Farm Machinery
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Lecture - 21
Design of a seeding equipment: PART - I

Well students welcome to my lecturer number 21. We had discussed in the previous lecture about the fertilizer equipment, we have talked of a GPS based fertilizer application system, we have talked of embedded system and GPS module based application system of fertilizer. Now we will talk about the seeding equipment design, which is very important here. Now since here there are various components of a seeding equipment for example, you would like to know that what will be the hopper size, what should be the metering mechanism, type of metering mechanism, size material of construction of that what would be the power transmission and what are the other details of that how do we do about this.

So, this lecture I have divided into three parts the design. Because every part must you must understand each part in detail so, that when you have to design the machine for any other operation or any other seed, you will be in a better position to do this job. So, I am break broken down into three parts; in the first one I will be talking of in part one of this seeding equipment design we will talk of the hopper will just talk of the hopper.

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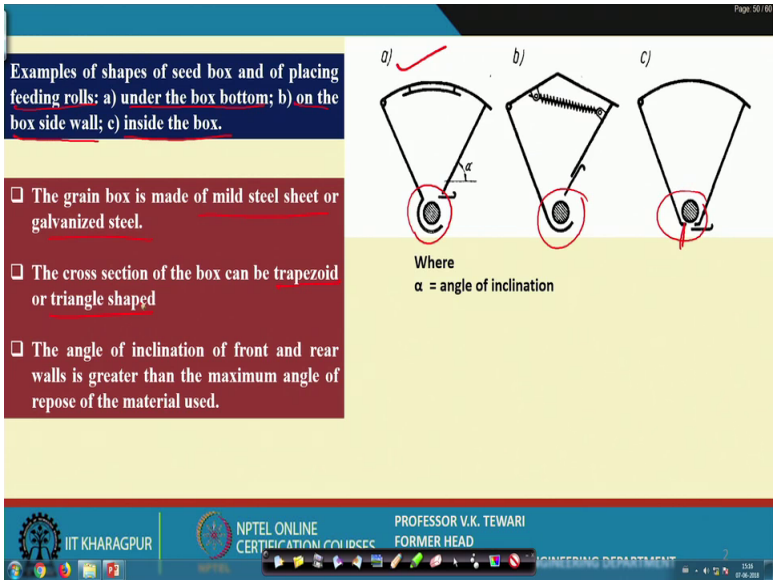

Now, what where is the location of the hopper, what are there with respect to the hopper, where will be the metering shaft there what type of metering will be there all this design. So, if we talk of the examples of shapes of seed boxes and placing feeding rolls, there could be a various examples, but definitely you would know that the angle of repose is one which plays a very big role in storing the material.

Because there should be proper flow ability of the seed, when we are talking of seed or when we are talking of fertilizer because for a fertilizer of course, it is a hygroscopic material. So, there has to be a starrer which will be always starring and so, that the lumps do not get formed, and then I have problem in the delivery of that fertilizer. But when we talking of the seed equipment, we do not need that much of starring of that, but what we required there should be movement of this there should be proper inclination given to the hopper. So, we will talk of the hopper and what are the different locations at which the metering mechanism system should be there.

So, if we see this number 1 here, the green box is made of mild steel sheet or galvanized steel this is the material of construction, we have certain aspects one is the feeding rolls, where should we put the feeding rolls? Under the box bottom, yes here this is where it is. We can have on the box side walls we can have this is the b we can have on the side walls you can have it or you can have inside the box total inside the box. You can have the system here there will be system for opening, and the material can follow from here.

These are the three types, now the grain box is made of mild steel sheet or galvanized steel, well this is a material of construction and it depends on what you want to do it will vary from the sophistication level you want or if you want to lighter one, then accordingly you have to go to plastics and various other aspects of the design of the material or selection of the material of the hopper. The cross section as I said cross section will have a greater wearing on the angle of repose of that. So, most of the hoppers do have these two types the trapezoidal shape or triangular shaped once.

The angle of inclination from the, of front and rear walls of is greater than the maximum angle of repose of the material used. Yes, this we need to have because so, that there is proper flow ability of the material that is more important and that is why you have a greater angle in the scale. Now let us see what we have plan further, while we are talking of the design of the hopper.

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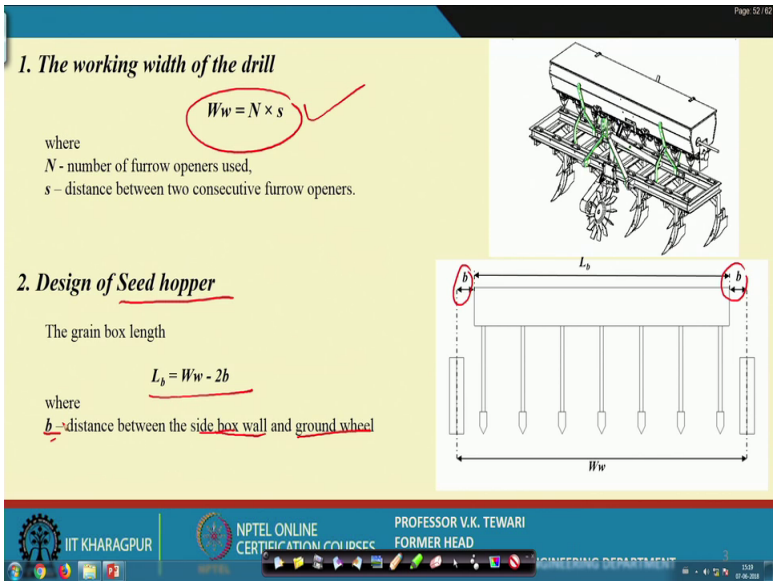

Well first of all you must know we were designing for what type of power source. Now we will limit our discussion to the power source particularly with respect to tractor, because when we are talking of machinery we are talking of power sources and medium to large power sources. So, when I talk of medium, we talk of say lower horsepower tractors to higher horsepower tractors. Now, for that first thing which we will be required is.

How long will be the from the width of the this particular drill or the seed drill which will be there, and accordingly what will be the size of the seed hopper. So, you can see that the working width of this is given by a very very simple, you I mean it is very simple to understand the number of rows and the distance between the consecutive. So, this is the total working width which will be there. Now this working width when we are talking of these total working width of the system. Now when we are talking of these design of the seed hopper here we would like to get the total length of that. Now if definitely you will appreciate the point that you should not be very wide beyond the width of the tractor because then it will have other complication particularly while, moving you will require lot of headland management and while transportation also of this.

So, we generally limit that becomes the width of that. So, an idea is there that what should be the length there. So, accordingly we have put here, the length of the box given

I like this when we have the working width minus 2b. This small distances we have kept because this is the box was side box wall and ground wheel this is the distance we want to maintain certain.

Now you would say how much in all that? Well it is all something from the rule of thumbs something from experience which comes. So, we will talk of these values later, but then you have to have in between this. So, you get an idea about what is the total length of this, now here the details are shown, let us proceed.

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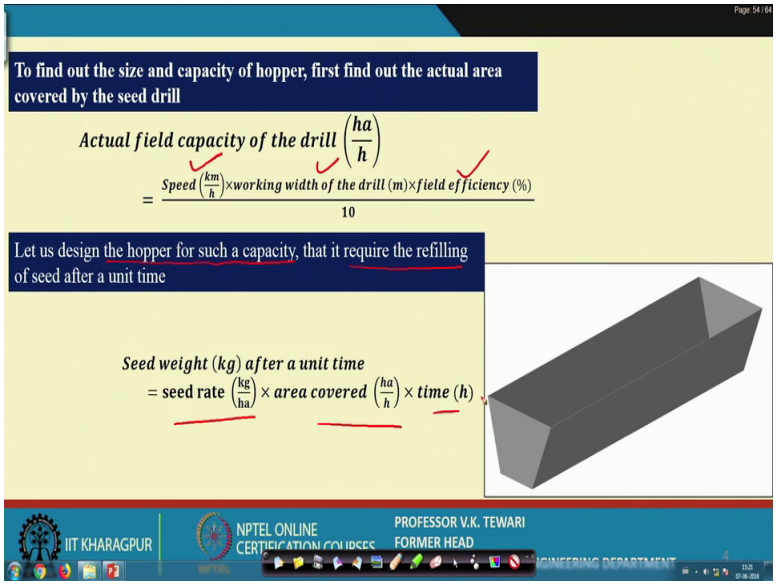

Find out the size and capacity of the hopper, by well to actual area covered by the seed drill.

Now, once we know we need to have some basic information that, what should be the size length is known that what will be the other sizes of that dimensions of that. But then this will depend on actual field capacity of the drill how much field capacity, we are planning to have. So, this will depend on the speed, the working width of drill, and the field efficiency. Now when we talk of the design of the hopper for searching capacity, what sort of refilling. Because you do not want that once the tractor goes into the field and if the field is very very large about 10 hectares, 15 hectares, 20 hectares 100 hectares you would not like that once they start it should just finish and then come back definitely not. So, considering all the practical points of view, you would like that we should have some refilling of this.

And the moment you talk of refilling you would also talk of how much should be the filling on to that box in the seed drill. So, this will be further, what is the seed rate you want, how much area you want to cover per unit of time or in a given time. So, if you assume that we want to cover certain say we will take (Refer Time: 08:25) or oil will stop the work after sometime and then fill up then you that gives you an idea about the amount of the seed which you want to have inside this.

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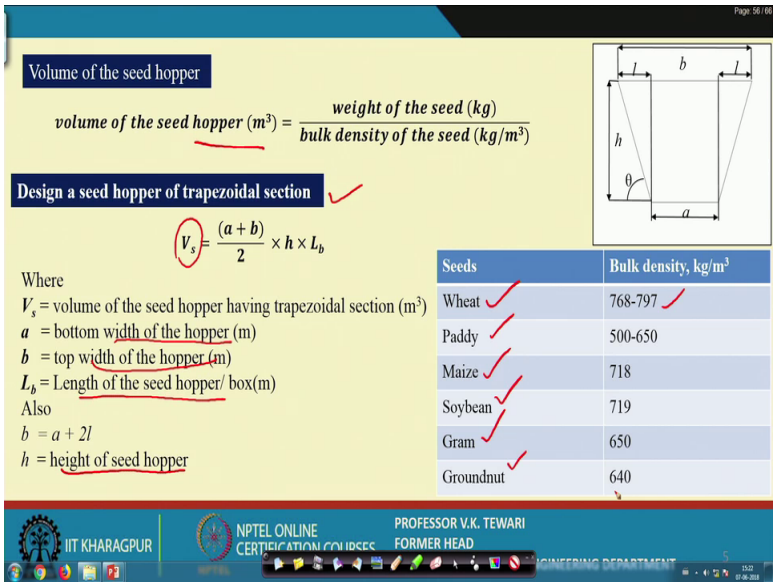

So, the volume of the seed hopper now then it is easier now it its very simple if you go through the details of this diagram which I have given here, we will be able to understand how to get the volume of the seed hopper.

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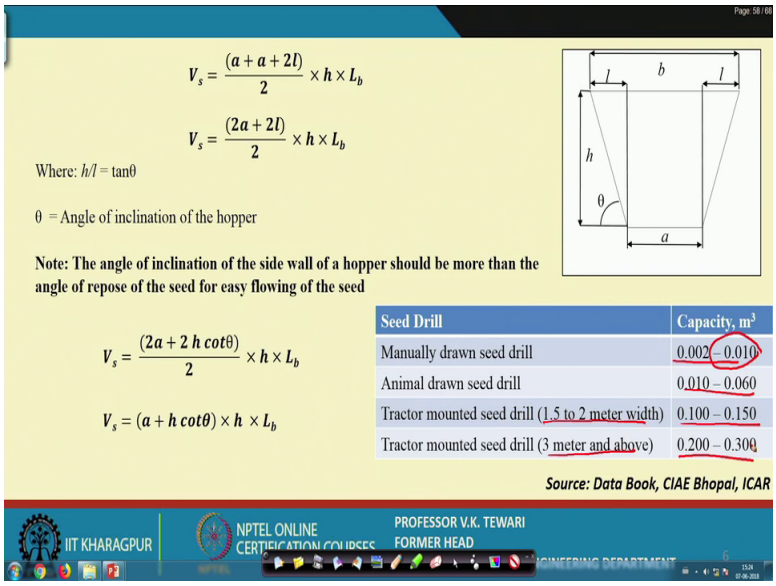

Volume of the seed hopper here, and then the trapezoidal section we are giving the trapezoidal section here. So, from standard knowledge of geometry you should be in a position to get this V s with respect to what is the bottom width of the hopper, what is the top width of the hopper, what is the length of the seed hopper and what is the height of the seed hopper.

So, knowing all this you will be in a position to get this seed hoppers dimensions. Some idea is given over here that if the seeds are say wheat seed, then the bulk density is there because you will require the total weight because that weight is to be carried by the seed hopper. So, you will definitely require what should be the strength of the of the material of construction of the body of the hopper and hence the thickness; because you should be able to take the that much of load. So, for some we have given you this bulk density for paddy, maize, soybean, gram, groundnut these are the values which have been given you can utilise this values when you want to design.

Well continuation from there here we have made it very simple you can go through if you go through this slowly, you will understand each step you will be in a position to find out, how we are in a, how we have found out the V s with respect to the different dimensions of the hopper. The details of nomenclature of all these have been given and it should help you in finding out the total volume of the unit. Certain other information

which we have given is the capacity what are the general capacity of these hopper capacity of these hoppers.

Say for example, say manually drawn seed drill if you have manually drawn seed drill, this is the amount varying between this to this animal drawn seed drill about this metre cubic is the capacity, tractor drawn units about 1.5 to 2 meter will have so, much metre 0.15 meter cube a capacity or tractor drawn units 3 meter or above something of this. Now this is from a design data book, which we have got from this particular source.

So, we have given it for your information at this point of time, depending on what you want to do. So, it is very nicely explained here and you would be in a position to understand this with little bit of geometry knowledge, which you have already I am sure.

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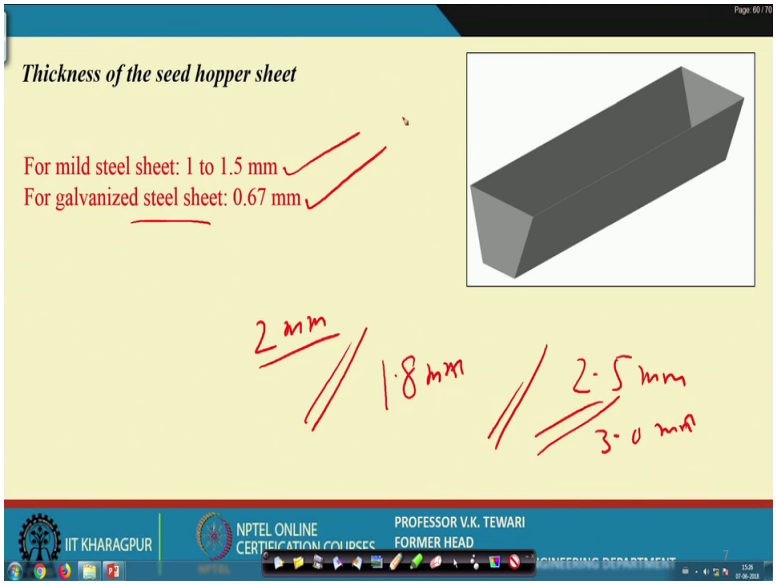

Thickness of the seed hopper well; considering all machine design knowledge and the total weight which is coming onto the hopper material and the shape etcetera, I am sure you would be in a position to find out what is the thickness and you will go to the market for selection of that that materials thickness and many a times, if you see that the see you find out the thickness is about 2 mm and the sheet which is available either for 1.8 mm or mm or is available for 2.5 mm or 3 mm.

Now, depending upon your requirement if something in between here, in between here, in between here now, it is your experience or your designer's point of view, that you will

choose a material which is slightly stronger. And because it will have to work for a longer duration of time you would like to take even slight higher thickness will help us.

So, from the literature and from our experience, we have found out that for if you take mild steel sheet then this is the thickness, which you can pick up from the market, if you take galvanized sheet this is the thickness which will do the job. So, this will help you in getting this information and hence you can find out the thickness of this.

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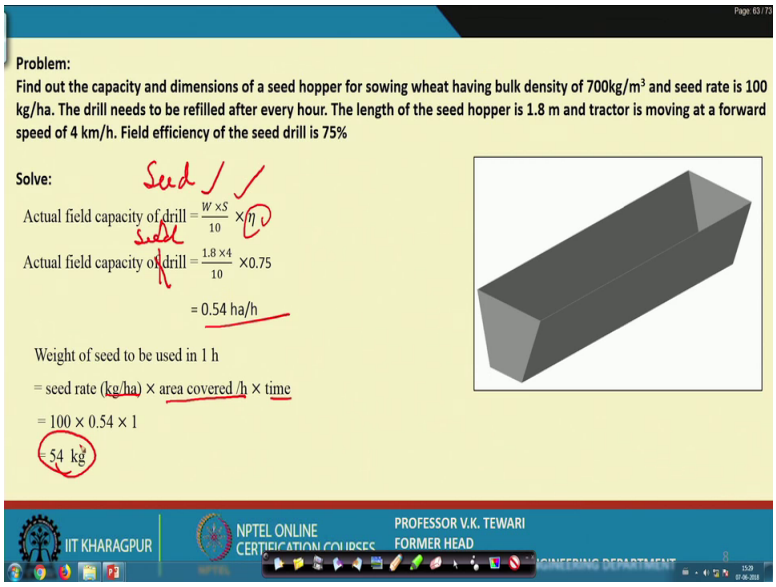

Now, problem has been given to you. So, that you are in a position to understand what is this and how do we how do we actually use information or knowledge which has been given to you it is like this. Find out the capacity and dimensions of a seed hopper for sowing wheat having bulk density of 700 kg per metre cube and seed rate is 100 kg per hectare, the drill needs to be refilled after every hour this is the requirement.

The length of the seed hopper is 1.8 meter a limitation has been given to you and may be the data which will help you to proceed at from some point of time, if you go back to the informations or the equations which we have given earlier. So, this will help you in putting this value and coming out with the details and tractor is moving at a forward speed of 4 kilometre per hour.

If the speed is 4 kilometre per hour so, you will have some information has to when it is moving at certain kilometre how much width it is covering, you will definitely need to

gets certain things so far so, that you can find out the capacity and dimensions of the seed hopper. Now we have done it for you here actual field capacity of a drill where here we mean we mean here the seed drill mean seed drill here.

So, at this location also we do mean seed drill seed drill. So, you see that actual field capacity from the standard information that we will find the width, the speed of operation by 10 and to the efficiency. So, this will give you straightaway what is the actual field capacity of the of particular seed drill, if the width is about one, if the length is 1.8 and the speed operation is this.

So, width into length pi by 10 the units have been taken care of and say accordingly you will get. So, you find here that the actual is 0.54 hectare per hour, this is the capacity. So, if you see this. So, weight of seed to be used in 1 hour will be seed rate, which is known to you and then area covered per hour into the time. So, we have taken time of one hour. So, every 1 hour we need to refill.

So, we should be knowing what is the amount that has to be there. So, very simple if you multiply you get that, this is the amount of seed that should be there in the hopper. So, if you have this information, then you work back about the dimensions of this you stocks of the capacity and dimensions of seed hopper. So, this information has given you a straightaway, how much is the total weight which you want to have inside then it is going to details of further.

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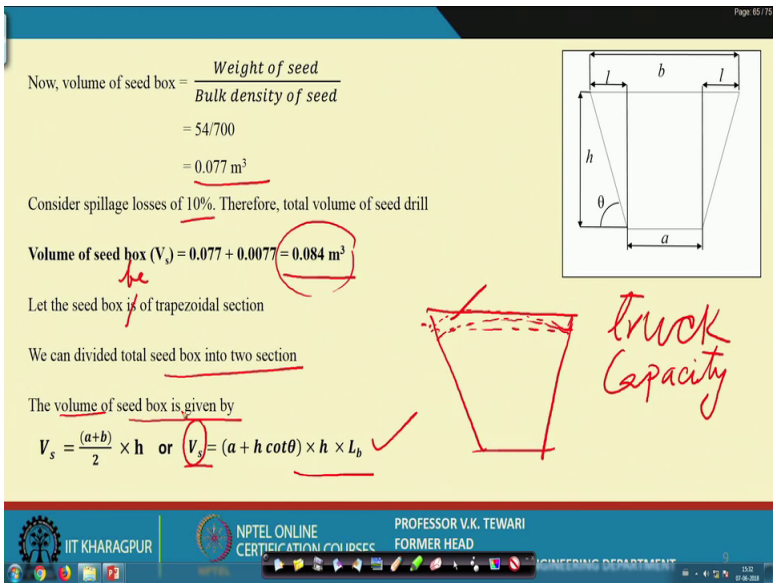

Well then volume because you could find that a data is also given about the density of the seed rate, seed here is wheat seed which has been given the problem. So, once we know the weight of the seed and using the density of seed, you should be in a position to find out what is the volume of the seed box. So, this is the volume of the seed box.

Now, we do not as I was talking earlier at one some point that we do not fill just about up to the beam of that which we call is the truck capacity I can explain, that if you have something like this and if you fill up like this, this is called the truck capacity; this is called truck capacity. But we do not fill it like this we do have certain free board and we do not want because when the machine is going inside, we would not like to fill up this, but there will be a certain free board.

So, this we will not fill up right, this we will not fill up, but then it will not be like this it will be virtually you will find that this will become something like if it is up to this then it will be something like this here yes; that means, it will not be because of the seed it will cover something like this. So, it will not be a truck capacity, but we heat capacity as if there is a heat which is kept inside that regular seed. So, therefore, we will take up free board which you might have also come across such a thing when you are deciding about irrigation problems and all that you might have come across.

So, there is this could be taken as 10 percent here. Using this as 10 percent we get that the volume actual volume then gets modified to this we would like to have this. So, let this seed box; let the seed box be of trapezoidal section, which we have already taken that we will go for beside a triangular or trapezoidal. So, we will take because we have discussed this will take a trapezoidal section. Now we can divide total seed box into two sections, the volume seed box is given.

Therefore the volume of the seed box is given as this now this will come depending upon how you understand the details of the seed (Refer Time: 19:14) theory, which we have given to you and the on that basis you will be in a position to find out the total volume of the seed box V s.

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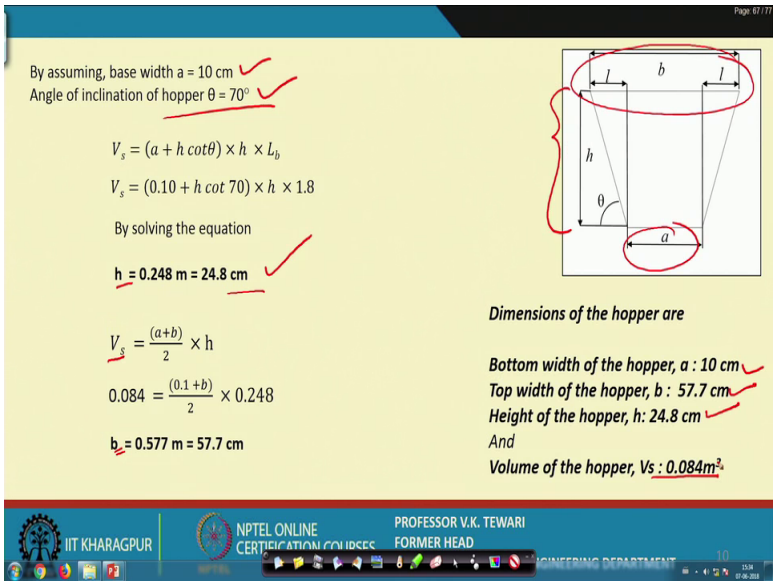

By assuming base width this, this is important actually, as I said as a designer you need to have some experience of what it is or if you are a new designer, you must see what are the already available equipment and what are their relevant values. You can measure them and find out and have some idea why they are depending upon the information that you want to gather.

So, it is very essential for a designer to have this information in hand, and on that basis only this assume a. Now this data, this data a has been taken as 10 centimetre why we assume? As I said that we need to assume if you go through the already available machines or the fertilizer or the seed drill machines, we will find that the values vary around 10 12 centimetres or so. So we have take in that let us say this is this now angle of inclination of the hopper.

Now, this is important we said while designing that we take a value higher than that of the angle of refuse of that and the values varies from about 60, 80 to 70, 72 degrees or so. So, therefore, in this we are taking about 70 degrees. So, if you take this as 70 degrees we are in a position to get the h value which is this here that the total height of this will be given as 24.8 centimetre.

If you put those details you will be in a position to get this I need not go into calculation and showing to you are smart enough to understand how we can get this. So, V s is then

using the V s equation which I was given earlier we are in a position to get b, and this b is this ports and here the total now the top of this.

Once we have a has been found out, b has been taken and the value of h has been forms. So, we know virtually every dimension of that. And once you know this dimension you know the length of it you should be in a position to find out the capacity and the dimensions of all the details. So, using this, dimensions of the hopper that have been designed here for the problem in question, if the a is this value then top width 57.7 then height of the hopper and volume of this is this.

So, this is an example which explains what we had taught you there and what is over here, If you want to take up more this thing you can design your own problems or if you have any questions about that, you can always ask us about those questions. We would like to answer and maybe that in due course of time when we have the assignments and other discussions, we will talk more about these things and clarify if any doubts where whatsoever.

Thank you.