Mining Machinery
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Module - 10
Lecture - 55
Equipment for Shaft: Winding Machines

Welcome students today we are going to introduce another, type of machinery exactly it is a system that is, we say it as a winding system that is particularly for evacuation of the products of underground mining will have to bring it from the below the underground or from the underground we will have to bring it to the surface and then only you can do it.

So, now the way to take the man and materials to underground and then take out the product out this is a system called winding system which you have studied already in your mining methods that how the excess to the deposit is done.

Now, we will be just briefly discussing about what is winding system is and then the introduced basic machinery component which are there in a winding system that winding machines we tell; may be it will be a just, brief introductions and in a subsequent class we will do some numerical and design calculations with respect to this winding system.

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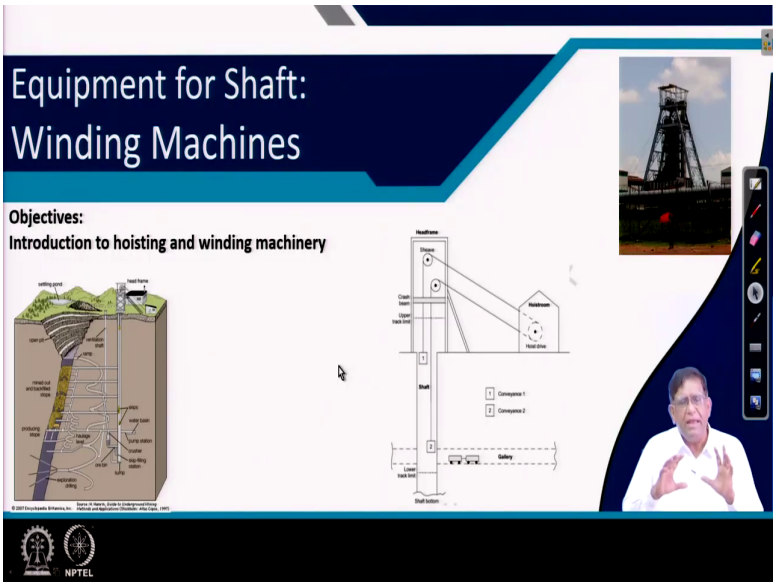

Now, coming to this I think you have seen this particular photographs in number of places wherever you go to a mining site this is a characteristic symbolic iconic diagram of underground mining this is called a headgear always we see that; that means, we know that below this there is a, underground mining work people go down the yards.

Now, here today in this discussions on winding machines we will be just introducing the hoisting and winding machinery. Hoisting is where lifting, now that could be that as you know the mine shaft could be an inclined shaft or can be a vertical shaft.

Today our concern will be mainly, the vertical shafts; in your inclined shafts sometimes you take the material by conveyor belt by rope pulleys or by other means you can, but in most of the vertical shaft we are having this winding systems. You know about the vertical shaft.

So, for example, here normally, we are having this winding systems, where we are having this vertical shaft in any metal mine suppose, this is the way initially there were surface mining then, there is an underground mine for these deposits of the say gold mining is done like this.

Then, from the shafts there will be this edit or this connecting roads they will be making and here the production process will go on and from there that material will be coming over here. So, we can also come by from the surface we can make the haul road and then from their haul road we can go by you can drive your car up to down this by ramp.

So, there is a 2 way of accessing either by this ramp you can go to this levels and the underground or you go by this then, your you lower a cage to this point over here and from there you can go like that. So, that system is there.

So, now, whole this winding system where we are having a hoist room a winding house there will be having a drives just like our wind and from there we will be having this head frame as a this type of structure from that head frame will be having the sheave from that sheave we can lower down this cage or skip there is another 3 system which is called skip to take the material out and do it.

We will be discussing some of the about the skip in our next class. But today, you know that this is a conveyance that which can be a skip or a cage they are bringing over here and this is a gallery where, you can do the mining operations on this area you are bringing the material as you say by locomotive mine car or anything over there and you load this things inside that conveyance that case and you lift it. So, that is what exactly in a nutshell what winding system is.

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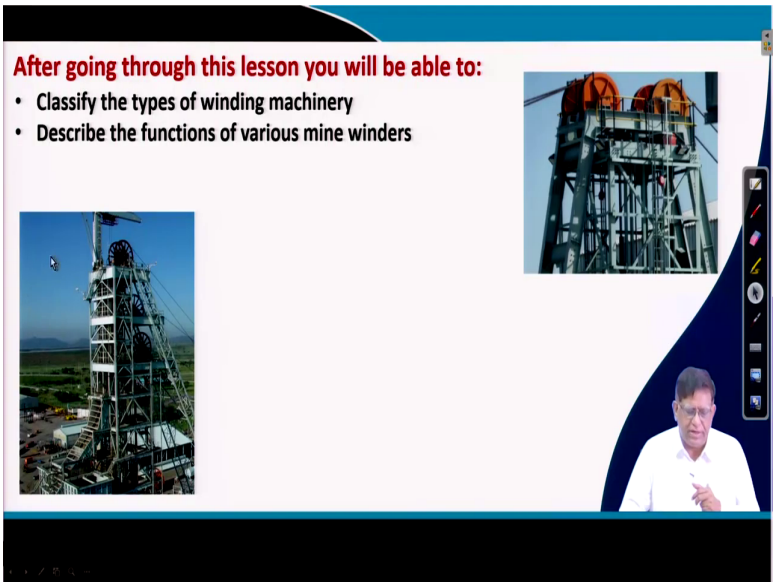

Now, how that is done? You might be this today's class will be discussing about what are the different types of systems are there? You can see in this diagram where from the diagram itself you can tell that because there is a skip there for that skip unloading arrangement is here.

You can see here there is a 2 systems; that means, the shaft has got a double cage 2 cages can do go up and down over here that will be the diameter of the shaft is quite big here by seeing this head frame structures we can tell about that.

So, here also you can see that what will be the different components you can see here that sheave will be there and this ropes are there you can see that different level or can be done by different rope, different sheaves are also here in this particular head frame.

So, one thing is there, depending on the requirement that, how depth? What depth? You will need to go how many operations are that how many levels operations are there? Accordingly, we can do it over there. You may be knowing that, in India, we had some very deep mines like your gold mine in when there were this, your Kolar Gold Field was operating fully.

That in the Kolar gold mine there were about more than, 2 kilometer deep this shaft where this whole winding system it was there at a level at a 2 level; one level was there inside that which has a which had a very very specific, old time this winding system I do not know if those systems have been kept in any museum there. Now, that Kolar Gold Field is not there that champion reef that is a the type of, shafts which are being operated was a very good, that example of didan technology.

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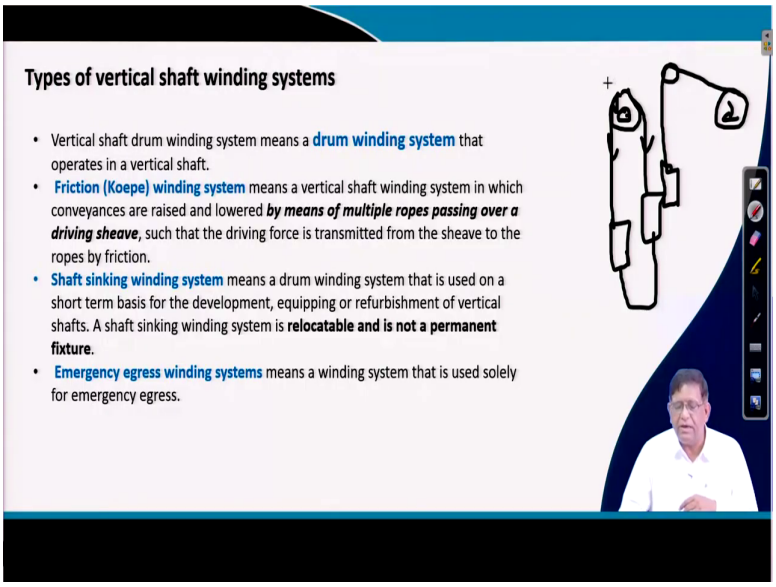

But today, there are number of different type of winding systems that when we say talk about a mine hoisting or mine winding you can see this 4 types of systems are very common that is your drum winding system. The drum winding system means where the there will be one drum on which that your rope will be wound and that that rope will go over a sheave and then the cage will be connected. So, a drum winding system is basically a just you can think of basically it is an winch.

Then, there is a friction winding system in which, there is basically the you will be having that your one sheave will be there and then your rope is a connected over here and then your this convents will be connected over here and then, they will be just you may have another conveyance connected over here these 2 are connected together.

So, this is what is happening, this whole system will be running there is no separate extra rope like that say in a drum winder we had the drum on which this rope was there it was going over a sheave and then it was connected to the that your conveyance over here.

So, this was rotating, but here you can see that this is rope is here this sheave is driven by your, the power and then, by friction this power is transmitted. So, that is your the tension difference over here that will be able to. So, this system which is a friction drive system which is also called is koepe winding system.

So, we will be discussing about this what is this koepe winding system what are there? So, then shaft sinking winding that is shaft sinking means when you want to do a underground mining at that time initially what will be done; you will be having this your surface is there.

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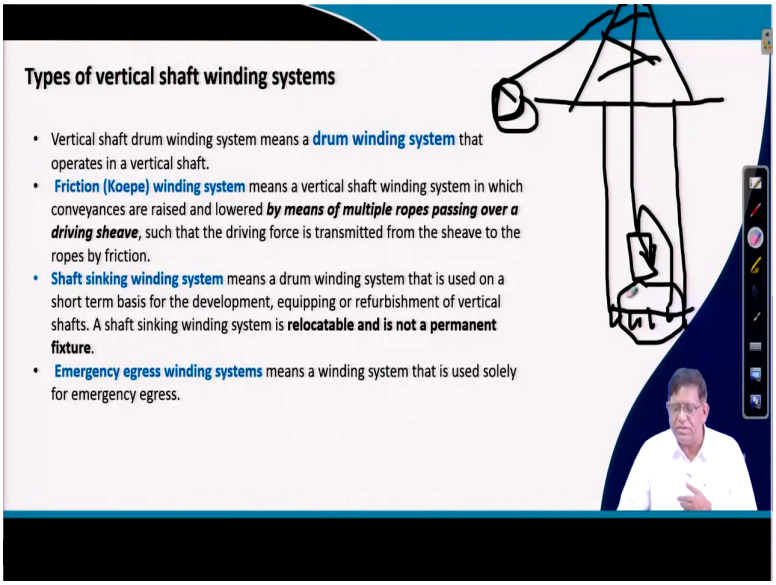

So, you want to make a first a shaft here. So, that you will be doing this. Now when you have to make this well type then there you will have to do this is exactly will be blasted or here the operation and these material will have to be taken.

So, what is done they will be constructing a structures over here and in that structure they will be having a rope system here you may have the whole bucket and then you fill up the material over here raise it over here to raise this, this can be given connected to a drum here and this rope and then that type of a winding system will be developed in case of your this a during the sinking of the shaft or; that means, to excess to the mine when you will be doing a that starting job at that time that winder is not like as a full pledged that when you are we are working that operating winding system and that shaft sinking it is a temporary job.

So, that temporary arrangements and it requires exactly to take out the material they are depending on the type of machinery type of system they use this shaft sinking can be different and then there is a emergency egress winding system you may be remembering that there was in the first big accidents in that mine disaster in a eastern coal field where 78 number of workers were trapped.

At that time you may be, you may read somewhere in the history that IIT Kharagpurs Professor Ramlu. He designed a capsule and to that capsule was lowered down into the, that location where they miners were trapped and by that the miners were taken out. So that means, an emergency egress. So, you can you make a drill hole and true that you will have to leave that.

So, that type of temporary lifting arrangement is also a winding system. So, when we talk about the mine hoisting it could be this 4 type one is a drum and koepe winding in general, but we are also having like this your shaft sinking time and also for your emergency egress.

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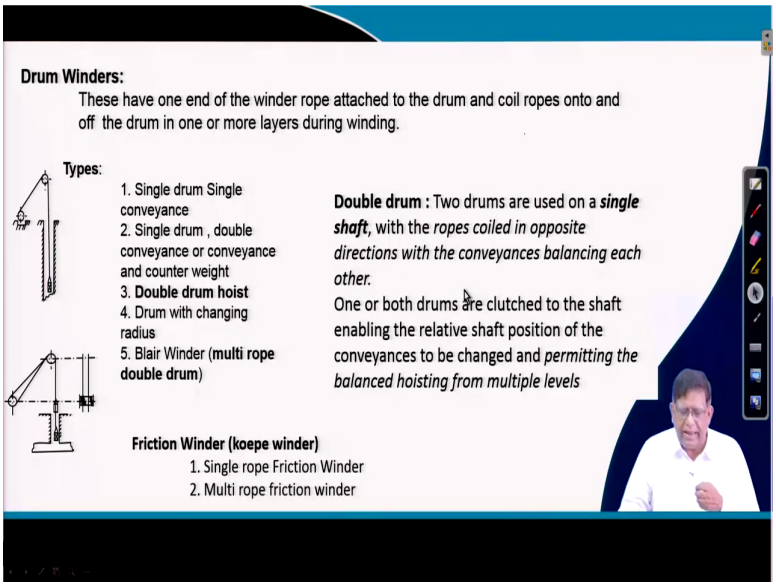

So, the most important is the drum winder that drum winder as you have seen here it can be of different types as it is say the drum winder have the say one end is connected to the rope and the cage is there it is going down the shaft and it can be a single drum single conveyance one drum and only one conveyance.

Similarly, it can be single drum and double conveyance; that means, your there will be 2 conveyance that one drum, but you are connecting with 2 that is, what is there? This drum as you can see here this drum has got the 2 part compartment over one from one your empty one is lower drum the other one your raising the things.

So, this could be done from the one drum 2 system, but there is a double drum hoist this double drum hoist where 2 drums are used with a single shaft that is your, that there is a shaft is one, but there are 2 drums lowering the systems over lowering your cages and skips.

So, one or both drums are clutched to the shaft enabling the relative shaft position of the conveyance to be changed permitting the balanced in hoisting for the multiple levels. So, this is a system when you have to correct the material from different levels we can do that.

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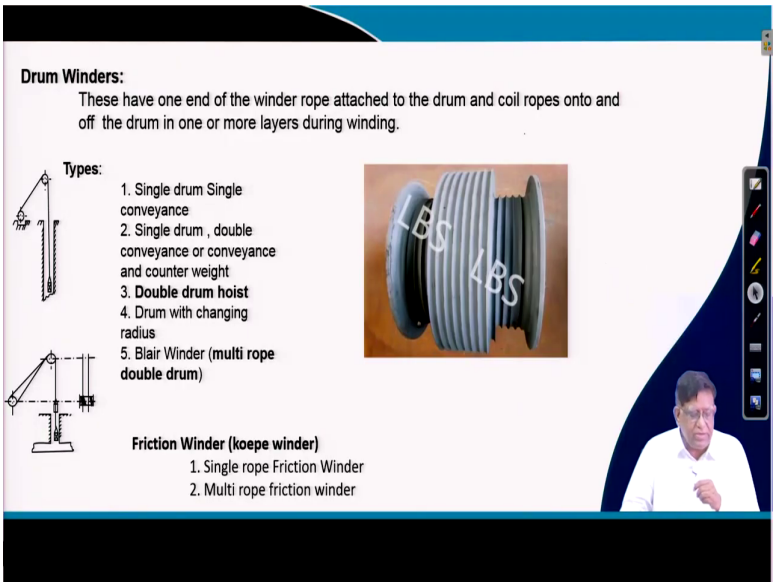

So, there is also this double drum, where you can see as a variable that you can see the diameters can be varied depending on that means, you can accommodate different length of rope over here. So, this type of that is your, with a changing radius or variable radius drums are also used.

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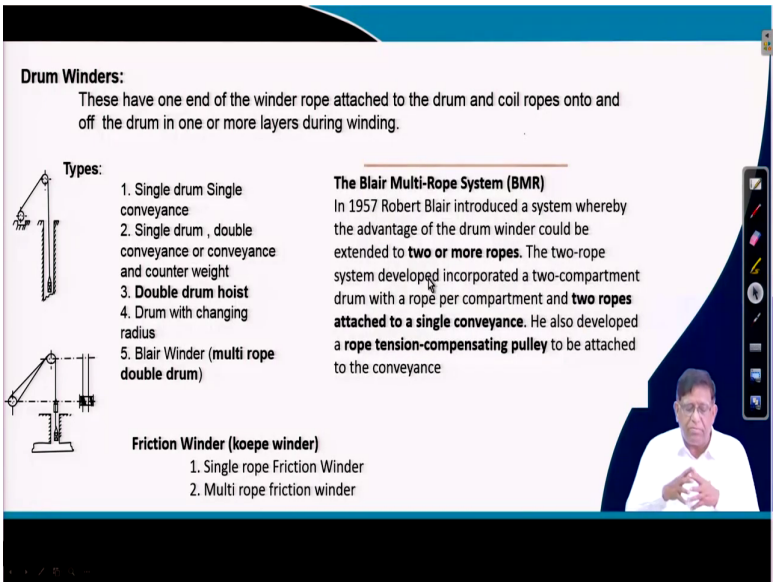

But then there was exactly in I think 1957 or all with blen Blair Winder came this Blair 1957 this Robert Blair developed this system where exactly the drum winder could be extended to 2 or more ropes. So, that way that exactly the drum design that got number of different type of drum winder. So, when you go for designing a hoisting system you need to make a study of this how it has developed and then this how you are exactly collecting the systems over here.

Now, the 2 rope system that was developed to 2 compartment drum with a rope per compartment and 2 ropes attached to a single conveyance. So, that is a, that is the way exactly the balancing systems were developed over here.

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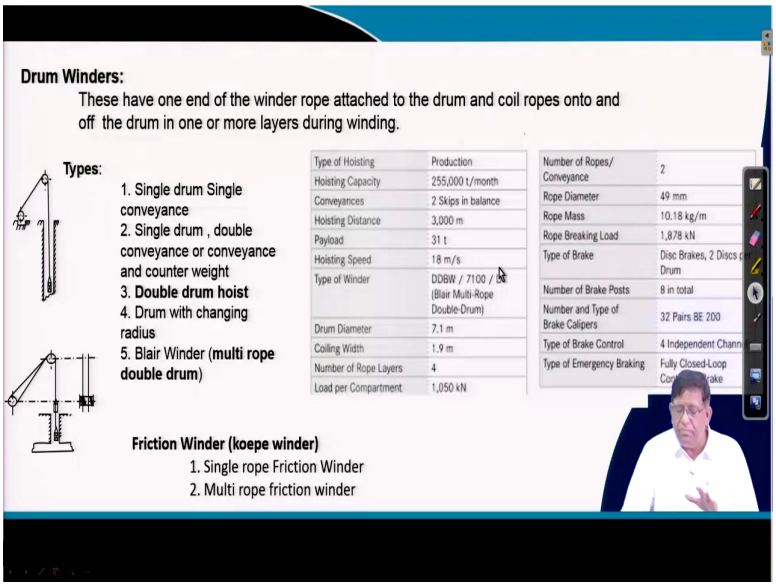

Now, the other thing is your koepe wind it is this in a you can see here before going to the friction winder that how a that your double drum what are the specifications you can see now whenever you are going for designing any winding system you should see that the things which are necessary.

It will be design for a particular capacity, it will have to whether the skip or cage for that will have to be defined then from what depth the material are being lifted, that will affect the design of it. What should be the pay load; that means, how much load material it can hoist. Then what will be the that type of vendor that will be exactly your all the other components design will be depending on this your depending on how much you want to invest in your capital; then this drum diameter you can see here this Blair double drum that will be a 7.1 meter is the drum diameter.

Now, why that drum diameter it will be having a that is your what type of rope you are using normally the diameter drums diameter should be 100 times the diameter of the rope because if, the rope is coming at a particular diameter then if, you do not keep a large diameter then the rope will be having lot of bending stress.

So, because of that this drum diameter and the rope diameter that is called your bending ratio; this is an important things over there. Then the coiling width that how much exactly one rope will be giving a coiling; how many number of layers can be there on the drum? If a; if a drum that is your if you make a number of more number of layers, then what will happen there will be more weight will be coming into the lower layer and then this rope will be stressed and which by which the rope life or the rope damage may takes place.

That's why you are not going to have a more than your 4 5 layers; then load compartment how much load it can take in, one particular sections of the drum? Then, how many number of ropes you can take? that rope diameter you can see here this is your about 49 millimeter and there it is a diameter is 7.1 meter.

You can find out how it has taken it has taken more than 100. So, that this the rope is properly protected then rope mass is very very important that, what type of rope you will be using for your hoisting purposes it should have what is it is mass per unit length is important for calculating what will be the power requirement for driving this hoisting system.

Then, what is the rope breaking load; that means, the property of the material which is being used over there that is a rope is made of their breaking load is important then you know about the factor what factor of safety you are taking over there.

Then this is a type of brakes that is your, when it gets accelerated at that time you will have to apply brake. So, that the type of brake is also very very important in a hoisting system. Now, how many number of brakes, brakes will be provided then your this depending on that brake design this brake calipers it is a because of it is a using a disc brake that how many number of disc will be kept.

So, similarly that you are how the whole control that winder control system that winder electrical and electronics engineering, which has being applied there it is a total system. So, if any one of you like to take a total design of a hoisting system, it is a very good exercise you can study about a month to make all the point and then you are designing you can develop your expertise over here.

And then, just like we are not having much experience nowadays in India in shaft sinking similarly winder design and winder maintenance winder replacement on that also we are having a the scares that is your our supply of skilled man power is less. So, you can develop your expertise in this field.

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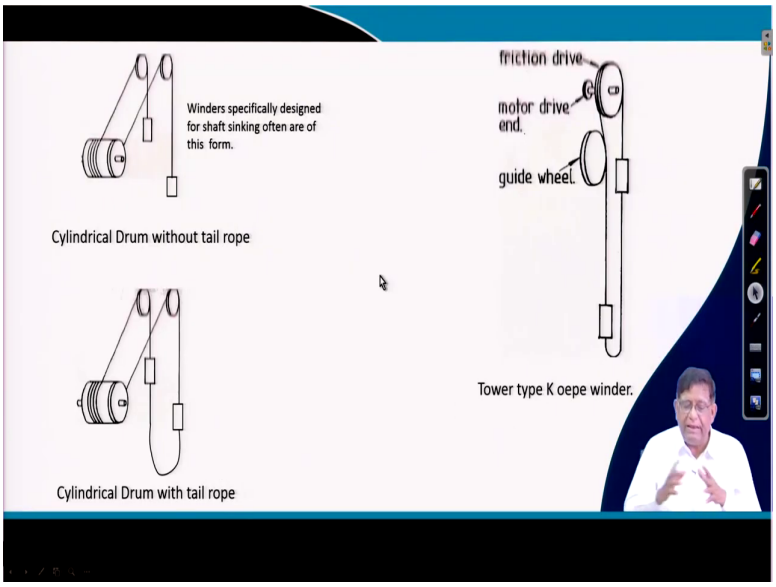

Now, this koepe winding is basically you can see here in this, this is a drum winding on one drum you are having this a, the 2 cages connected and here you can see that how this cylindrical one drum and then this it is connected with a balanced rope.

Here without a balanced rope this is again in the design calculations you can find out what is the implication of it because when it is coming when one is lowering then, the other one is getting of that you can see here when one side of the rope is getting winded; other rope is getting un-winded there direction of rotations here is a different.

That is how exactly, a 2 compartment of the one drum is used for taking 2 conveyance up. That in a friction drive a koepe winding this system you can see there is a sheave and then, your exactly there is a guide wheel by which exactly the angle of wrap is increased over here and it can have one turn depending on the system and then this sheave is driven by a motor here.

You can see this, for and then this one rope is going and that it is connected with a balanced rope sometimes, a flat rope is used to increase the weight on this balanced rope. So, this is a koepe winding

system here this particular one can be mounted on a top of a tower and that is why that, your whole winder can be a tower, tower mounted winder. Otherwise this drum winder often it will be a ground mounted winder.

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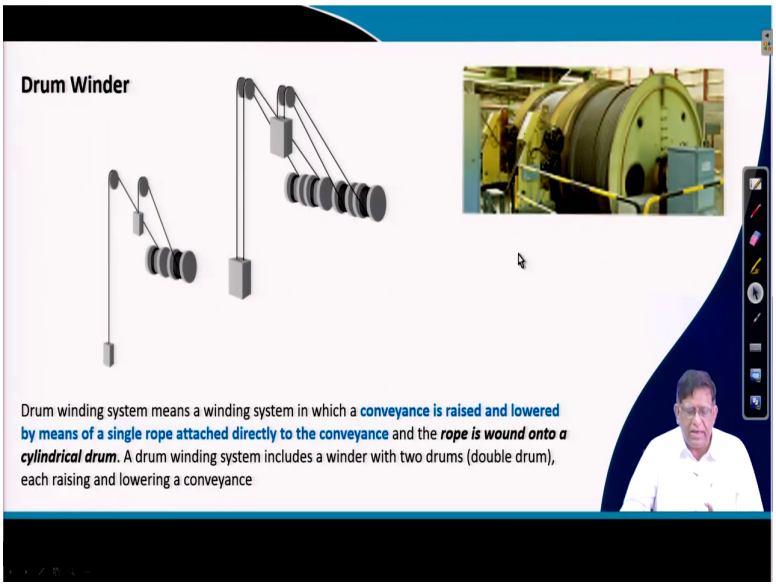

So, by that exactly you can see here this, in a drum winder that main thing you can see the drum that is on which this rope is connected. You can see how the drum that is a compartment on one shaft it itself 2 drums can be connected like that.

That means this is a system in which in one shaft the 2 that is a that your conveyance is moving with a differently, but here; you can see there is a only 1 rope here there we are giving a 2 rope depending on the load that is your different type of drum winders could be there. So, that is a drum winding system means, a winding system in which a conveyance is raised and lowered by means of a single rope attached directly to the conveyance and the rope is wound on to a cylindrical drum.

Now, this why it is say the cylindrical, but there could be the drums are not always cylindrical there are different types of drum if you read the book by say Professor Ramlus winding systems that is a

there are textbooks any minings textbook there you will find that different type of drum, there could be this with a double compartment drum, there will be a conical drum, double conical drum.

So, those are there; you can read the SME handbook there also you can see the old development old designs and then our comparatively the new books there are lot of. In the new winding system basically, the control and the drive these have applied that there are more developments have taken place it has become more energy efficient and more safety.

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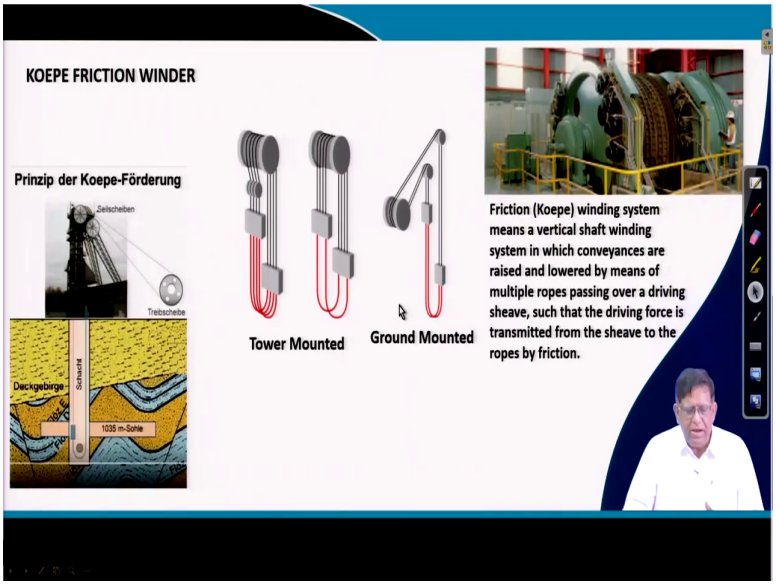

Now, as you see in a koepe winding system, you can see here that is your sorry this is now, in a koepe winding system your this tower mounted you can see over here this is the drum where this rope will be moving.

So, we can have this friction winding system means a vertical shaft winding system in which conveyance are raised and lowered by means of a multiple ropes. So, this could be in a ground mounted if you are this drive the motor, if it is placed on the ground then the drive will be here and

will be having an extra pulley and then it is going. And in a tower mounted you are keeping this ones at the top of the tower.

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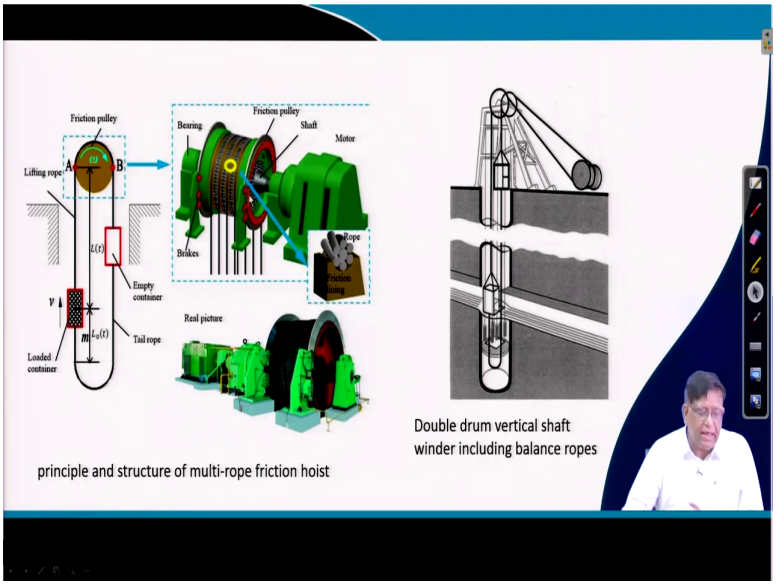

So, this is the way how exactly the koepe winding system works. Now, this you can see a how exactly the arrangements are made now when we talk of a shaft and this winding system you need to have a headgear structure; these structures and their location of the drum and this arrangement is the basic starting point of a designing.

So, in a koepe winding we can have this your, the sheave or the drum on which this number of ropes are going over there and this ropes are connected to this your, the container through which it will be brought it could be skipped or it could be a cage

So, that if you see that what are the main machinery therefore, a koepe winding system. We are having this friction pulley on which exactly there is a rope will be getting the power from this friction pulley and this friction pulley is mounted on a shaft this shaft is mounted on this bearing.

Now, here in the design you will have to select that what type of bearing will be there what type of that is load will be coming on this shaft what will be the torque required and then once you know the torque then you can find out what will be the power of that motor.

And now, here on this the wheel there is a on the friction wheel we are having a grove on that grove this rope is sitting and then it is making over here. So, this arrangement now sometimes in a drum winder also this sheave on which your rope will have to be sitting.

So, now you can see here in a mine winder basically this that your, the drum it will have to be kept a breaking arrangements. So, that you can stop then there will be some of the instrumentation will be necessary; that means, from here only the data will be taken that at is what level the cage is because while you are going down that you will have to know that where it is there and then it will have to say this will have to stop only when here there may be number of such type of layer could be there.

Now, that to get that level you will have to exactly know where that what is the present position of this. So, that is why, you will have to have an indicator that depending on this the diameter of the drum how many turns it has gone. So, you can know that what length has gone. That means it can be found what depth it is there. So, those type of instrumentations are available.

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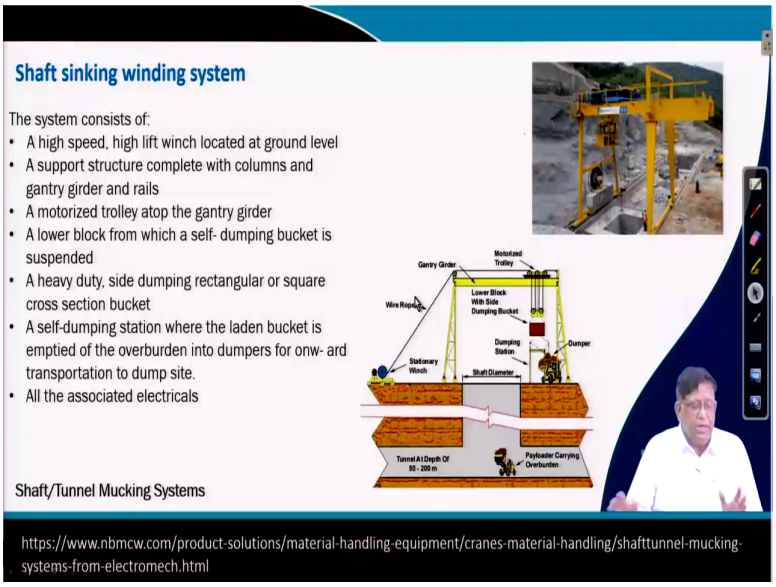

Now, coming to this say when you are doing a shaft sinking; that means, initially to give a shaft sinking a temporary arrangement of hoisting system is made here. You can see in this figure now, this is being opened here there exactly there by creating this hole just like you can see here they have started sinking a shaft or making a hole over here.

Now, we can have this type of arrangements in which say you are having that hoist drum this stationary winch. It will be bringing down this you can put it this can be slided over here you can lower it and then your this container will be lowered down then, this container will be loaded by that, whatever the working systems are there. After that it will be raised then it will be pushed and here and then it will be unloading there will be a chute by which it will be given to a dumper and it will take the muck and will be thrown at a different place.

So, this type of system where exactly a shaft sinking need to be done because the that this winding system only will be telling you what will be the progressing or rate of lowering the shaft because that muck which will be generated if you cannot remove it your progress for that shaft sinking will not be faster. So, that is why this type of winding systems are used for sub sinking.

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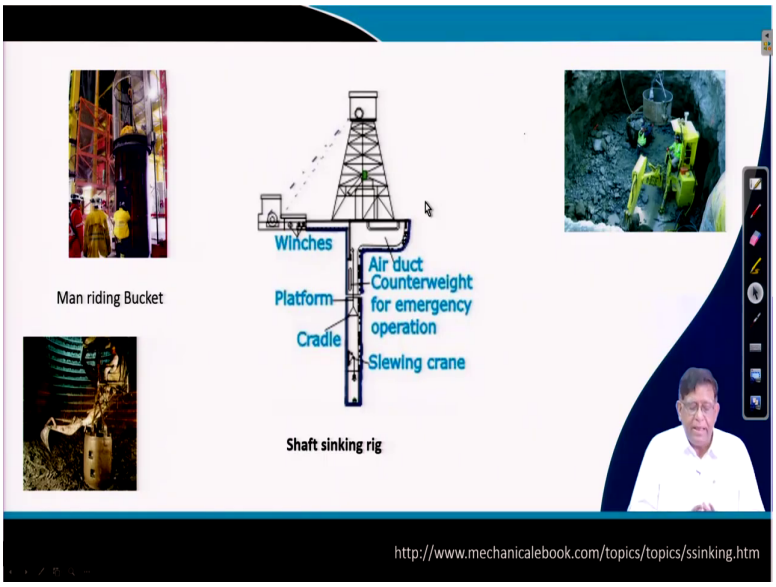

Now, once again you can see that, a sub sinking rig that here your shaft is being lowered here different type of system is there in your development of, that your mining your first shafter, when you study about access to the mine you do the sub sinking while sub sinking you have studied about this.

So basically, there is that wind systems you know this component then here that type of container will be there the persons can be sitting over here and then they can collect the material put it over there and that will be raised by this type of shaft. So, at a bottom these are the operations carried out you can see this container and that container will have to be lifted by this system that is a sub sinking system.

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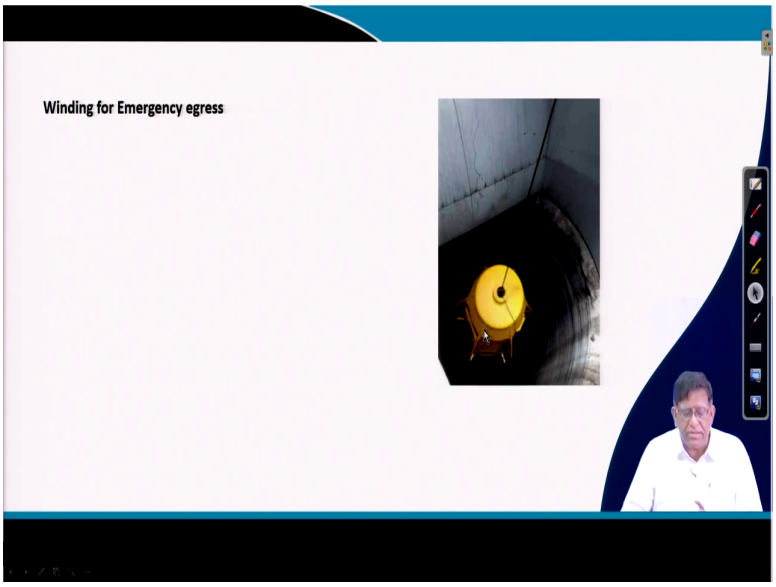

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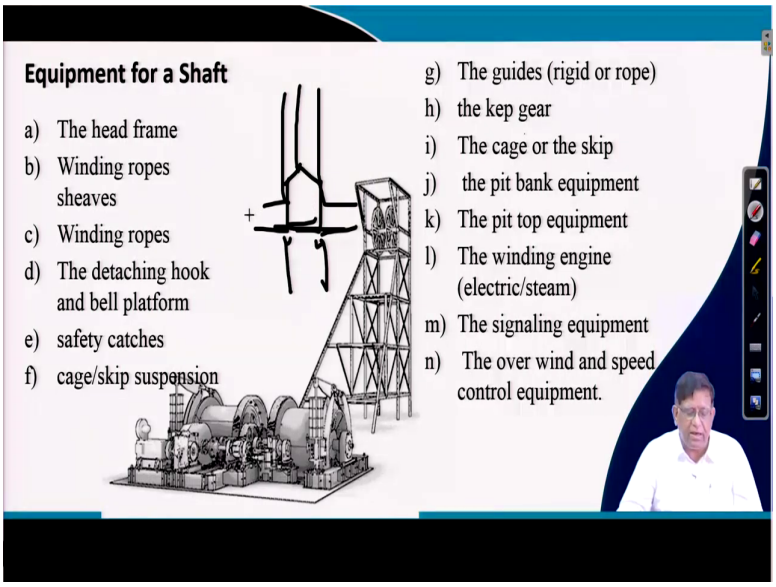

So, sometimes for emergency egress you will have to make this capsule to lower down make a drill hole and then you can do it over here. So, when we talk about that your whole system of winding what are the different equipment are here that if, you see the what comprises this shaft of that winding system you will have a head frame like this type of one head frame will be there where there will be the winding rope we have already studied about the steel wire rope that wire rope is the main things over here.

Then, this winding sheave these are the sheave you can see on which the rope will be moving then there will be a detaching hook what is the detaching hook; that means, when it will be connected to a cage and it is coming over here if the motor is getting over winding and you are not breaking or unable to stop.

Then what will happen? The whole cage and everything will be coming and hitting up at this your sheave then everything will get worn out. So, that over winding protection it is done by the detaching hook and bell platform.

So, this is a safety that in a as per the mine coal mine regulations and the mines act that is your you will have to have a automatic contrivances that is a safety devices in any winding system there it comes that there you must have a detaching hook then safety catches; that means, if something happens there if fall down it will have to be how it will be there that safety catches is a part of the winding system.

Then, your cage and skip how will be suspending the cage and skip; that means, the rope which is coming and you are connecting to the shaft that is to the cage that how exactly you will be terminating the rope how it will be there that is called there are different type of systems called cappel. That we have got a wedge cappel and then this a say timble cappel there are white metal cappel different type of termination of the load is there and then you suspend.

That suspending also, in the way you have connected the cage to the wire rope is to be seen over there then there are the guides that is your. So, that the cage do not oscillate it will have to be kept under a guide and the kep gear when the cage is going down then when you are meeting the your suppose it is going down the shaft and here you are having the gallery when it is coming over the gallery this cage when it is coming down at that time it will have to be resting over here.

Now, that is why, there will be in the shaft system will be there. So, that it will be exactly holding this cage and then it can be let level is maintained. So, that the trolley or car can be pushed inside that cage. So, that arrangement by which it is made it is called kep gear that is, a just like a finger like of things it will be holding the cage.

So, that it does not oscillate and the, it does not exactly it does not vibrate. So, that keeping that thing rigidly. So, that the cage that they different mine cars can be put properly then there will be the cage and their skip that how to be arranged and that is another component.

The pit bank equipment; that means, exactly where it is a banking that means where it is meeting the gallery at that time what are the things should left to be there particularly for the communication. So, that the winder operator must know that, when that cage he will have to put on and off. So, there will be a communication system and then there also at the top surface there will be certain that your controlled and monitoring knowing the level detectors and all will have to be made at the pit top and then the main is the winding engine.

When we say that engine what is the prime mover whether we are working it with a diesel engine whether we are working with an electric motor or whether we are working with a steam engine. As per the mines act it was there that you will have to have a standby power supply system over there that is why you go to any old colliery you will find that along with that your electric motor there is a small boiler and steam power is generated.

So, that if any time this electricity or any other problem that is by the steam you can have an alternative way of that running the hoisting system because that is the main evacuation system you will have to follow the safety standard and standby and all the time you will have to make a highly reliable system then your signaling is important and then over wind and speed control mechanism. So, these gives you an overall what are the different equipment there in a, that is your main system of winding.

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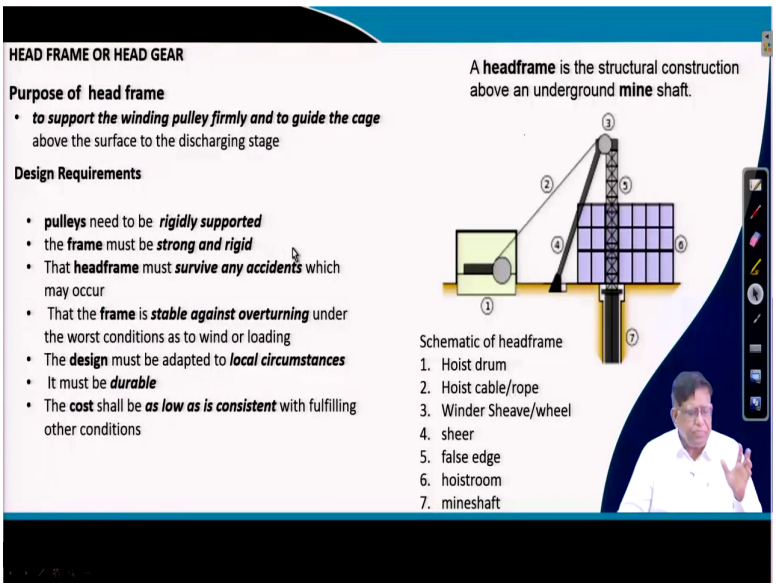

So, that head frame or a head gear which is there you can see the main component you will having over a shaft that is your main hoist drum will be there and a hoist cable will be going and then winder sheave is there from there a sheer or a back straight is called just to give a supporting structures today

your main head gear and then there will be the false edge wherever you will be having the catches and all and there will be the main hoist room where the other facilities will be there and that mine shaft is there.

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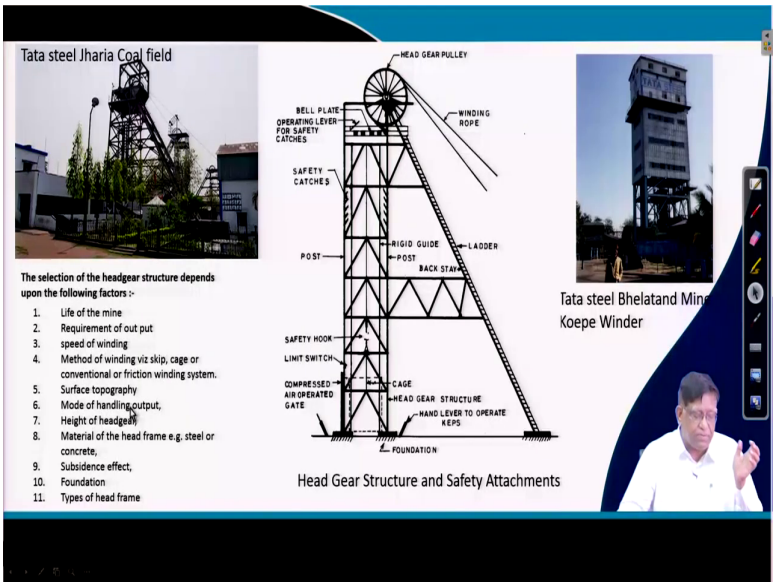

So, you can see that Tata steel which is running your underground coal mine in Jharia Coal field there this is a drum winder system they have and also, this was one of the very good winder that is at Bhelatand Mines of Tata steel in the Jharia coal field they have got a tower mounted Koepe Winder I think this was one of the first Keope winder; which was installed in our country and then in that you can see that when will be designing a winding system you will have to design each of this component.

What should be this structure and column system what will be this structure what are the different type of load will have to be taken. So, you will have to see a 1997 that Dr P.K. Chakravarty has written that book mine winding system published by CMPDI. Please go through that, all the calculations how to be done that is you are designing this are given. As a mining engineering student you can make bring the all the calculation in an excel sheet or you can develop a small software for winding calculation software that can be developed by the students today.

And then the they are exactly, what are the main component as a bell plate and that you are detaching hook we said this is a safety plans as over here then safety catches are there if any, over winding or this is a falling down it will catch the cage over here then these are the post that is tower on which that whole frame is structurally it is getting supported.

Then the safety hook which is kept over here. So, that the over winding protections as I said then there is a gate is operated by compressed air. So, that the cage when it is coming over here otherwise it is it will as and when if, this automatically came and close. So, that people do not come and do not fall down into the shaft below here.

And this will have to be a proper foundation structures and because it will be having a static and dynamic load and then under wind and all everything it must be robust it must not fail because that is the primary things away mining industry.

So, this when we are designing it you will have to consider the life of the mine that requirement of the output speed of the winding method of winding then surface topography mode of handling output height of the head gear that is your materials and then what are the different effects coming and foundation that will have to be designed altogether.

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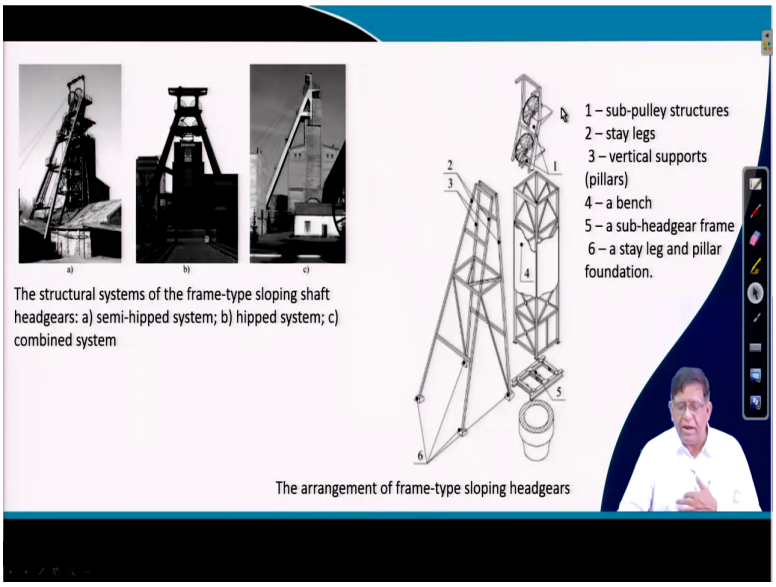

And you can see here, there are different way of placing the things. Now, again here today you are knowing that, you have been studying the stress analysis you know now finite element analysis now many of our, this installations which are available they are all having their remaining life need to be accessed.

So, exactly whether they are still going to performed required life of the mine on that there is a new students as a today you may not be going for having a new winder installations, but whether they present winder there working or not you need to take up some studies that exactly how to analyze that design back and then need to find out how much exactly there the reliability or that risk at present.

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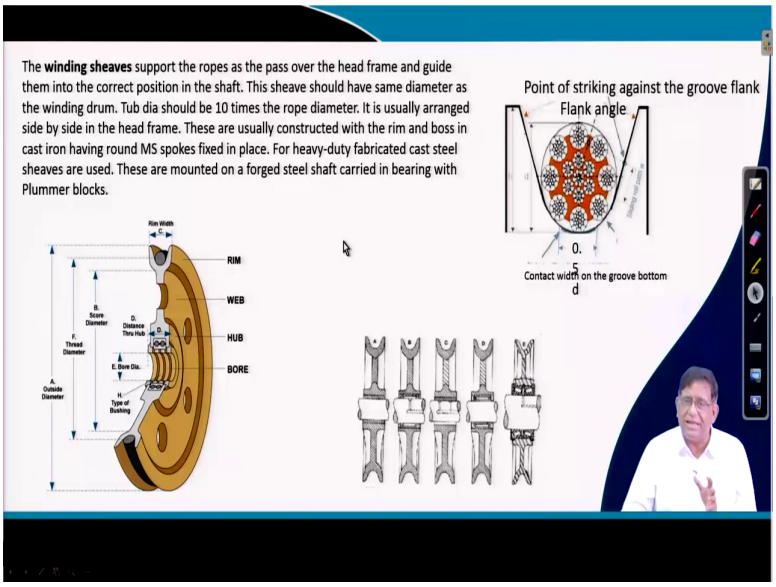

So, for that there are lot of studies can be done; and as I say that the sheave on which the rope will be moving that sheave also are of different design depending on whether you are having a roller and thrust bearing whether you are having a just a bush bearing or there you are having a how you are doing a lubrications here.

This sheave design where this, your rope will be meeting over here there could be a different things that sheave itself is also designed that your bearings are over here; that means, shaft will be going on this and then this diameter. So, this is also a part of analysis you can do. Because, while you are operating at that time if your rope and the sheave that your grove if, they will have to be properly matched. So, that in a proper running there will be a liner on that liner this your, rope should be properly matching.

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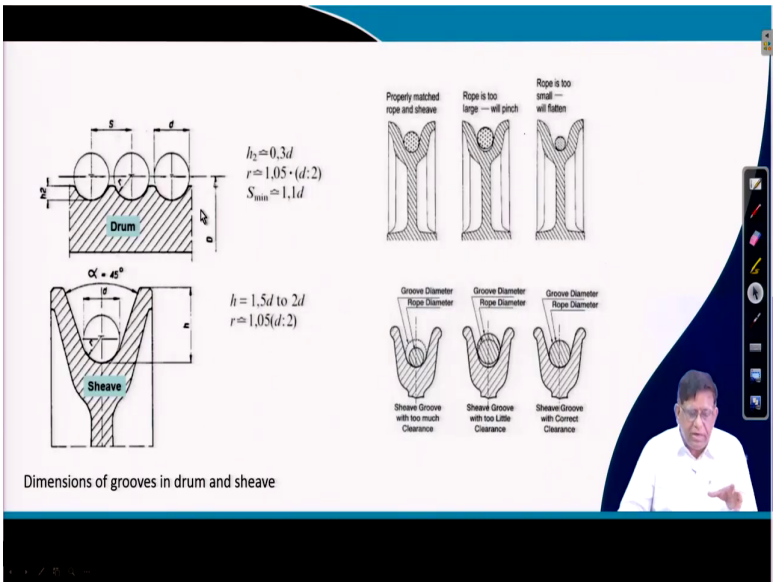

If your rope diameter is smaller than this your that sheave grove diameter grove radius then what will happen? There will be oscillations and you will be getting dynamic load so; that means, the operational problems can be discussed can be studied separately over here.

So, that is your how exactly the your total what will be the dimensions of the drum that how much length or these are all systematically need to be studied in that introductory class, I am not telling about the design, but you should remember that these are a, advanced studies of the winding system which will be giving.

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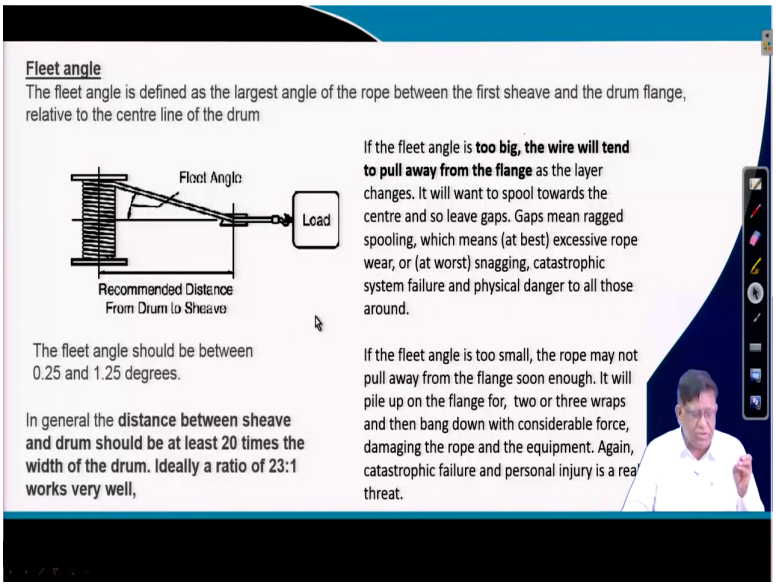

But, in general you must know one thing that when you are giving this your sheave is there if you take a plan view that drum the rope will be going to one end and then this will be coming over here and then going. So, this maximum angle which it is making it is called your fleet angle.

Now, this it is your right side fleet angle and left side fleet angle depending on the how the rope moves. Now, if you do not take the proper fleet angle which should be your 0.25 to 1.25 degree. If, it is more than what will happen this rope will be touching the flange of the sheave and by that the rope will get weird out.

And if the rope becomes that is it is strengths come out or it become weaker you can see that what will be the danger because whole thing you may be having a say, say your 200 300 meter long of rope weight and the total weight is resting over here. So, we must keep this wear rope pair in a good healthy manner and for that your fleet angle design should be proper.

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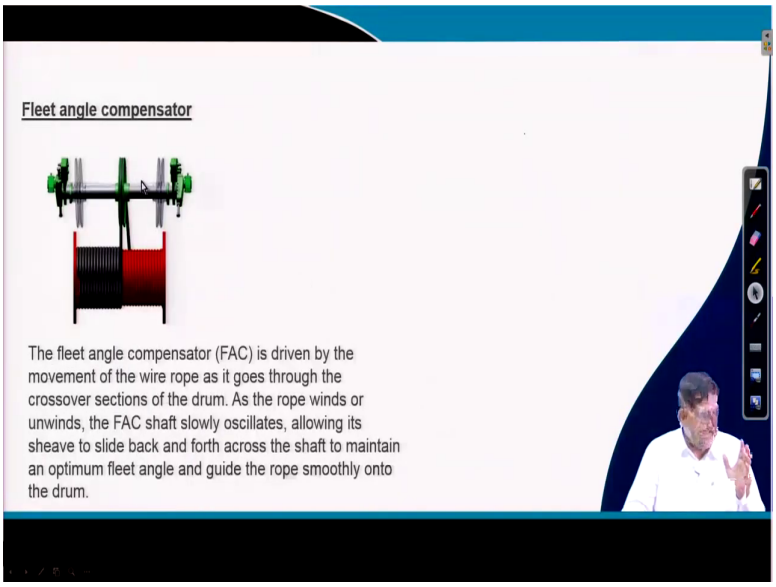

So, similarly you can see that nowadays, there is a fleet angle compensator. These are the new design how people have developed that is. So, that the fleet angle do not increase for that they will be monitoring and then they will be making the compensation in the rope a new additional system has been given as a fleet angle compensator. Why I am telling is that? There are lot of areas, in which you can go on develop some innovative things.

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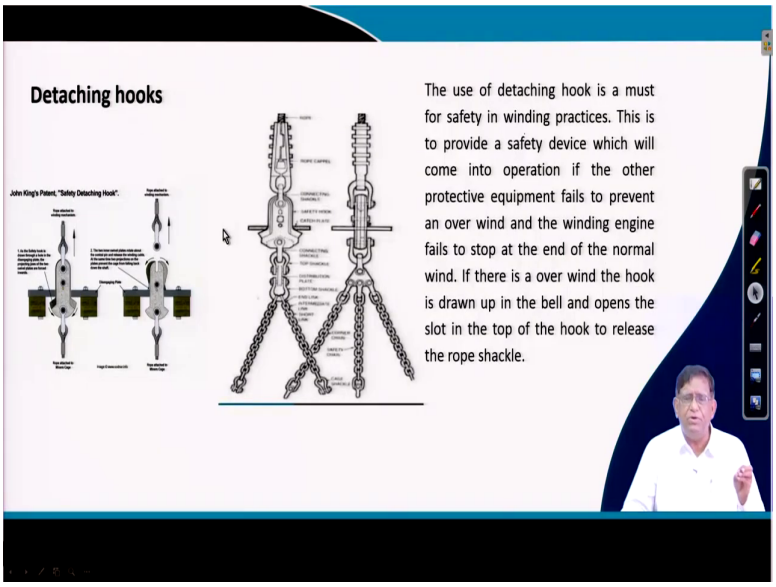

So, that detaching hook and then how it is suspended? That is this is a cappel which cappel this rope is terminated over here and connected with that your detaching hook and these are the chain on which the cage is connected?

So, these type of things you need to take up. So, you can start studying about this; What should be the strength of this chain? How will you design this chain? That which, will be is fail proof, it will not fail that the cage will not get detached over there.

What should be the strength of this hook? These are the things exactly, when you are going to do an engineering study and it is not only by knowing that this is what we have given in your today's class is to get some of you to take up some of yourself study project on designing of this components and this system.

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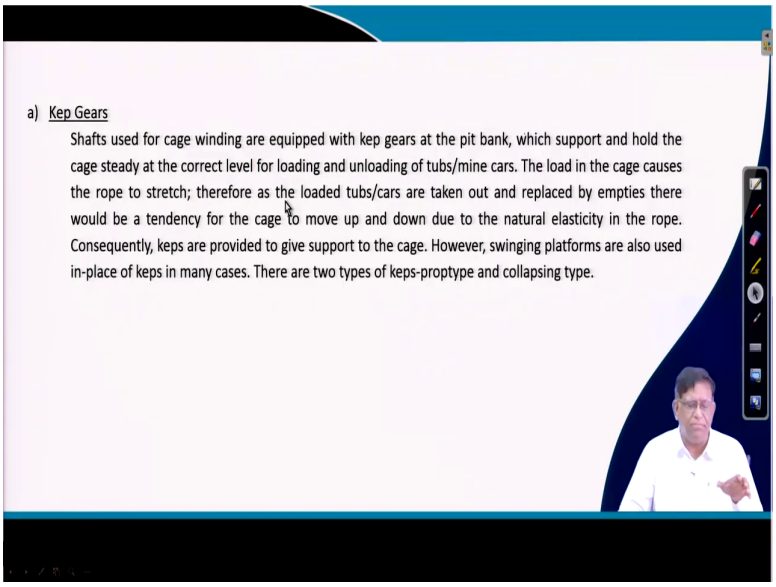

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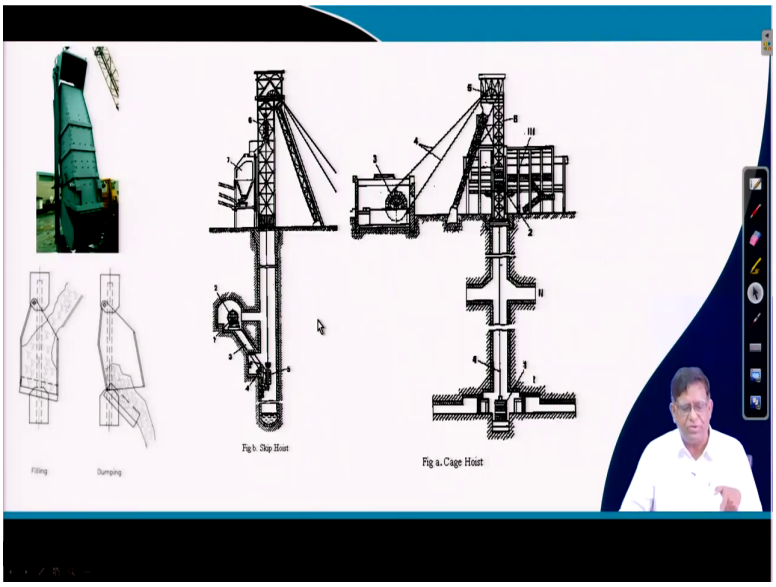

What should be their strength, what should be the type of material and that whether each and every component that kep gear then also the winding system you have got a cage hoisting. You have got a that your skip hoisting that skip is loaded over here these are studied in your underground mining methods in a that how exactly that skip is loaded.

Now if this is a skip is a container that container when it is filled up by this mine car is loading over there this shift that the material is getting loaded here it take it up and then from there it is unload and it is going to a hopper and then it is giving and then it can give it to a conveyor belt and can go.

So, that means, the winding system it is only giving these arrangement, but other component depending on that the whole system will have to be designed and that is the job of the mining engineers. So, if you respect yourself as a mining engineer this hoisting system that engineering they are designing and all work you must do this is a skip exactly how at that point you are putting inside the arc you will have to construct a structure by taking out the material there how exactly you have controlled strata how you have protected the. So, that this will not collapse that is again a mining engineer job.

So, that mining engineer will have to do the basic calculations and these mechanical and electrical engineering do not think that it is exactly the only other people will do it. So, as a mining engineer to know about the system to have a control you will have to study this part.

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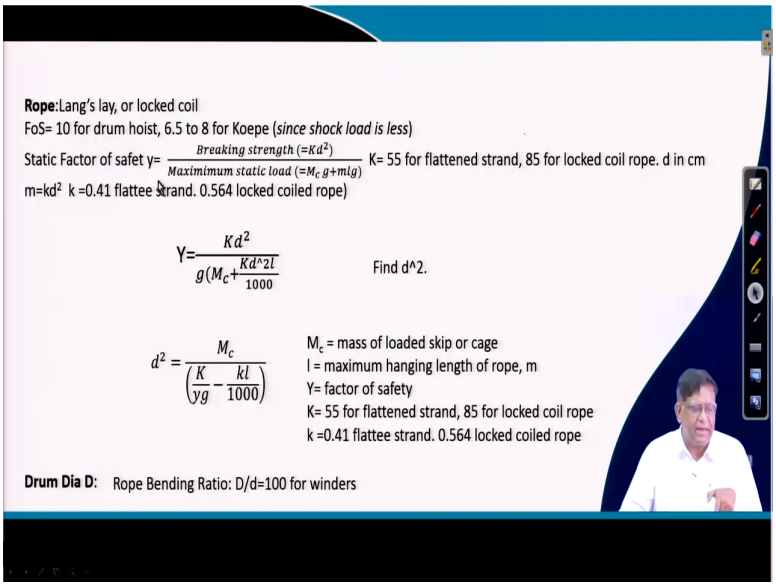

So, this is a photograph of a skip which is used over here and then, you know about this the we have already discussed that is in a rope your that is your Lang's lay and locked coil ropes are used and then their factor of safety it depends on this your breaking strength and the maximum static load. The breaking strength is given by this factor called k d square where, k value depending on your flattened strand it is 55 and then locked coil rope it is 85.

And then this, maximum static load it depends on exactly how much mass of the loaded skip and how much is the total weight of the rope, which is coming and there if you get this is your factor of safety Y. Then you can find out what will be the diameter of the rope that will be collected for the winding and once you know the diameter of the rope from the rope bending ratio you can find at least what should be the minimum diameter of your hoist.

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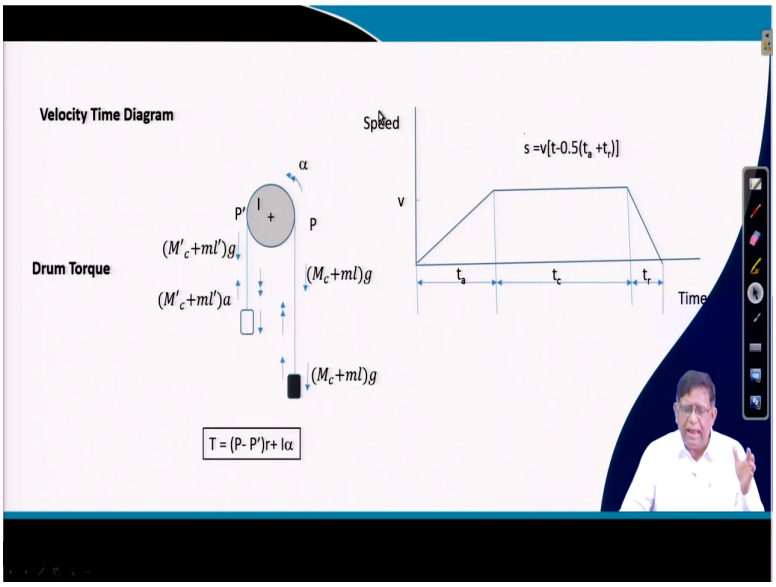

So, that is the things you will be studying and then if you see that, what is the speed time diagram of a winding system; that means, it will have an acceleration time, a constant speed time and a retardation time going from your peak top to the gallery level where you are going to this.

This peak top time at that time to drive it this will have to be coming for a given how much the torque coming and the torque and the drum will be coming exactly because of this your how much empty torque that is your loaded top is going up and the empty top is going down. At that time the total how much mass is what is the total force. This is your empty tops and this is your total of your loaded top.

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So, once you do this calculations you can easily find out so; that means, as a while you are selecting a drum the winder or a keope winder number of parameters need to be studied.

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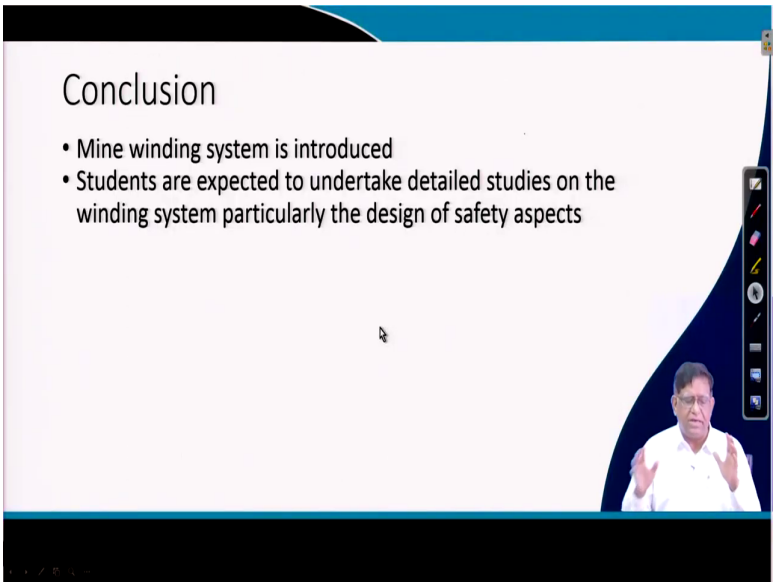

So, in a nutshell I have told you about that the mine winding system is a system, which is the mining engineers need to know very carefully because this whole underground mining how will be doing operations and their evacuations everything depends on the proper and smooth running of the winding system.

It is exactly the whole that you can say the core of a mining installations and that should be without any fail without any risk must give a very high reliable and safety so for that this need to be modernized this needs to be properly controlled and operated.

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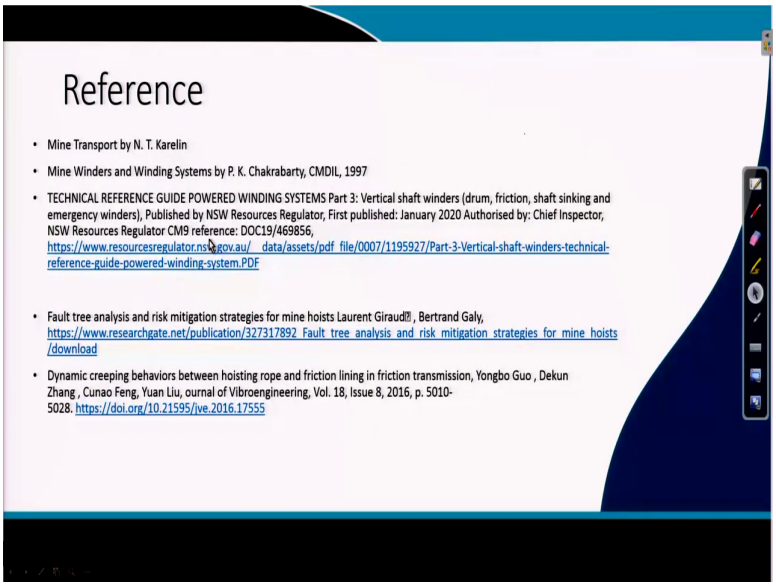

So, that is why I wish that you take some detailed studies of this system and then you can do there are lot of things are there books are available. You can read that mine transport by N.T. Karelin, but the mine winders and winding system by P. K. Chakrabarty this book gives the how Indians have designed and how Indians exactly during the 70's 80's 90's.

Number of winders were also installed and then there are whole thing are CMPDI is to do the design of those winding system by our Indian engineers that methodology which are very well documented in this book I wish you read get that book and develop a simple software for as a design of winder and then on that basis you can go on doing and if you do that practice you can think of the other hoisting system whether you can serve in the hoisting skip or hoisting system can be used for the in some that locations.

For example, in the hilly areas then all where you can give a good designing of a new holiday that is a, your, a tourism sport can be developed by incorporating some of this systems over there. So, that is why learned that engineering you will be having a different way of marketing that king in future. So,

with this I hope that you have understood what is the mine winding system; in our next class we will be going to calculate few of the numericals if possible ok.

Thank you very much.