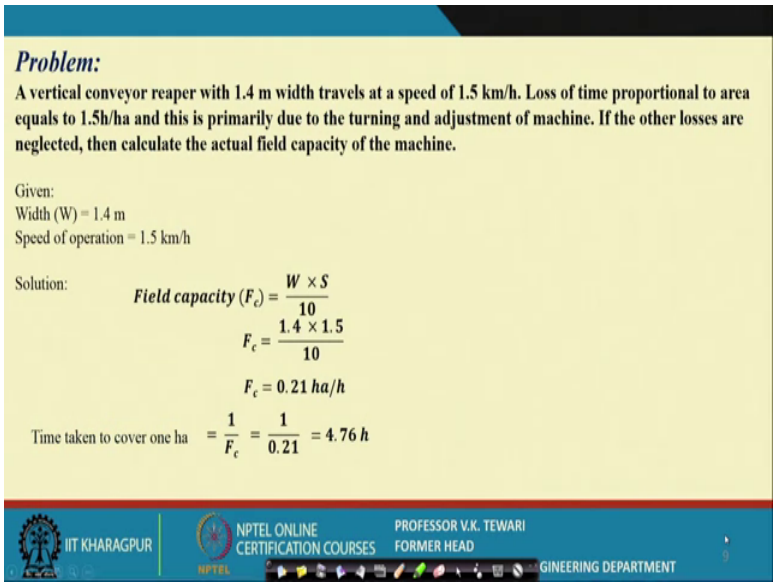

We have picked up a problem for you we want that you should also try to see how these are used and what are the relevant way of understanding the these advices. Say for a conveyor the problem is a vertical conveyor reaper with 1.4 meter width of the reaper travels at 1.5 kilometre per hour, loss of time proportional to area equals to 1.5 hour per hectare.

And this is primarily due to turning and adjustment of the machine, yes, turning losses and other adjustments required for which there is a loss. If these losses are neglected, let us neglect these loss then calculate the actual field capacity machine very simple one, but yes it makes you think to how you will go about it.

See, you must have seen that the field capacity is W S by 10 we have heard, where W is the width of the machine, S is the speed, W width in machine in metre and as S is the kilometre per hour, W S by 10 which gives you field capacity in hectare per hour. So, using this you will straightaway get this thing, but then time taken to cover 1 hectare is points 4.67 just reverse of this is what it is.

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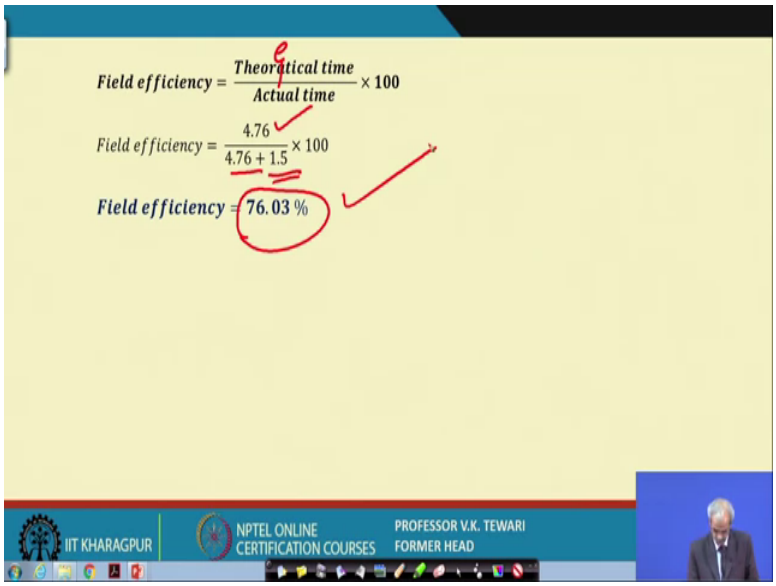

Now, you have been given that a certain amount of time is lost. So, field efficiency is theoretical time. Now, there is a mistake here, this is e theoretically theoretical time and actual time so, actual time theoretical time by actual time into 100. Now, field efficiency is that your theoretical time we have work this much, but the actual time will be we which will add up the time which has been lost so, you must add this. Once you do this, you get the actual time so, the actual time is available and theoretical time you have worked out. So, the field efficiency is this is the field efficiency now this was which was ask to you.

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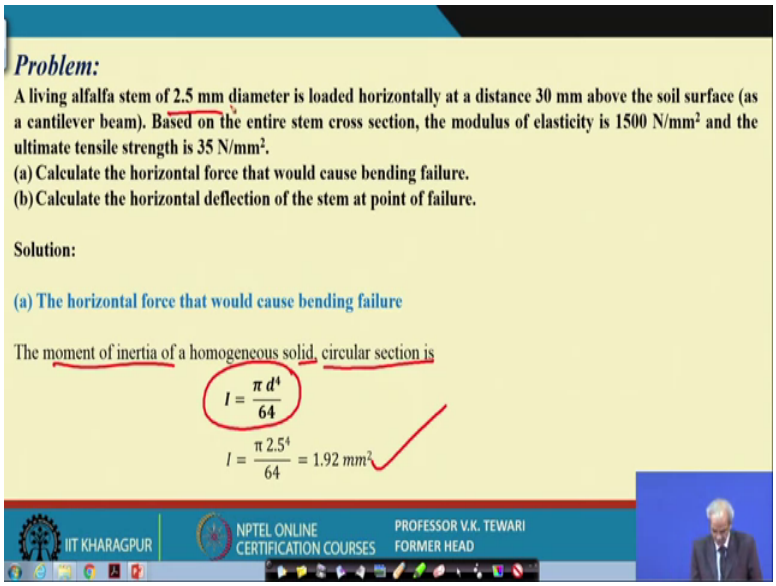

Now, another problem has been taken to make it clear slightly more clear. See a living alfalfa stem of 2.5 millimeter diameter is loaded horizontally at distance of 30 millimeter above the soil surface as a cantilever beam. Now, based on the entire stem cross section the modulus of elasticity which is given as 1500 Newton per millimeter square and the ultimate tensile is strength is 35 Newton per millimeter square. Now, we need to calculate the horizontal force that would cause bending failure and calculate the horizontal deflection of the stem at the point of failure.

So, very good a problem it will bring your knowledge of these strength of materials and the way we do. And the formulae which we have already given in this respect of a cutting and bending force is required for the plants and these structures which we gave earlier. So, we have utilize this over here, you can see here this is the one which is given for solid and circular section so for moment of inertia. Now, moment of inertia is found out from **w**here d is the diameter of that which is over here, so the d diameter of the stem of that plant this is known.

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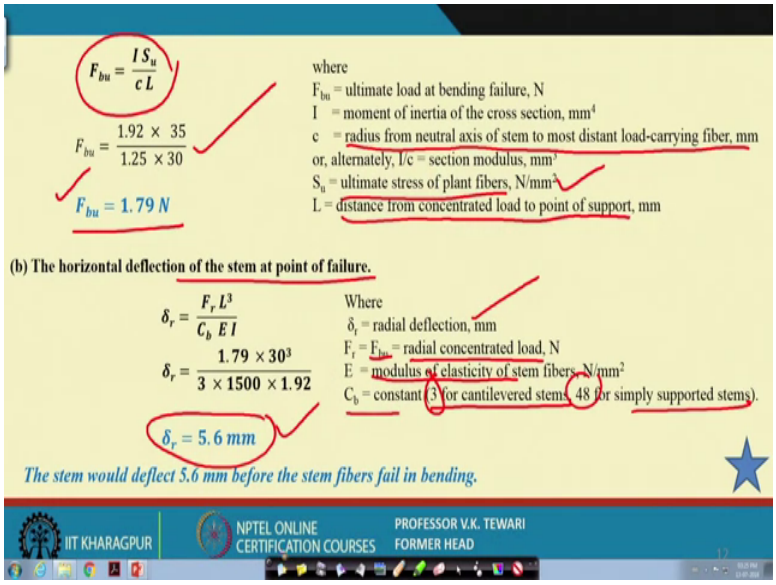

Then what was the formulae, if you go further you will see the formula which is now this is the formula which is used here, where S u is the ultimate stress of the plant fibre which is given already given. Then I you have found out from that side and c is the radius from neutral axis which is a very important here. Now, and L, L is the distance from load to point of support now this these values are given in the problem itself.

So, you can put these values here and get F bu. Once you have got this then horizontal deflection of the stem at the point of failure. When the failure takes place what is the horizontal deflection which has taken before the failure takes place of that plant which we had discussed earlier. At initial there would be energy for compressing it and then it come for a compressing and then cutting and then final cutting. So, before the cutting takes place failure takes place, what is the level of deflection which will take place, so that using this a particular formulae which has already been given to you these formula which has been developed.

So, we getting all these varies of radial deflection, then the F bu is nothing but radial concentration of the load is nothing but this one here. So, and modulus of elasticity of that material is known. So, using C b is for a cantilever beam it was given to you that what would be there. So, it would be behaving like a cantilever beam so, for that C b is equal to 3. And if it is for simply supported beam value will be 48 or so.

So, using this we are getting the this is equal to 5.6. So, then in this particular lecture what we have talked? We have talked of the fruit crops, cereal crops and then fruit crops and what are the various mechanisms available. And then through a small two problems we wanted to illustrates some of the concepts which we have given over here. Now, we will advise you that you go to the literature or go to the books if you are interested and more know more about it. If you have further questions which you want to ask I think we will be definitely ready to answer to you as and when there the come to us.

But, I think this keeps you and overall idea about what are the crops cereal crops, what are the root crops fruit crops etcetera, what are the basic principles involved in that and how they work? We have shown you certain videos also to appreciate that how they work actually in the field conditions. It is worth showing because, this course does not have anything to do with the laboratory. So, at least these equipment which are being used, we wanted to show you how they work in the actual field conditions and we have shown. So, we look forward to your questions as and when come.

And thank you very much.