Mining Machinery
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Module - 06
Lecture - 34
Longwall Mining Machinery Armored Face Conveyor

Well friends, we have started talking about Longwall Mining and in that in the last class, we discussed about the shearer just introduced and then, in that system, we talked about that the shearer is mounted on the armored face conveyor. Now, today we will be discussing about or just giving an introductions to this armored face conveyor on which different numerical and calculations will be done later on in your course.

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Now, as you know that is a armoured face conveyor it is just a it comes under some pans, this conveyor is a its a made of a modular unit, small units together in front of the your longwall face.

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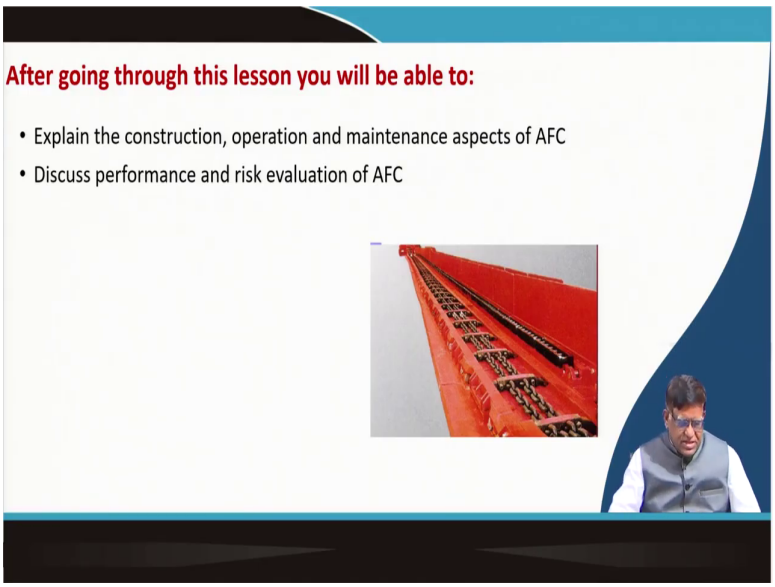

You can see that those pans, they join together and then they make a total chain conveyor over here. So, now we will be discussing about this chain conveyor, how they are working in front of a along with a shearer and power supports.

So, we will be able to explain how they are constructed, what are their main components and then what are their main performance, how they will have to be optimally used, the whole safety aspects of it that is also very essential.

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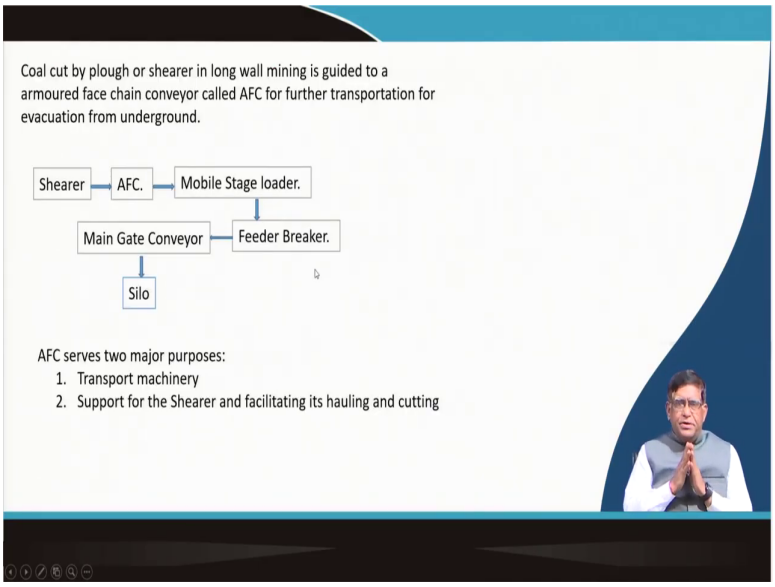

So, if we see that how exactly the coal is a taken out by longwall mining, we know that our plough or shearer these two are the main machines which are used for cutting the coal from the seam.

Now, once this coal is cut from the seam, it is guided to this armoured face conveyor which is exactly a trough in the trough, there is a chain and then in one side of it towards this say goaf, another side is your this support is there and then in between that when the material falls, then it is scrapped over the trough by a chain and flight bars.

So, this a and they take this material to the T-junctions in a longwall face you know as this panel is either retreating, then there is a main two main gates are there and this your

transverse weight is your longwall panel is there. So, from that, this it will be forming a T-junctions with this where the mainland, main conveyor belt is there.

So, there will be a stage loader another piece of equipment is kept at the T-junction from here, it will be given to a feeder breaker or directly through the main gate conveyor depending on the type of the coal.

If the while sharing by the shearer, if the coal is coming with a big boulders, then it is in variably go to a feeder breaker and then, from there that a main belt conveyor; main gate conveyor it will take the material up to the surface where it can be loaded to a silo and from that silo, it can be loaded to the main transporting sections.

So, this is the material flow in a longwall mining and there this AFC that is Armoured Face Conveyor, it serves two purposes, one is it is a; it is a transport machinery basically, it is a continuously continuous transport that when as soon as the material is being falling on it because of the continuous cutting by the shearer, then it will be as a continuous transportation just like a chain conveyor, it is carrying the material.

The other thing is it supports the shearer to that is it will be standing on it and then, it will be moving, its travel or the hauling of the shearer is also facilitated by the AFC. So, I think it is clear to you that the armoured face conveyor is a conveyor system which is working along with the shearer, shearer is the cutting machine and the cut material is transported by AFC.

Now, this face conveyor it need to be a little bit flexible that is it can be aligned, it can be pushed and this also give a that is the facilitates the working of the support system that is power support, how it will be giving its legs and all anchoring and then, as the power support will be moving one by one.

So, it will be also that is say sometimes it is called it allows a snaking that means, you can it is a flexible in the sense, we can make it to move once and then the other one is at the back

like that you can get a flexible because it is connected with the pans. So, we will be studying about this equipment.

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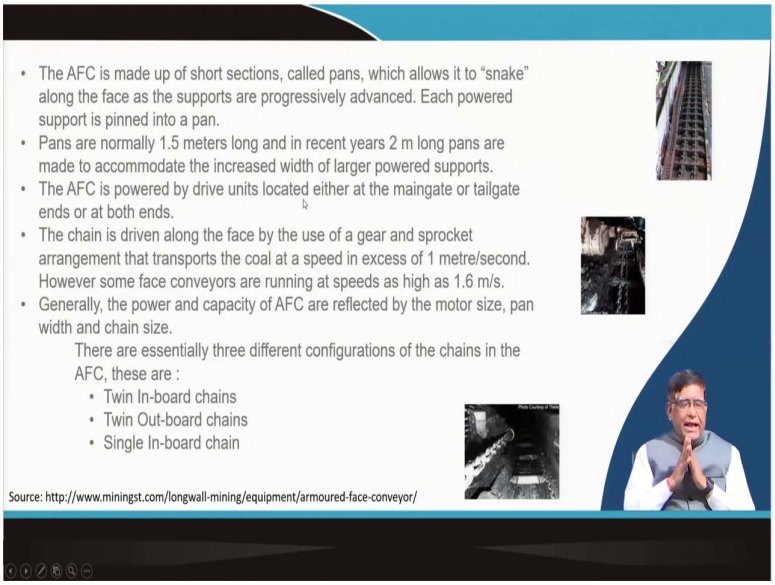

As you see, this is a AFC, it is exactly made up of some short sections. Now, this small short sections are called pans. As you have seen in the previous diagram that it is coming as a this is one pan. Now, like that it is made up of this pans and then, it allows to snake along or that is the it is as the supports and the progressively advanced.

So, this all supports will not be advancing at a time, some are advancing, some is lying there so, it allows the whole conveyor to be snaking, it can give a curve on it so, that is what it is exactly a that it is because this pans are pinned to one another so that this flexibility can be achieved.

Now, this pans are normally of your 1.5 meter to 2 meter long and they accommodate that is exactly the widths and then this your the legs of the power supports which will be there, it will have to give a that is a facilitate their working. Now, this system what type of movements are there, that is exactly there is a chain, that chain need to be powered, it will have to be driven.

So, for that, there will have to be a driving units that is called your drive head. So, this armoured face conveyor will be having a drive head. Now, that is there in the two things that is a main gate and the tail gate. Say main gate means where this whole the your main conveyor belt is located and the that your coal will be transported. So, this your the drive units can be put either in one of that.

So, as in longwall mining, it is there this two gateways are there, one for your as a ventilations that air will be coming, the other air will be going and there exactly we are facilating to over there. So, in the chain, which is there, it will be for a driving you know there will be a necessity of an electric motor, that electric motor will have to be coupled with a gearbox and that will have to be coupled into the main shafts which is driving the sprockets for the chain.

So, this is the normal power transmission system. Now, you can easily tell that what type of coupling will be there for this as it will be in a very heavy load will have to be taken over there, in underground operations, it will have to be as is as you know already this will be the fluid coupling which you have studied already.

Now, the fluid coupling will be used, then the electric motor which will be used, what should be the special requirement for that also you know the two things should be there; one is it should be your flame proof enclosure and intrinsically safe circuit because if it is to work in a gassy coal mine. So, those are the DCMS circular requirements as it is true for all other machines, it is true for AFC also.

And the speed at which this chain will be moving, it is exactly sometimes 1.2 to 1.6 that meter per second and it is, it can be made variable depending on your how the power systems and the systems are designed. So, this the motor size and the pan size, they exactly specifies this what will be this armoured face conveyor system.

Now, this will be of course, determined by how the shearer will be cutting, how much coal will be coming and loading over here. The total power requirement on the AFC will be depending on what is the rate of coal being cut by the shearer. So, that is why that shearer drum design and the shearer that vane design, shearer that operating parameters, they will be dictating what will be the AFC parameter which will have to be designed and calculated.

Now, before going that you know need to know little bit what is its structurally? Structurally, you can have a three types of this armoured face conveyor in which there may be your twin in board chains that means, two chains are there centrally located or there may be two out board chains that is two chains which are there at the ends or there could be only a single in board chain that one chain at the center of it.

You can see here I think in this figure, see if there is one chain and the flight bars are there both sides, it is a single chain. You may have two chains at the two ends that is your outboard two chains. Here in this, we are having the two chains inside the board that is on the pan itself there. So, now I think you have got a fair idea about what is a or what is an armoured face conveyor and then how they do.

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Now, let us little bit of more detail, you can know about what are its requirements. If that is to work in a longwall coal mining which can produce you can you might have heard that there is a with the shearer, when I talked about this I curves 1000 that is which can give up to 6, the up to 1 to 6 million ton of coal can be produced from 1 longwall mining that is say longwall mining is a high producing mine.

So, in that, when such a huge load is to be taken that means, it should be structurally very strong that is why, the chain design that how the chain will be there, how the links will be placed that need to be at structural strength requirement is very very important. Then, it should be bendable or flexible that means, when there your one power support leg is pushing it the other one, it should have that flexibility, it can bend that is also one requirement.

Other thing is the whole work will be within that your underground coal seam thickness which can be 1.2 meter to 5 meter it say so, that means, even if the seam thickness is small that it should be able to work at a very low height. The other thing is that, this a it will have to this supports that power supports must be facilitated so that because of these things, it should not obstruct its movement.

So, that is it will be connected with that, then it should be the all the trailing cables, the power cables for and then the even the hose pipes and all which are going to the power support system, their accommodations should be facilitated, it should not obstruct there. So, that by the movement of your this AFC, your hose pipe should not get busted so that means, it will have to be properly space need to be managed.

And then of course, its speed depending on the capacity of the mine that is your capacity of the shearer, the evacuation should be proper. So, that is why that speed is a very very important thing. If you are having a very high capacity shearer, then the speed at which the material will have to be taken is a that it depends on what is the width of the pan and then, what is the depth of the trough that will be affecting the that is your capacity and then the speed.

Now, coming to this is a what are the main components of this system. We said that this is connected by linking or joining the number of pans. Now, in a pan what are there? You can see in this diagram that there is a this has got a L type of shapes here, there is a back plate and then, there is on the back plate, there is one your track is mounted, this exactly this track is over which the shearer will be moving.

Then, at the front, there is a ramp plate so, and then it will be pushed, it can just move over there that any material that also can get collected over and then come up to the chain. Then this is a twin chain is there when a you are having this particular sigma section you can see here a sigma section is there that is dividing these two chambers like things here, your the top chain race or the base plate is here and then, the bottom chain that is your return chain will be coming through this.

So, there are two chambers type of things are here. And is a the main flight bars are that is in the chain, you are having these flights connected. Other than that, this type of pans will be connected to one end will be called your main gate, main end and then, another is your tail end. Now, this chain, it must be having a proper tension and that is why the chain take up or tensioning arrangements will have to be also made.

So, the cut coal will be falling onto this trough that this it will have to fall on this trough and then, this say endless chain will be taking the material and then, this coal is then will be dragged along the trough to the T-junctions where it will have to be given to a stage loader. So, you must now remember that this say where is the material is coming from? That is coming from the shearer.

You know that in shearer which guides the material to the AFC, you know we have told in your previous case the cowl, cowl is the part of the shearer which exactly will be guiding the material and then, once this material is coming over there, then it is going to the T-junctions, there is the next equipment to which it will be loading is called the stage loader.

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Now, you can see here that is this is the your end drive, you have seen the motor and then the couplers, then we are having this sprockets and this shaft is being driven. So, this is the drive head part of it where you are having this frame, drive unit, motor, fluid coupling and the chains sprockets.

So, this you can see what is the type of chain here? That is twin chain in board that is a chain. You can see here, this is the flight bar that flight rod which is there which exactly drags or push the material towards the other end.

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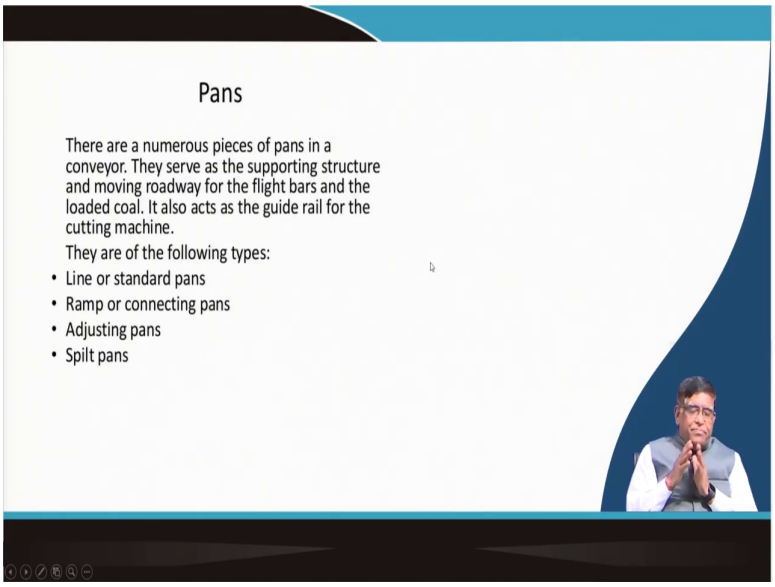

Now, these pans which are exactly coming in a number of them, they will be joining together by that your a pins and then, that is why there are different types of pans are available, it can be a line or standard pans, ramp or connecting pans and adjusting pan and split pans.

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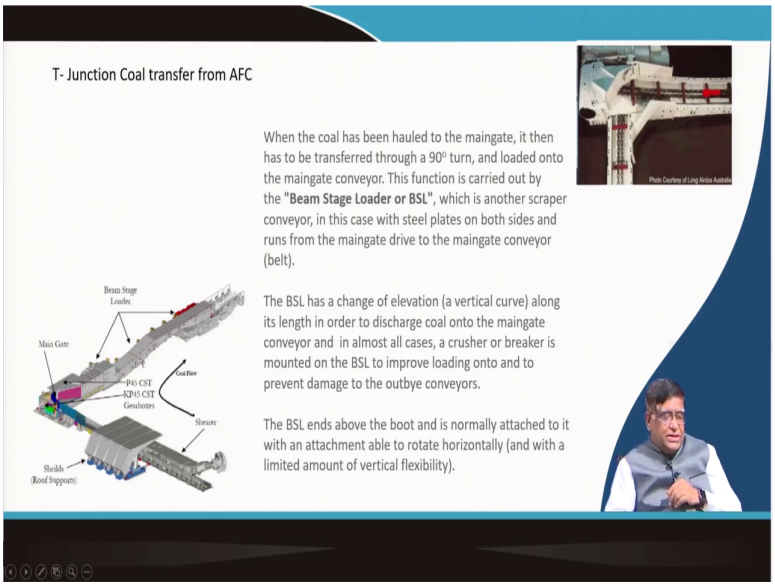

Now, that all the pan that you can see that if this is your the main chain conveyor that armoured face conveyor, your shearer is here, these pans are connected together to form it. You can see this is the that shield or the support system, power support is there.

You can see that the power support, this point is incurred over here so that the pushing can be done with the help of this taking this as a anchor and then, this main gate we are getting, there is a beam stage loader that means, from here, this material will be coming like that and then from there, it will be transferred to another chain conveyor which is there on the stage loader.

Nowadays, stage loader is nothing but it is a another conveyor so that now the material will have to be taken to a feeder breaker. From the end of the stage loader, there will be a feeder breaker. In that feeder breaker, exactly there will be a your that is a breaker, coal breaker will

be there which will crush that coal which is of over size and then, it will be feeding to the that your main belt conveyor.

So, this stage loader or that beam stage loader it is called because it is a on a beam, it is mounted that is why it is called beam stage loader and it the stage loader, it can be exactly at the end depending on where there is that size of the height of the your feeder breaker, the coal may be little bit raised so that elevating systems can be made available over here.

You can see here from that stage loader, it is raised that material over here, here we may have the feeder breaker or this is the main conveyor.

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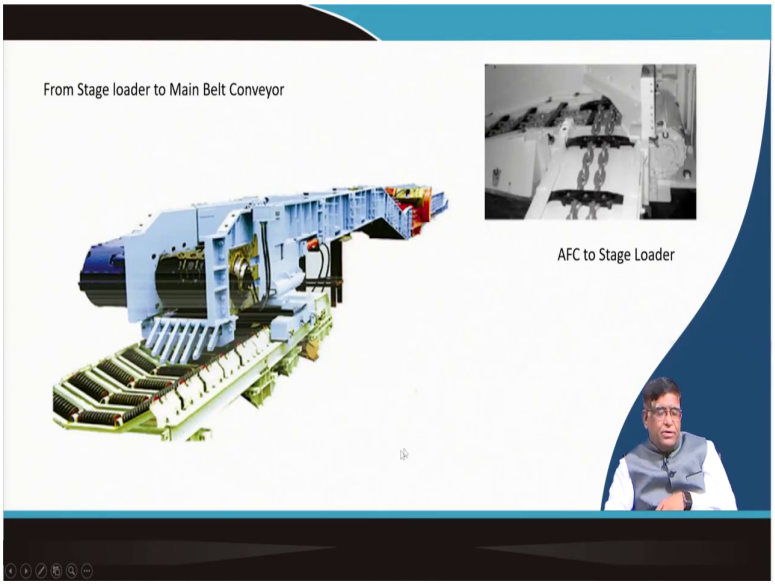

Now, you can see here that is that it is a coal is coming from here, it is elevated to this and then from that your beam stage loader, it can go to the main conveyor belt. You can see the

trough belt conveyor which will be coming over there. You can see here, we will be discussing in our transport machinery, why this type of idlers are here.

This is how a trough belt conveyor will be discussing in the transport. So, that so from AFC to stage loader that is from one chain conveyor it goes to the another chain conveyor that arrangement is done underground near the longwall face T-junctions.

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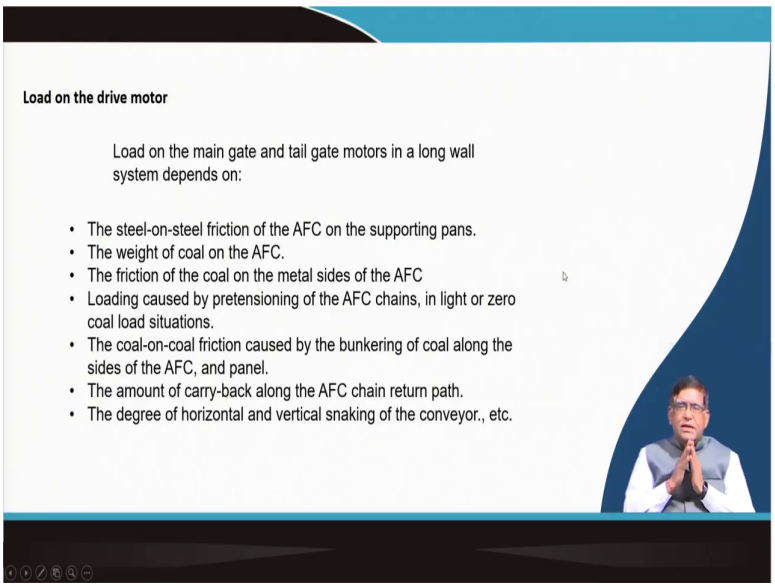

So, now the main thing over that how much load on the main gate and tail gate motors and that in that system will be coming that will be depending on that how the what are the different resistances. So, that means, to drive the chain and the conveyor material over there, your the how to decide that what will be the motor power required to drive it that load will be different resistances.

So, in a detailed calculations, when you do we will be doing that is what will be the coefficient of frictions, there will be steel on steel that chain is giving a friction on the pan, then there will be a weight of that coal it will have to be overcome. Then, there is a friction of the coal on the pan that also will have to be taken and there will be material to material friction is also there and then, this your the tensioning of the chain that also will have to be made.

So, that is so all these resistances will have to be taken into account and then, if the material is having literally if your that seam is slightly inclined, then a little bit of your gravity resistance also will be coming. So, all these resistances and then your will be taken care of to calculate the motor power.

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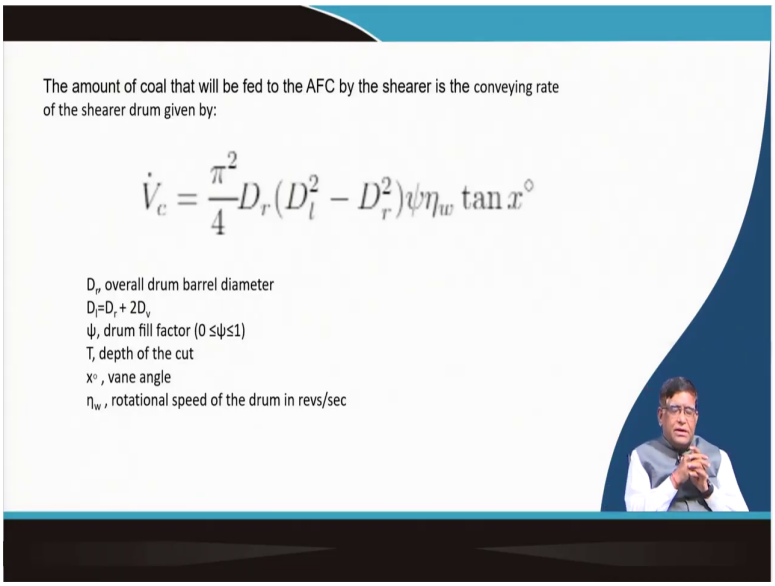

But the main thing is that rate at which this shearer will be cutting that will be depending on that your what is the shearer drum diameter and then, this there shearer drums there is a vane formations that for that how much depth it has cut and then, your what is that vane angle with that these parameters will be dictating it.

Now, this is a matter which will be discussing while we will be doing the different type of calculations at the later part so that and some of you can take up the that your mini projects or a separately, you can study this is a how the drum is designed for a shearer drum and then, how the design of the shearer drum affects the productivity of it at that time, we can do the detail calculation.

So, this is, there are a lot of research recent articles are also there, you will be reading those who are interested to do little bit more analytics on these things.

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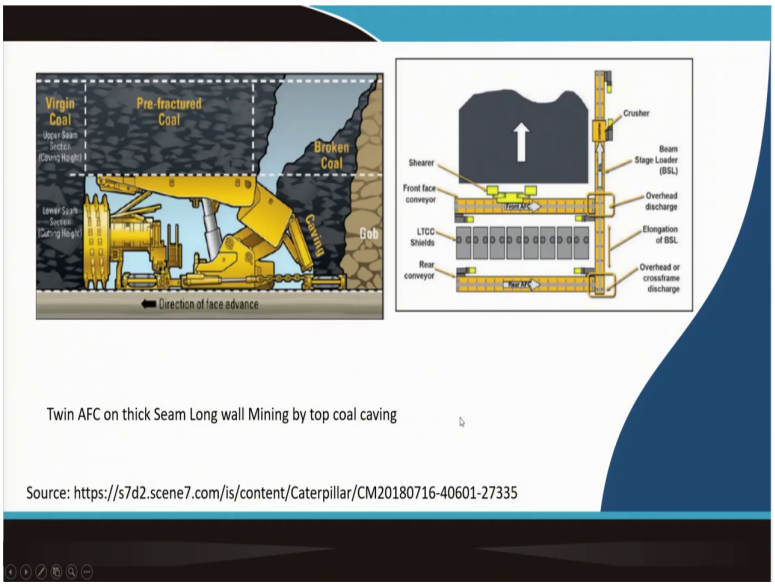

But the another thing is very important that is so far we have said that this coal seam is a very thin seams there we are working. Now, there is a method in longwall mining called your top coal caving. Now, that means here you cut to certain extents, then the upper portion of the thick coal seam are allowed to cave in and then caved one also will have to be carried out.

So, that method of long wall mining, they used shearer and armoured face conveyor, but here you can see that there are two armoured face conveyor. If you see this figure carefully that is your the coal seam thickness is very very thick seam and you can see the diameter of the shearer, this is the shearer which is standing on this AFC armoured face conveyor is here.

Now, when this coal is cut, you can see that this is the your main support. Now, it has cut. After cutting, when it is there, this armoured face conveyor is pushed, it is coming towards

this side, then what is happening that portion of coal which is there at the top, it is now unsupported and they cave in, they break by its weight and fall.

So, that is why, this power support which is using here, you can see that it has got not only this canopy, but there is a the outside this part which is allowed to collapse and that material will be falling on there is another that is your AFC which will be also carrying the material to the tail gate.

So, you can see here in the plan view that means, we are having the main AFC, front AFC it is called and then there is a rear AFC or a rear armoured face conveyor. So, these two conveyors, two AFCs are there with the operation of a single that your shearer and then, both that they will be carrying the material and it will be given to the stage loader.

I think you have understood that in this Longwall Top Coal Caving, it is called LTCC that is a method of longwall mining for very thick coal seam. If your coal seam is thicker than the exactly this that how much we can negotiate is depending on the size of the drum.

If the two drums that your in a double drum ranging arm shearer, if you take the sum total of the two diameters if that is if your coal seam thickness is bigger than the sum of these two shearers diameter, then there will be, you cannot cut that coal and then, there will be certain coal will be remaining.

If you do not have a this type of AFC, in that case what will happen? Your this coal and all will be remaining in the goaf, this is the goaf area that means, that in long wall mining as we said earlier, you just retreat, you go first you drive the two your gateways to up to the end of your deposit and from there, you will be retreating.

When you are retreating, you are taking out the coal and you are allowing the whole of that is your roof and the starter to collapse and it will be remaining there in the goaf. So, only in between certain coal which are not getting properly that you cannot cut which is unable to cut

by this because of the size restrictions, it remain there and also certain gas and all which is remain there, that remain in the goaf.

So, normally what you do? You do a just you shield the wall properly so that the gas and all everything remains over there. So, that is how exactly the mining operations are carried out. But with the advancement of this machinery that means, you can now design a robust power supports which can be more than even sometimes you are having 5 meter; 5 meter, 5.6 meter like that type of high this power supports quite sufficient to withstand the load.

And then, while working there is you are maintaining the safety of the people who will be working in this also they will be maintaining this your machinery and then, it will go the top coal is allowed to cave in and then, you are collecting over here. Now, normally that as I said in earlier class also that sometimes if it does not cave, then it becomes problem, then you will have to induce this caving, sometimes they do some blast and other operations to cave it over here.

So, this is how exactly a machinery can help you to get the coal. So, in this one you can see that this armoured face conveyor when it is a part of this shearer and the power support in a combination, they are working, and this is the way. So, there are detail things are available, you can find it over there.

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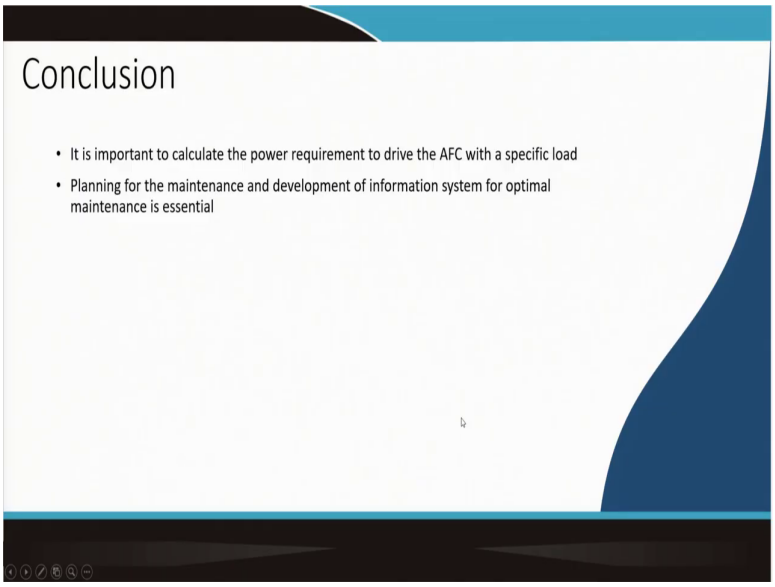

So, coming to a conclusion that is our it is very important to calculate the power requirements to drive the AFC and that specific load. Now, and the planning of the maintenance and development of an information system for optimal maintenance is essential. Now, while saying that what you need to know about this AFC is how you will make them run without any trouble and that is where the whole that your understanding of the mining method and understanding of the machinery is required.

So, in our next class, we will be discussing about this your power support also very briefly and then, when we will be coming to our classes of doing some practical calculations and numerical, we will be studying about that how much power is required to drive and then, that we will be studying the basic maintenance pattern how will do it.

But one thing you please remember this the managing this the power support and the AFC along with shearer, it is a very very technological job and if you do not do properly, particularly selecting the machinery say for example, in the power support that how much should be the pressure that what will be the pressure that the cylinder will take depending on the load, if you do not calculate it out properly, then your whole power support may get collapsed.

And by such things because of the improper that is design of the supporting capacity, there had been many panel got lost and buried which cannot be recover and it is a matter of few your hundreds of crores of rupees can get waste. So, that is why while you are doing a basic investment, your technological requirement need to be properly assessed.

So, I request you to kindly go through the different literatures available as well as in the textbooks which we have already prescribed, you can read that book by Professor N Shinde, you can read book of a semi-handbook and also, you should read recent journals articles. So, this a South-African mining and metallurgical society journal is an Australian mining and metallurgies journal, they do publish some very good articles of the current research.

So, I hope you will be preparing a note on the what are the different manufacturers of armoured face conveyor and then, how they are maintained. Please develop a small write up on it.

Thank you very much.