Bulk Material Transport and Handling System
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Lecture - 06
Constructional Components: Trends of Developments

Welcome back to our discussions as we have introduced in the last week, the various aspects of bulk material handling and transportation system. And I hope by now, you have completed some of the self study work that I have referred to you in the last class. And I hope that regarding the scope of this subject the areas which are critical regarding this bulk material handling in different industry like mines, boat, thermal power stations and as well as in the our food agricultural and food technology area, fertilizer area.

All these areas where bulk material handling is used, I think you have learned about that to certain extent. Now, in today's class, we are going to start another module.

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This module is on belt conveyor, because in the bulk material transportations to a large extent this, belt conveyors are used which already you have been introduced about the various type of belts. Today, we will be discussing some of the general ideas regarding the constructions of the belt conveyor.

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So, after this particular lesson, you should be able to illustrate the constructional components of belt conveyor that means, you will be able to draw some line diagram and then identify what are the main constructional components and then you should be able to describe their functions that what are they. And then which will ultimately allow you to analyze their functions, analyze their design and then you will be able to exactly look into the standards, which are being used by the manufacturer for designing.

And you should be able to do further online investigations through from the World Wide Web regarding the trends of developments of this technology conveyor belt technology. And also you will be able to specify some of the factors that will affect this design. So, that is in a nutshell we will be discussing in this particular class.

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Now, here you know that this conveyor belt as you have seen, it is a continuous belt that means, but it is manufactured as a piece of belt they are brought and then their ends are connected together to make a continuous belt. So, that is basically a conveyor belt it is an endless belt that is running around these 2 pulleys. And where does material is fed into or loaded into at a point and it is the stitches at the other end. And the belt normally for bulk material handling it will be forming a trough on the trough this material will be going.

Now that type of trough belt how it is there in this figures you can see that can be a different type it is a plain trough belt conveyor or it could be in a rope conveyer or a very we can see that picture threshold mounted conveyor belt which is that running over difficult and different type of terrain. And also there could be a system of number of 2 belts are coming together and then taking the material to another belt. So, like that a system can be developed by using this conveyor belt.

So, a conveyor belt is used for conveyor system deployed for fast and efficient mechanical and automatic handling of loads. So that means here during this whole part, there is no intervention by human being. And that is why even the whole operations at the big conveyor belt operations it can be done automatically and it can be done remotely. So that is why it is a very good advantages technique. So, there are different ways you can see when that escalator which you

can see in your supermarkets, those are also nothing but a conveyor belt. It is a conveying system, a belt is there where it could be a chain, chain driven belt conveyor.

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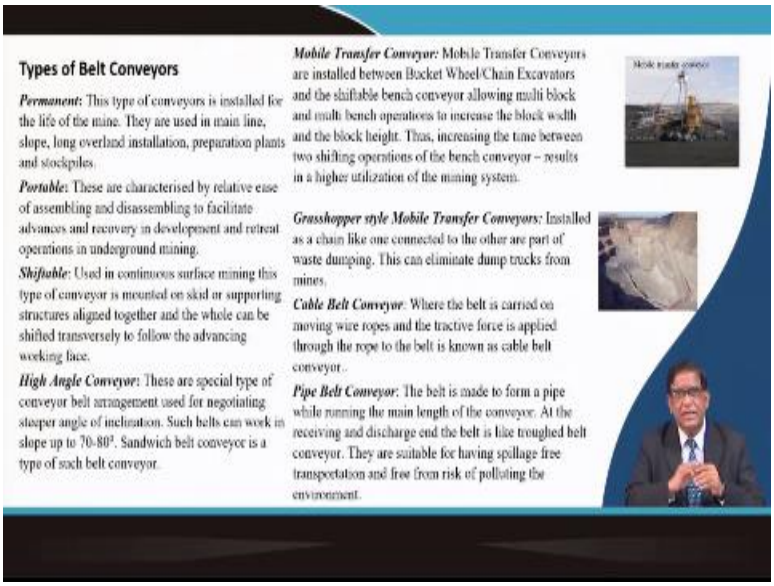

So that is a different type of belt conveyors could be there. As you can see here, this is a slide which is giving a lot of information that is your the type of a belt conveyer can be a permanent type or a portable type. Permanent is on the land it is spin or in a plant, it is permanently installed you cannot wait, but in a portable one you can take the conveyor belt from one place to another places there are portable conveyors. Shiftable conveyor is one which is placed and then when it is required it can be pushed to a new location.

And that way it can be shifted from one location to another location. And there are high angle conveyor we have tools that is exactly if normally the material will be sliding down if you are trying to put on a conveyor belt on up so, but by making certain arrangements, you can make this conveyor belt to take up to 90 degree. There are that, sandwich belt conveyor there are your flexural they have got a box type conveyor belt, those type of high angle conveyors are there.

There are also mobile transfer conveyor that means they are exactly in the mines is used they will be having 2 booms. And with that one will be receiving the other will be the discharging and that whole 2 booms will be mounted on a machine scroller mounted machines as you can see in

this and that is movable it can follow wherever the loading machines will be loading at this end and it is transferring it to the other end.

So, this is a Mobile Transfer conveyor. Similarly, there is another that Metro Company has produced as a Grasshopper Style Mobile Transfer conveyor. Here you can see in this figure there are if you see a blowout of this particular finger will see it is looking just like as a grasshopper, number of grasshoppers are there just end to end standing like that your number of mobile conveyor these can move travel and they can make the orientations as and when it is there.

So, this number of mobile conveyor they are forming a chain and then they are taking the material out from this without having any tracks or without any diesel consumption over here. So, then there is also a cable belt conveyor we have discussed that is your the belt is carried on moving wire ropes that is a cable belt conveyor. And then there are, pipe belt conveyor which we have also told you in the introductory class. So, this is just only a review.

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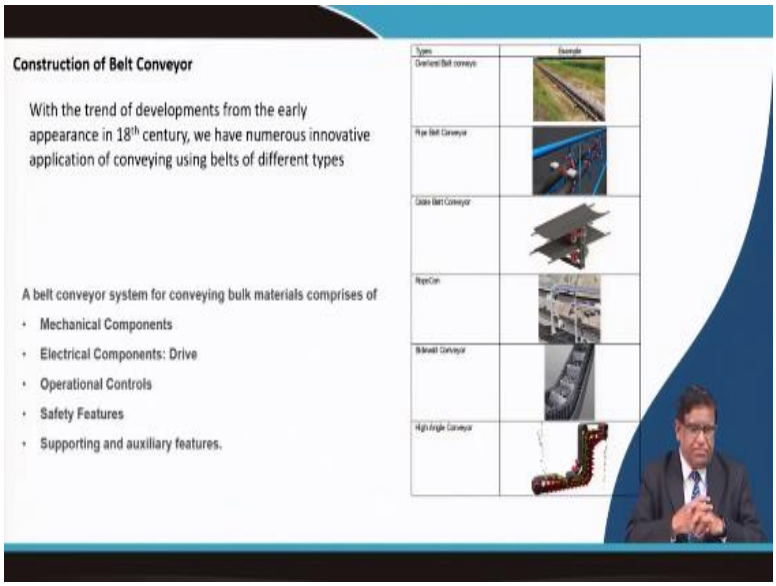

Now, you can see that this belt conveyor, how they are constructed. As we have said there are different types of conveyor belt. But this started the history of conveyor belt it is very fascinating it started in 18th century people used only with that the wooden belts were used. And then by the early part of 20th century, this became a very advanced technology and from the middle of from

the 1950s onwards, there is a tremendous development in this and a lot of applications have come you can see the history of it.

Now this is a; what exactly comprises of a belt conveyor system, there will be certain mechanical components there will be certain electrical components that is the drive that most of this conveyor belt will be running on a electric drive that means electric motors. That means the drive system components will be including that from the electric motor it will have to be taken to the end pulley of the conveyor belt on which the conveyor belt is running. Now that means to give the drive to the end pulley from the motor there will have to be a gearbox.

And then that will reduce the speed of that and they will have to be placed in a proper type of coupling and then they will have to be given proper type of bearing. So that means that and then it will have to take care of a lot of working conditions for example that when a conveyor belt say about 1 kilometer long we tape 2400 millimeter width, where 1000 of ton of material will be laying over there. And now if the after a electric failure if it is to start then you can think of what will be the starting torque.

Because this whole load on the conveyor belt will have to be moved. Now such as starting torque normally if it is what will happen to the motor if suddenly a very high starting torque? Your motor will get burned. So, there the drive will have to be designed in such a way that during the starting it can give a soft starting the starting torque can gradually increase and those are the development there we will be discussing the drive systems and their components.

There are another thing is the operational controls this conveyor belt it will have to be stopped and started at the same time during if there is any emergency is there turn off while working then you will have to stop it on an emergency basis. If there is something going wrong then it will have to be monitored and then if some belts require it may happen that this a conveyor belt may do a 2 and 4 motions that a variable speed may be necessary, sometimes going at a slow speed, sometime it may require.

So, different type of operational control is there, but at the same time for working with a safe it will have to have certain safety features, so, that it does not cause. So, those are the components that in during construction of it. Then what are the different types of supporting an auxiliary features? Because, if it is a long conveyor belt, you want to go from one side to the other side, there should be some features that let there be a walkway or a breeze by which one can cross the conveyor belt. So, in a designing and constructing a conveyor belt all this type of components will have to be designed.

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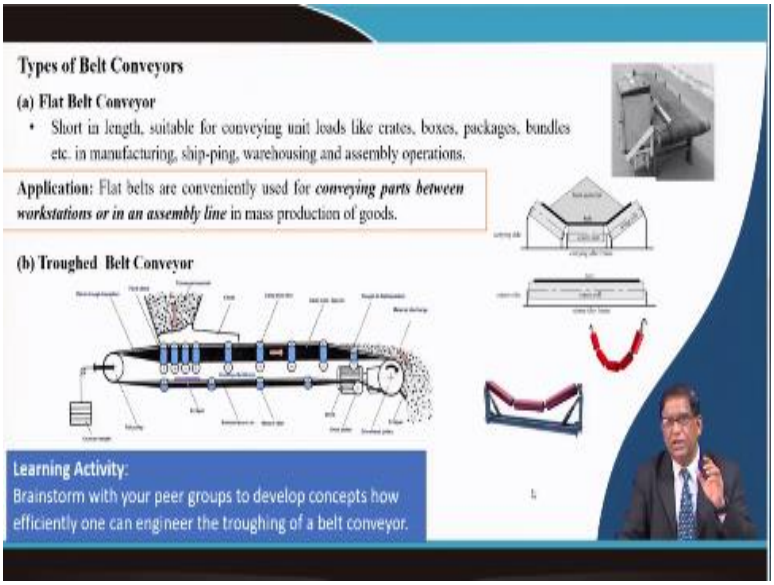

Now, that will vary with the type of conveyor belt normally there are 2 types of conveyor belts that is your flat belt as you can see here, the belt a flat one and then this is exactly for very short distance and then where you can take unit loads are taken you might have seen the flat belt conveyors in the airport where your luggage are being transported over there. And also the flat belts conveyor and sometimes in the name of weapon conveyors which is still instead of rubber belt you can get a steel belt.

And they are used in fitting a conveyor belt or while receiving the material from a hopper that below that there could be a flat belt conveyor, which we will be loading into next day that other type of belt conveyor called your troughed belt conveyor. So, these flat belt conveyors are which exactly in a plants and also in some of the unit load transportation you used. But in the trough belt conveyor, the conveyor belt is forming a trough like this as you have seen in this figure.

That means that the carrying side is this but the return belt below that when it takes at the end of the pulley, it will go over a flat belt. So that you can see in this figure where you are having this if you can see that between the 2 ends, this conveyor belt is there where the material is being loaded by a hopper or a chute and that ditch chute this portion which is also called as skirt-board. And now there are some these are the idlers on which the conveyor belt is standing.

And then you can see that there are more number of idlers here, where the loading is being done so that impact load can be taken on the conveyor belt. There are special type of idlers, we will be discussing about that these are called your impact idlers. Now, these carrying idlers and they did this one return idler. In this form, at the end with the ditcher is there, at the end the drive is fitted over here.

And that also you can see that this conveyor belt when it is taking a turn another pulley is given over here, just show that this that wrap exactly that wrap angle where this belt is touching this pulley and where this is leaving the pulley, this angle is called your wrap angle that is increased by another pulley called snub pulley will be knowing about their own will go for the conveyor belt calculations, because this has got an impact on the tensions and the drive. What will be required for this conveyor belt? We will be discussing about that.

Now, today you just know as the constructional components we are having this exactly your head end and that is exactly your tail end, this tail end is given attention over there, so that this belt remain all tension so that the power can be transmitted. So, basically, a trough belt is on a troughing idler, the troughing idler can be a garland idler or as you can see here, these idlers are separately mounted on a platform and then forming a trough giving a troughing angle over here or it can be having a this type of garland.

So that is 2 type of conveyor belt one is your flat belt another is your trough belt, these 2 type of conveyable systems are used. Now what you should do? You should amongst your groups; you try to find out that exactly how you can formed this trough. So, this is you can there are a lot of different types of designs can be made, so that the trough can be made over here. So, ultimately

how you can retain more material, how you can make a trouble free transportations, wider what are the present type of arrangements are there for giving the troughing.

And then can you think something of your own new for innovations. So, do some discussion and brainstorming amongst you.

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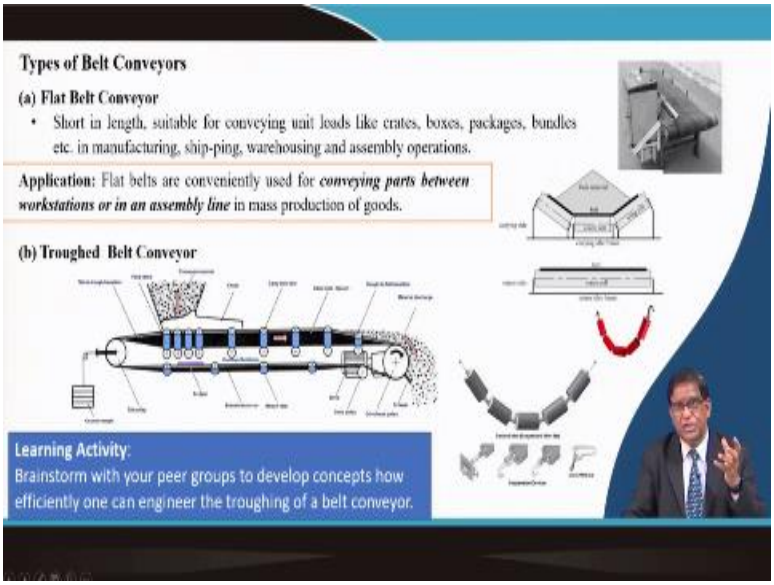

You can see here that these is end of the troughing are the garland idlers it can be also hanged by different type of hook systems try to think that what could be the effective. So, that quickly it can be done it should be reliable, it will not break. So, design a pretty good hook which can be very easily locked, you can see some of those hooks around and try to think and give some engineering way of a new types of hook or garland.

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So anyway, coming to this trough belt conveyor, it is exactly compared to the flat belt conveyor, their belts are wider. And then these 2 edges are lifted. So that it will have to make it tough. To forming the trough on the idler you will have to see but one thing is true when the belt is running at that 2 end you have got the belt will be running over this 2 while it is going like this at this stage and at this stage these 2 ends will be flat.

Now with the flat ends, but in between it is making it tough. So, what you will have to get how this trough will be formed on the basis of idler that is where most important thing over there. So, you can see here that this idlers can be placed as a series of them and then the troughing is formed. Now that trough will have to as you can see this, it can be by garland and you can see that conveyor belt while it is sitting over there idlers is forming the trough.

Now, this is very important that how these idlers will be kept on the frame, you can see here there is a supporting frame for the conveyable. So, in the constructions you will have to see that supporting frames should be strong at the same time, it should consume less amount of steel, because the more this amount of steel more will be the cost. So, there will be an optimization problem can be created over here and we can see that how your capacity can be met.

And then your overall constructional material requirement will be less at the same time it will serve the purpose. Now there is normally the carrying capacity of your trough belt is higher and

then you are the trough belt are used for a very long distance that transportations unlike your trough belt conveyor. So, now, these are also called a long centre conveyors, because they in a normal long centre conveyors the belt tension is high the belt because what will happen it will have to be carrying a long distance.

And then they say total load of the belt is also high and you will find that is your a very high tension belt will have to be created and then the centre to centre that is making the belt to run truly that means it do not show it to the end there is a another important area to be noted during the designing part of it. Now, when we talk about the applications, the trough belt conveyors are very widely used, you can find in all mining industry, in the metallurgical industry, in the port, in the fertilizers everywhere.

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Now, when we talk about these constructional components, you should know that what are the general characteristics that the belt will have to be designed or the whole system can be designed for different profile. It can go vertically it can twice it can go horizontally, it can give a horizontal curve, it can give you a vertical curve, then also it can have a change the directions why it is going over there then it will have to give a directions perpendicular or a different angle. Then the conveying capacity, this also should be controllable.

If you design a conveyor belt for certain 1000 ton per hour, then the type of drive you will be using. But if the belt is having only loads of 2000 ton per hour at the time that same motor it will be running more power but how exactly you can handle that running the same conveyor belt for different capacities optimally. Then also it is very characteristic is it will be continuously flowing. Now that if you are having a big that how will you control the load will be coming say in a batch wise?

If it is loaded in a batch wise and if it is pulling on a continuously then how the system will be behaving say for example, if on a conveyor belt you are loading the material by a the front end loader or a side ditcher loader. So, every one load every load will be going as a hips on that conveyor belt. And then if you are loading from one conveyor belt to another conveyor belt at the time the loading pattern will be different. So, the total design will it change because of this your that non uniform load on the conveyor belt and the uniform load of the conveyor belt how it will be there, those are the things exactly taken care of while designing the system.

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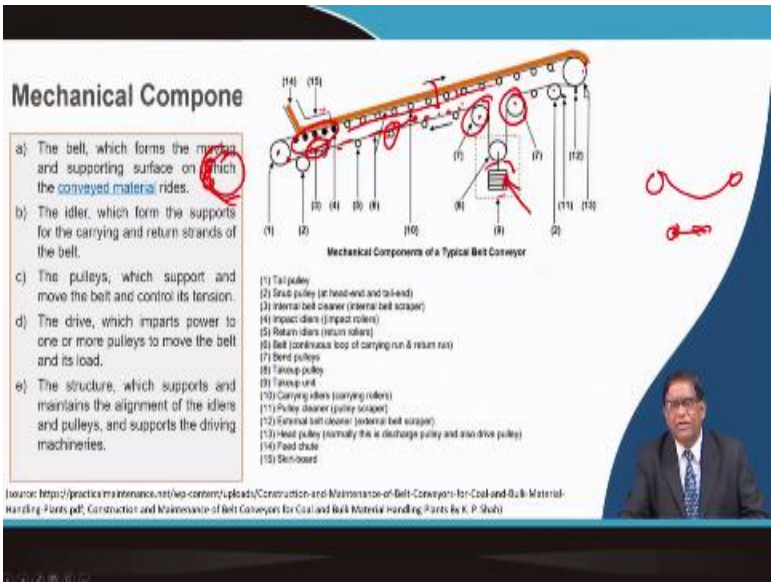

So, now, coming to the whole mechanical components, you can think of this particular diagram I have taken from the book of K. P. Shah, that it can show that as we have said we are having your one hand that is this is your tail pulley and this is your head pulley. Here we have got a snub pulley that this snub pulley is exactly increasing this is your angle of wrap we have got this is

your loading section. You have got these are the impact idlers here impact idlers, these are called carrying idlers that which are spaced at a particular one.

Now, if you make this space wider than there will be between these 2 there will be sag of the belt. So, this sag is this is not to be there, they tried the space between 2 idlers will have to be properly selected. Now, when it is coming, this is called your bend pulley these 2 are bend pulley now their job is exactly this conveyor belt is taken over here and given a take-up that means if the belt tension is less that will be loose belt then by giving some weight over here, this weight will take this conveyor belt so that this tension is maintained.

So, this type of this is called a take up system called gravity take up there are different types of take up we have that a loop take up or screw take up on different conveyor belt different idlers. Now this is your return idler, which you can see that the return idlers are spaced wider because there is no load coming on this and at the end this side you have seen here there will be a scraper that means if the while loading onto that material, if it is falling on today, they your return belt, then that material should not get trapped between the pulley and the belt over here.

That is a problem. We will be discussing those problems in our maintenance lectures. But this scraper job is to clean the conveyor belt from any return at any material if there is a spillage and the material is coming over here onto the return belt this material will be carried and then it will coming over here. So that it will get trapped into the conveyor belt in the pulley that is to be avoided. So, now your mechanical components are very important.

And then the main part is the belt is the then idler, then the pulleys then you are the structures there will be a supporting structure which will be taking the thing and the drive as well. So, I think by now, you were able to name the constructional components of a conveyor belt just to recapitulate what are those, the belt that pulleys and end pulley, snub and bend pulley. Then we are having idlers that are carrying idlers, return idlers, impact idlers there are other idlers also that is a self aligning idlers, those we will be discussing in the neither idler class separately.

Then we are having a that is your a power or a scraper that clean arrangements for the return belt the return belt, so that the material can be cleaned and also, there is a belt cleaner. So, that when the material is ditches from here, at that time, some of the things which will be sticking to the conveyor belt that need to be cleaned and that is given over here.

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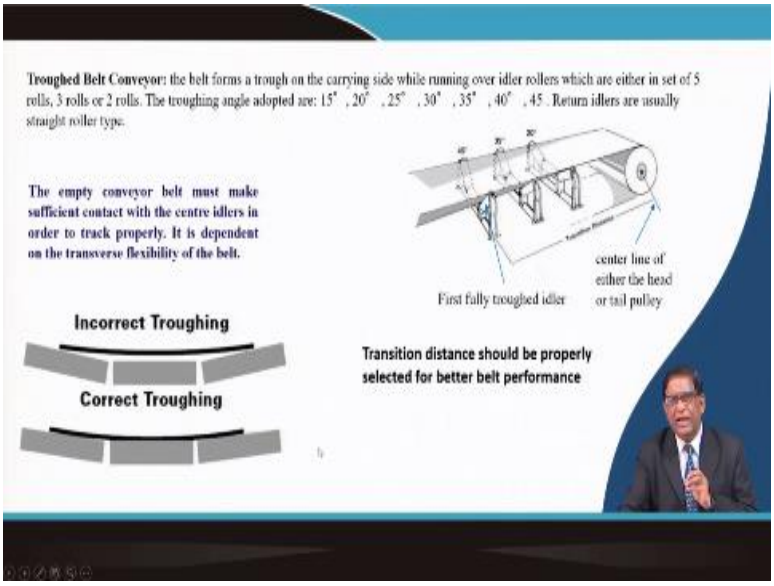

So, this trough belt conveyor from the your end, when it is coming that where it will form the trough, this is called your transition distance that means, here it is flat and ultimately slowly it is coming over here it is forming a trough. So, this if you do not make a proper transition, then the belt will be just floating over here, which will be giving them is to the belt because the load will be coming only to the end. So, the correct troughing it should be the whole belt should be putting onto the conveyor and that will depend on that transition distance.

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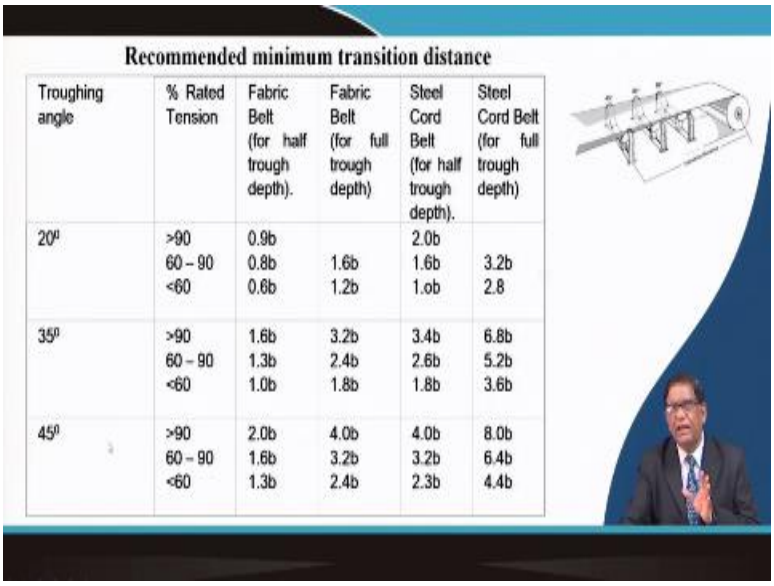

The different type of conveyor belts will be having for a different type of troughing angle at what distance these idler will have to be placed is to be designed those are done in a conveyor belt design.

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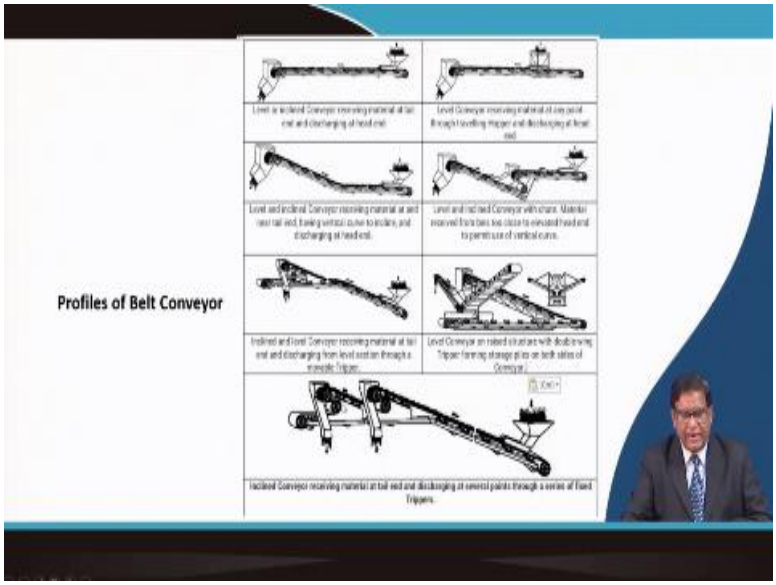

Now, that construction of a conveyor belt also depends on the profiling of the belt, now the conveyor belt profile as you can see here, it can be a horizontal profile in which your loading is taking place at the end or it is loading it can be anywhere in between. Then there could be a profile where there is a horizontal section and there is an incline section. Now, in between that while coming from this horizontal section when to leave it lifted over there, you can have discharging onto a discharge chute and from there the material is taken over here.

So, another one is that when the material is coming over here, you can discharge sidewise not discharging at the end, but you are discharging in this you can see discharging at the end discharge, but it can be discharged at the side, then this arrangement is called your tripper arrangement and that it is this discharge can be made at the 2 end that is your both side of the conveyor belt you can do it is a call a sticker arrangements.

We can have a both sided sticker that is from the conveyor belt material is going and separated into both sides or in the same side you can transfer the material sidewise by a tripper or moving tripper or number of partially it is loaded here partially it is loaded here. So, there are different ways of arranging or constructing the conveyor belt.

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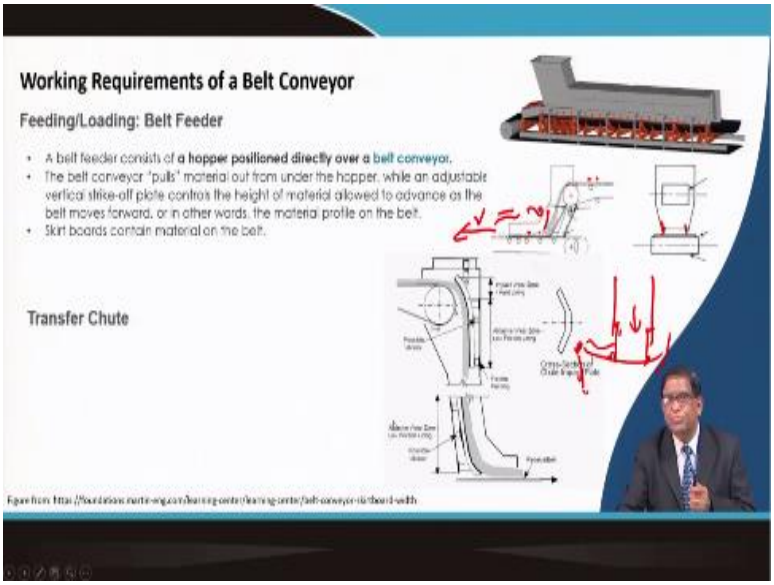

Now amongst the working elements of the conveyor belt, you are having this; your belt feeding system where there is a hopper and then there is this skirt-board. Now this feeding one, when we are feeding from a conveyor belt, this material should be guided to the belt conveyor, it is seen that if this belt conveyor is running at a speed v if the material which is coming over here and then meeting over here, if we had got a velocity v 1, that these v and v 1 when they are near equal, that is the best way of feeding.

Now, how do you do that? For that in which way you make them to follow them to the conveyor belt is very important and to good another thing is at the time, when you are loading over here, the material will be falling outside that try to avoid that this skirt-board part is there. Inside this skirt-board the material is guided onto a particular portion of the conveyor belt and then if you are having this is here you are loading onto the material on this conveyor belt.

Now, if the material can feed from here, so that is why we keep it to another conveyor belt like that this skirt-board is protected and you can give a seal over here, so that the material do not go that arrangement is also very, very important in a transfer chute. So, that means you are transporting the material with the help of now you can have a wood at that point, these wood will be having an inner liner, this liner is there so that when this material is hitting, the main wood is not getting damaged the liner may be replaced when it is requiring.

And then after guiding it over here, when it is coming on to this chute person, there is also you are giving a another liner show that we can get in trouble free operations and material is getting the necessary speed at the time of transferring.

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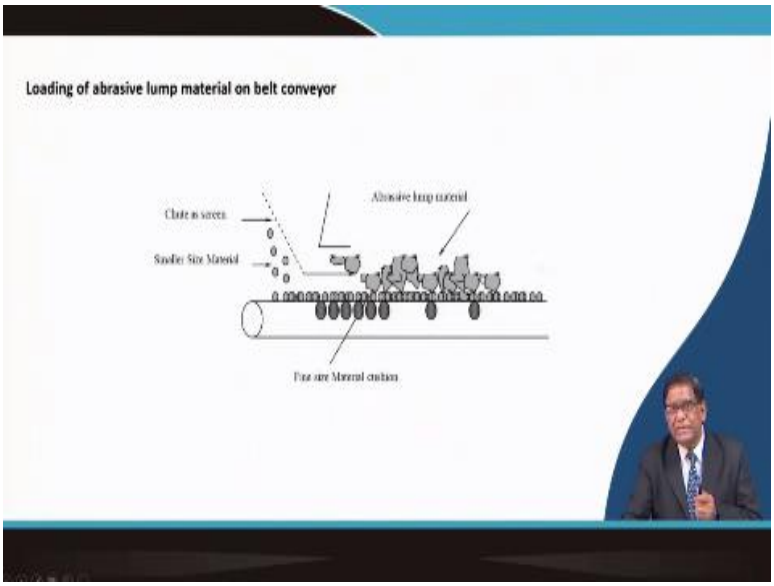

Sometimes well, if you put in the chute some of the perforated plate here the fine materials, it will fall onto the conveyor belt and then they will be started moving over here. Now, when the other that; lump materials which will be coming over here by the time you are having a layer of

fine material. So, by that exactly demister the conveyor belt by these abrasive material can be reduced. So, these are the different for any way you can engineer they feeding to the conveyor belt.

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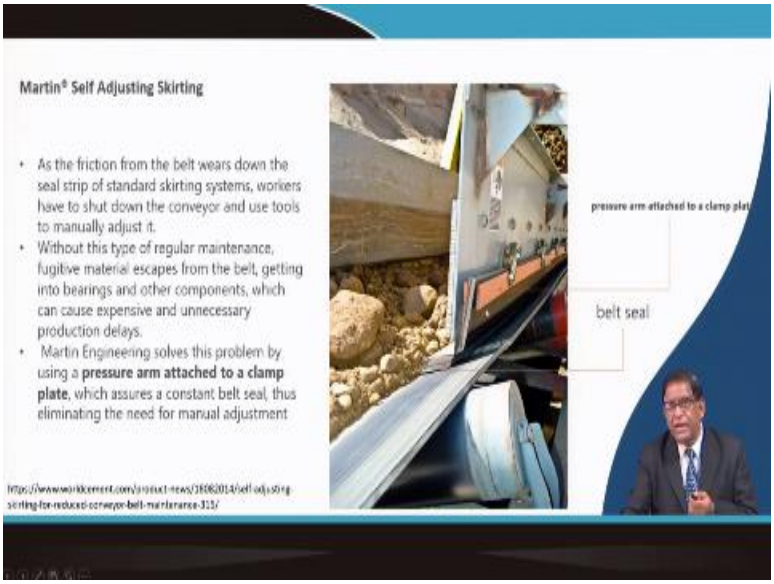

Now, this just skirt-board I was telling you here that Martin Company has that; lots of advance they have designed for the conveyor belt one is this is when that I think that from the top either from a conveyer or from other loading devices material is coming over here. Now, these conveyor belts this is the loading point below here, we are having the impact idlers and then you see this material will not be coming outside this well at this person when it is being loaded at that time.

Because of this skirt-board person, they have created a seal with this exactly a rubber which is having that is your softer than this main conveyor belt, rubber cover, top cover and they are forming a seal and they are wondering is there if it get worn out at that time, there will be gaps and material will fall. So, that shoe but the Martin has what they have done? They have designed a very intelligence system over here of this clamping, if there is any gap, it will automatically adjust the pressure and it will put all the time in contact. So, these are the things where innovations have taken place you can see over there.

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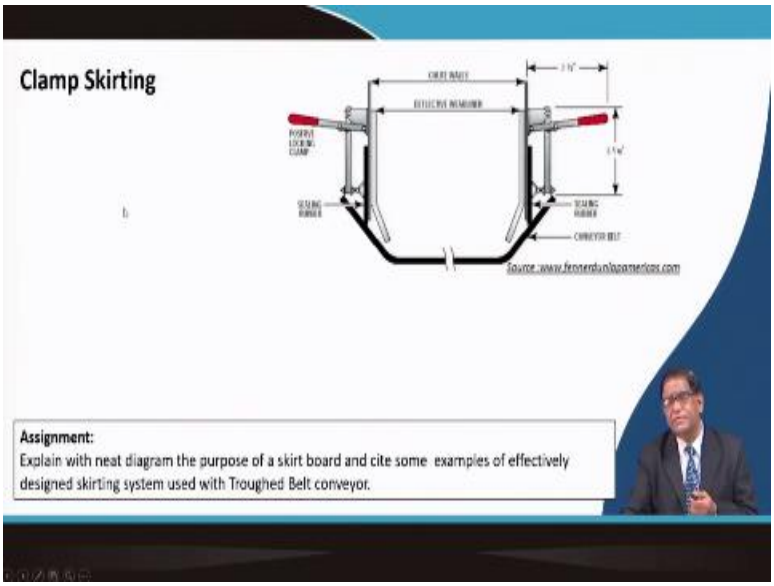

So, there are different ways of clamping of this skirting show that the feeding section can do well. So, you try to explain the purpose of his skirt-board and site some examples of effectively designs skirting system you can draw over here. So that you can remember that this skirting is at the feeding of the conveyor belt show that the material do not get is that it says spillage to the return belt that job is done over there.

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Then similarly in the unloading, I have told you that tripper arrangement, you can see here, there are some wheels and then a rail is there and that is a motor is there. Now, this is just like a trolley it can move towards that means this portion is raised you can see that this conveyor belt, it is coming over here and then it is raised and from there it is going down and then it is going like

this. So, this one pulley is skipped over here, which is a part of this revolving or a translating moving platform, which is the tripper.

And this material when it is coming over there it is discharging over this and there is a full plate by which you can make it to flow this way or to the other way. So, this type of unloading devices are there also sometime if you want to divert this material for coming and to make it fall into another hopper and then take it away that is exactly is done like that is a your; a plough blade, this is called a plough blade, you can make a fixing by different way or you can may have a v blade by which that is exactly the material is coming over here it will get split over there.

And boats and it will now below here you can keep another conveyor belt and take the material to the required position. So, these are the unloading devices.

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So, these are the basic components of a conveyor belt. Other than that, we have got a tensioning arrangements that conveyor belt will have to be kept tensions as I said, this is a gravity type of tension, there is a screw type of tension you can see here. This screw if this not is tied up, then it will be just coming towards this and so belt will get tensed. It is similar to in your bicycle you might have seen when your chain is getting loose what you do at the end of the; your back wheel there is a small knot and screw you tied it.

And then your will is that is coming under chain get tighten. That same system is there in a conveyor belt also it can be also a loop that means this conveyor belt is coming over here and then you are making a loop and there the smaller one you can move it through and pro and then giving this conveyor belt the required tension and sometimes this is exactly the whole thing that your pulley it is connected with a load for that this whole pulley can be pulled so that the belt tension can be managed.

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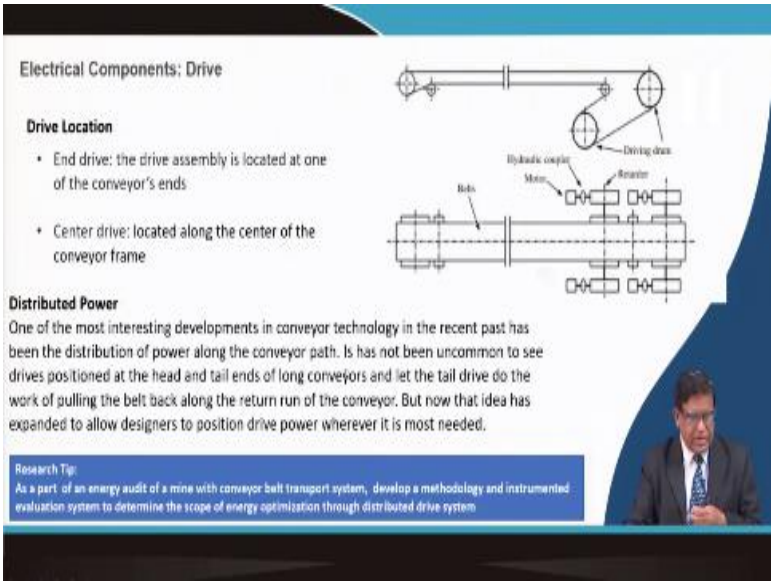

So, these are the different types of take up arrangement, the electric drive which is given to the conveyor belt you can see in the end pulley or there could be a second pulley both the pulleys can be given a drive depending on the your how much power required to the tension we will be discussing about those power calculations and why what will be the size of this motor, but you can see that the motor and then this very important is the coupler that normally fluid coupling is used.

You will be knowing now why fluid coupling here we will be discussing that but there is a gearbox and that gearbox is connected to this your drive pulley, now this in between that there will have to be proper bearing so that they can have a trouble free operations over here. So, one important thing is there, this alignment of your gearbox that your shaft and your pulley shaft and then the central line of the conveyor belt, this should be square that is called a line.

That means, both the end pulleys, there shaft should be perfectly parallel in sustainable installations. So, that these where the drive will be there, whether it is in the end or it will be in this end or in between that exactly a matter of discussions and that require where the how the tension is distributed. Now, there are also a different type of drive instead of this motor and gearbox, a small, small conveyor belts can be given.

And then they call a linear drive and then along the conveyor belt, we will discuss all those things in our electrical discussions that how linear drive can be given to a conveyor belt. Now, these power requirements is a very important things for calculations, we can do a lot of things over here your there are a number of free software's also available like belt analyzed you can download and check how different calculations for power is carried out.

Now there is also it is necessary that your unit to optimize the energy so, whether the energy is getting wasted, you need to develop the monitoring system and that is an exercise you can carry out for during this energy audit, you can find out that exactly how you can optimize this.

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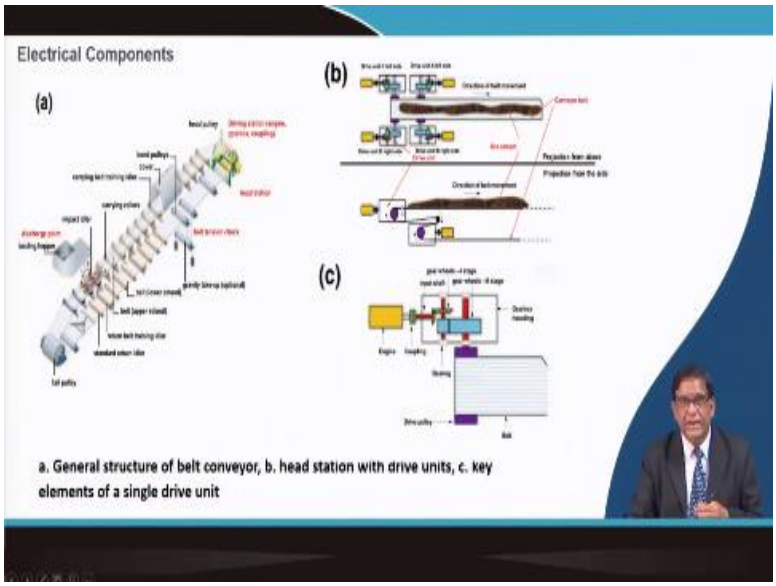

Now this you can find out that general constructional components I have told you already that is from the tail end and the head end and they are how the drive arrangements are there. So, a lot of literature's are available in this matter, you can see this in the literature and then we will be coming back to this electrical discussions later on.

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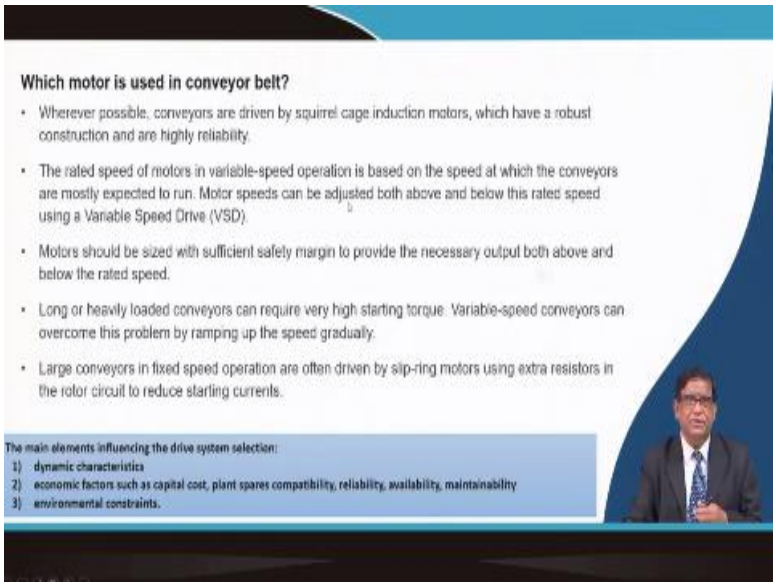

Because we need to be very careful about that what type of motor will be selected. So, this is nowadays these variable speed drive they are being used and then how they are speed controlled those matters, we will be discussing our discussion with electrical motor.

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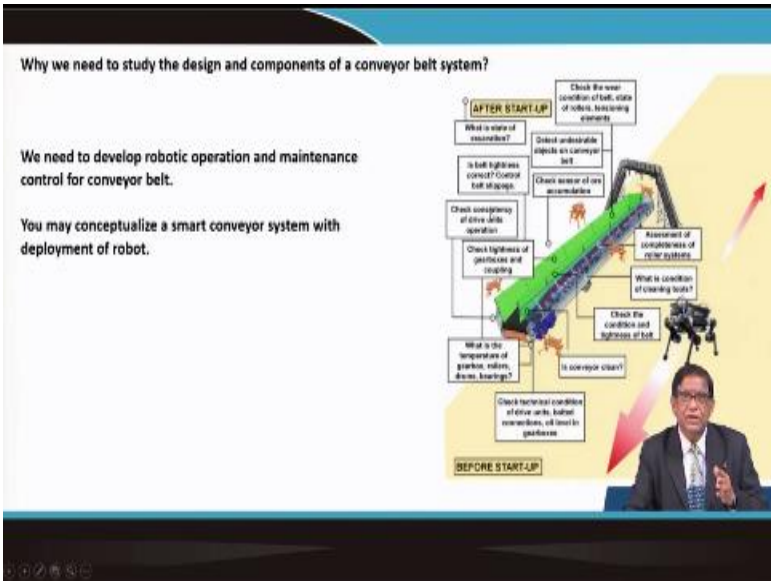

But one thing is important here that is what today being done in a whole conveyor belt technology a lot of developments has taken by using robots for its maintenance operation and control. Now in this diagram, I have given in the reference you can see that how they have started applying robot for this they will be doing the whole operations before the conveyor is started. They will do a total checkup whether everything is okay or not.

And after the belt has started at that time also the robot will be moving around this installations and find out that is whether there is a condition of it whether maintenance is required, when it is to be stopped, so there will be a lot of instrumentation and monitoring has come up. So, this is just only for your introductions to get an interest about knowing the constructional components well they are designed part. So that such type of robotic systems can be developed by some of you in your generation will have to work on that.

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So, these are the good references where these exactly these article by this Zimroz, Radoslaw you can read it and find out how exactly the monitoring is taking up underground mines, we have got also this is a number of articles on the robotic applications of conveyor belt.

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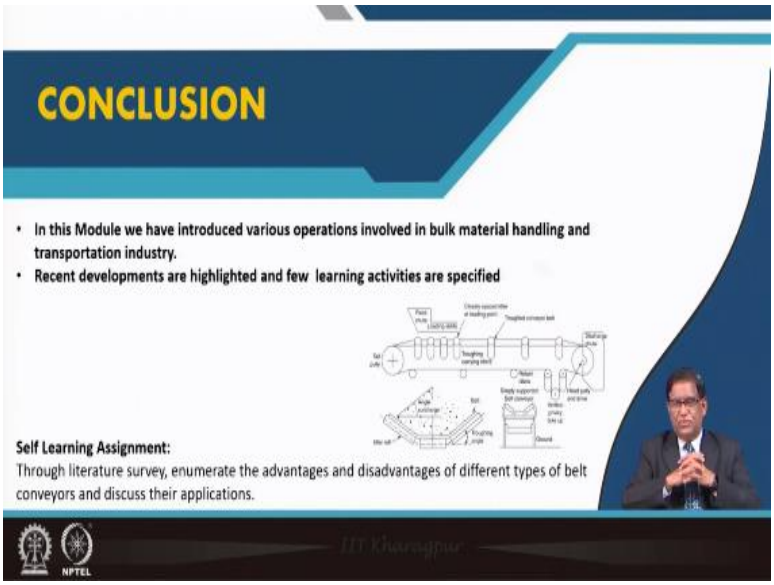

So, to conclude, we have introduced the various operations involved in the bulk material handling and transportation energy, but we know very briefly our objective was to know the mechanical components and constructional components. I think this figure gives you the general idea. We have got a feeder chute and that this skirtboard, we have got the impact idlers, carrying idlers, return idlers, end pulley that is a tail end pulley, hidden pulley, we have got a snub pulley, we have got this take up pulley, we have got the trapping idlers.

And then you try to practice drawing different type of line diagrams over here and also during the discussions we have told about the recent developments, so, you take up some of your self learning activities and through some literature survey, enumerate the advantages and disadvantages of different types of belt conveyors. That we have said the different type of belt conveyors are there.

So, it is you please find out where such type of conveyor belts are being used and then why they are there while they have been selected definitely for certain advantages, but there are definitely some disadvantages. Try to find out what are those bottlenecks, because who knows, you will be finding out a new solution giving opening of a new business for startup to be started by you. Thank you very much.