Bulk Material Transport and Handling Systems
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Lecture – 42
Ropecon Transportation

Welcome to our discussions you have how things are going on I hope you have started studying this bulk material handling and transportation, but you tell me whether have you been to Rajgir or Nalanda then if some of you have gone to Kolkata Science City, you might have travelled on some aerial ropeway that is another thing (()) (00:46) sometimes I told you about this aerial ropeways.

But thing is that you have travelled those rope haulage system which is there at Nalanda or Rajgir which is also there at Science City and many places. Now I tell you a story that in Europe there are many hills where during the winter season they go for this skiing that at the snowy mountains. So, there are many hills, good hotels are there now there all the people from the foothill they are carried by a system of ropeways on which there will be very some small cap type of, container type of case are there those are manufactured by a company Doppelmayr.

So, today I am going to tell about that ropeways you just think of the ropeways which you are having at Nalanda than instead of those carrier on which you are sitting or that container on which the people a group of 7, 8, 10 people are travelling instead of those on that rope if you keep your conveyor belt that means high above the ground so this is on a trestles that your conveyor belt is going and you are carrying the coal or your bulk material over there.

So, these particular system that was visualized and today in our discussion you will be finding this transportation machinery for surface mines where this system RopeCon this RopeCon is the world used by this Doppelmayr company when they combined the system of a different type of hybrid type of transportation system which is called RopeCon transportation.

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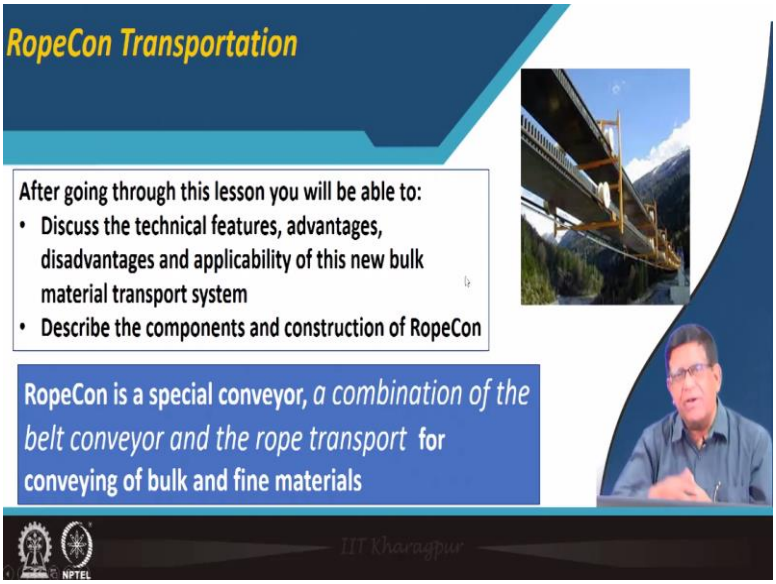

So, today after going this class you should be able to discuss the technical features, advantages and disadvantages and the applicability of this new bulk material transportation system which is there. Now I think it is more than 10 years, 15 years I think first I talked about this RepeCon transportations in 2008 I think in one of the mining conference at Dhanbad.

I first told about this conveyor system which is I could get that opportunity to see at Simberi Island in Pacific Ocean there is an island called Simberi where the gold mines, gold ore is being transported to the port for taking it to Australia from the mine about 600 or about 6 kilometer I suppose I forget the exact figure now, but that long distance conveying was done by this system which is a RopeCon.

In those days in 2008 there are hardly about 6 installations in the world, but today there are many installations and they are coming up from Guatemala to South Africa to many places. So, this has not come yet here to India, but I hope that some of you if you can develop R and D and research in this area this could be a technology of future because it has got number of advantages.

So, you should be able to describe the components and the construction of this RopeCon so that you can start studying and taking up some interest in this current developments and maybe who knows we will be coming up with a new dream, new technology. So, this RopeCon as you can see in the figure that is exactly this is just like aerial ropeway on the

rope that you can see the wheels they are moving, but this whole conveyor belt is on the wheels that is exactly this wheel which you are seeing here as a plastic wheel.

There axle is there or along the conveyor belt across the conveyor belt this axle is there and they are supported on this wire rope and then you can both the carrying side and the return side of the belt both have got side wall and the whole thing is moving and you can see from there and there is one support the other support maybe at a distance of 1.5 kilometer, 2 kilometer. So, such a system could be it is really a matter of interest let us see how we study about it.

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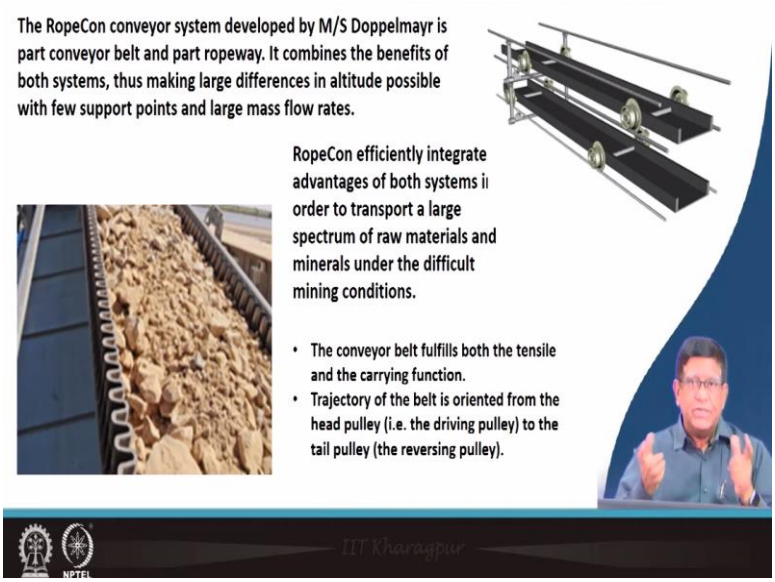

You can see that here as I was telling this is a conveyor system that Doppelmayr company of Austria it is an Austrian company they have that combined belt conveyor and these ropeways these two things they have combined and then already can you see this is a corrugated type of the sidewall for high angle conveying already which was there and use from about 80s there was one British company called (()) (06:04) used to give this type of conveyor belt with a cleat in between so that they can take it in a high angle conveying systems.

So, they have studied all the different systems and developed this hybrid system so it integrates both the advantages of rope haulage as well as that of conveyor belt and then they technically manage the problems and it comes out to be a very good economic choice. Now the conveyor belt fulfils both the tensile and the carrying functions because we will have to have attractive element here will be the rope on which that is your that rope is not moving.

The belt is moving, the belt is given drives just like at the end drums, but because of these wheels that belt is not supported on rollers. So that frictions of the belt and the idlers that is not coming, however, that only with very specially designed plastic belt what is a polymer that is synthetic polymer wheels which will be moving over the rope giving a very less frictions.

You can easily tell you about the rope that will be your local rope where there will be less frictions. So, this is a system in which the trajectory of the belt is oriented from the head pulley to the tail pulley from one end it is loaded and on the other end it is transported. So, one thing here that in between slight discharging and all that thing if you want to transport the material at different places there will be difficulty.

There are certain difficulties that if you want the flexibility and loading and all that thing, but many places here we do not require a flexible unloading system. You can think of when you are going to deep surface mines in India for our future coal and mineral demand from there already you maybe knowing that our Indian railway and then Coal India Limited they are having their joint collaborations with having a rapid loading system with silo which is coming in our that is your wherever there is our railway siding on which the railway wagons are being loaded.

Now in that silo you can bring from the pit even from underground mines this transportation system can start their loading at underground mine from there it can come up to the surface and from there go to the railway where the silo are there loading it on to the silo and from the silo welder wagons will be coming rapidly loading and then going to the metallurgical plant or to the thermal power station.

So that type of very advanced and technologically sound environmentally friendly system can be introduced with this particular system. So, I hope some of you will be getting interest in studying this. So, it is clear that what is this then you have seen in the previous figure a conveyor belt with a sidewall is there moving on wheels on the conveyors.

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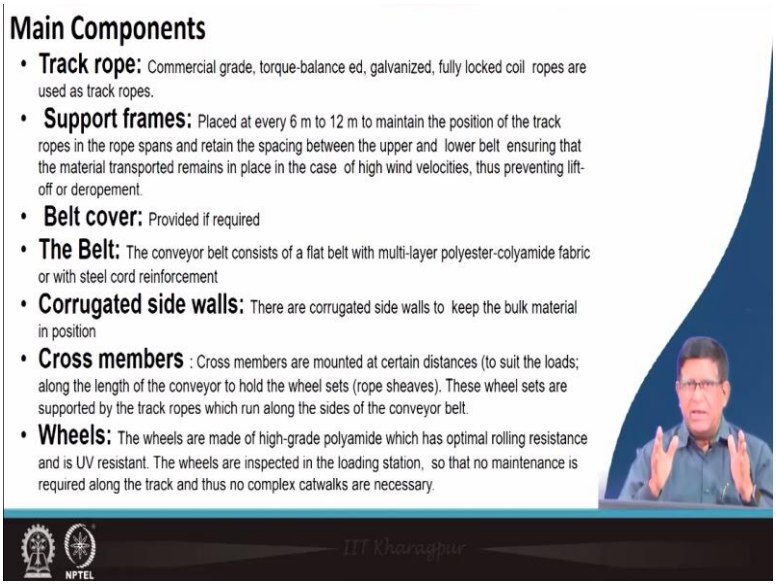

So, there are some of the components that you will find in this system is the track rope that rope which is there it is called a track rope just like a railway you have got the track on the trestle it is at a higher elevations you are maintaining this rope as a track on which that exactly these tracks is kept at that higher elevation by supporting frame. This supporting frame we can say sometimes it is called as a tower sometime you can say the trestle.

They are just like your transmission tower you have seen in your high when you are doing a 33,000 KV electric lines (()) (10:19) that tower we have seen a similar type of tower or it can be a tower just like you have seen in your flyover. In the flyover you have got a cemented pillar, similar type of pillar can be there and on that also you can have at a distance of 1.5 to 2 kilometer.

And there what we will have to see at that height what will be wind velocity when that wind will be swaying and your belt will be going out there when they will be (()) (10:50) and as because it is a rope it can form a catenary and it can give a sway and when there is no relative motion under these two that means the whole material will be having a sway there will not be spillage things will be very good.

So, this type of support frames for whole ropeway will be there and then there will be belt cover that is your we will have to provided the belt sometimes what happened that you want to protect it from the rain on depth trestle itself you can have a system to give a cover that is also possible. The main thing is the belt the belt will have to be a specially designed. They have made in such a way it is a flat belt.

We are not a troughing belt it is not a troughing belt it has got exactly the strength and other things which will have to risen it become less, but it has got a corrugated sidewalls because of that the material will not spill in all conveyor belt with the troughing belt you have seen that when the belt sway it would go to the side it heats over there sometimes while loading if you are not loading properly in the central line is not maintained you have seen the material spilled, but here is a flat belt.

We have got a cover you place any where the material will get distributed and there will not be spillages. Then there are these cross members that means as because this wheels will be connected with the axles and then we will have to have these cross members at different places to support it and then also that wheels how we will be having that axle which will along a cross member.

And then both sides there will be wheels which are made of some t polyamide wheels and things like that so that it gives a long life it does not wear when it is moving over the steel lower ropes and the friction between steel lower rope and that t polyamide wheel there should be such a wire resistance polyamide that these will sustain. Now so that means it is altogether it is a different way of transportation.

It is a little different from that it is not a aerial ropeway I will be discussing somewhere about aerial ropeway also, conveyor belt we have discussed though it is using a conveyor belt, but differently.

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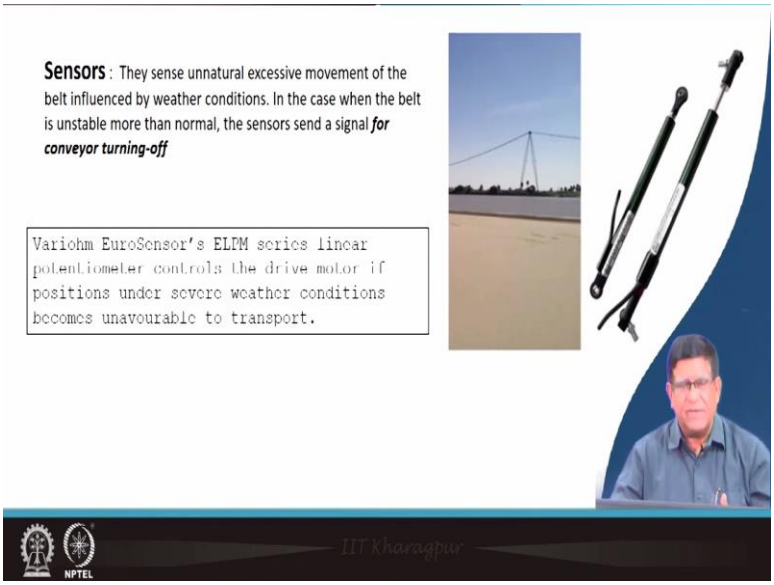

Now, other than those components there is another main component which is used that is these whole conveyor belt will be carrying material somewhere it can go even 30 kilometer and same single belt is sticking the material 30 kilometer. So, there if anything is going wrong and all will have to be monitored and that monitored can be only by that is you are monitoring a movement whether how much it is swaying.

What speed it is going, when there is a depressions that whether there is a elongation of the belt any deviations and all needs to be sensor. There are many type of sensors out of this very own euro sensors. They are making some of this their position sensoring equipment as you can see that figure they are fitted at different places and exactly they acquire. All the operational data which will be coming from a place and this is a 30 kilometer.

You do not require any persons to operator or maintain it only at the end stations and there are possibility on the trestle you can make a trolley to move along with the people in between you make inspection or the survey of the system health and things like that.

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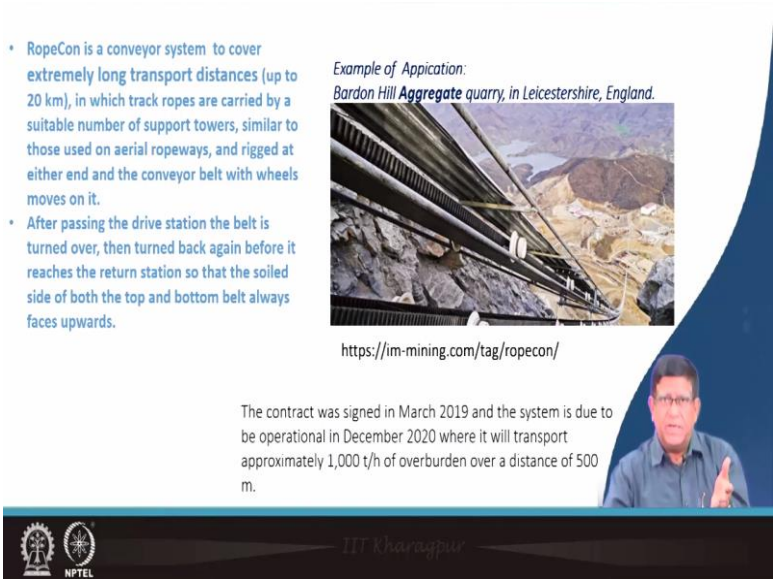

So, once we get this system this is a conveyor system to cover extremely long transport distance up to 20 kilometer, 30 kilometer it can carry in which whole track rope they are carried by a suitable number of support towers. For a 20 kilometer land it may be hardly there could be 12 or 15 towers maybe required and that is exactly this is just like your aerial ropeways.

Aerial ropeways are old proven technology in India also that is before independence that whenever there were the private coal mines they were bringing from the Damodor river the sand for in those days there were many underground mines, but they were having a small tubs that is your aerial ropeway cars, tubs in which the sand was filled from Damodar river and taking into the Jharia Coal field.

Similar things were there at the West Bokaro Colliery of Tata Steel they were taking the sand from the river side to the mines by aerial ropeway. There were some of the abundant aerial ropeway you can see when you travel from Jharia to Sindri near Dhanbad, but this system is having that some of these disadvantages of this aerial ropeway was because the material is taken in a container.

It is not a continuously moving so the throughput capacity which is must less, but here in this because it is on a conveyor belt you can take a 5,000 ton per hour to 10,000 ton per hour also you can carry by this system and there will not be any spillage that in a aerial ropeway the spillage was a biggest problem. So, this is how exactly the rope can get develop. So, now there will be drive stations at the end.

One end from there it is driving and belt is turned over at that and it will go to the other end. Now you just see here you have seen in the diagram in the figure the belt is going like this and then when it is return also you are seeing like that then how it has gone. So, it you take a belt like this when it will go that upside will be down. So, that means if you see here in the previously in that figure you have seen that your this conveyor belt you have seen here that both the thing your conveyor is upside.

So, that means when they have gone to the other side this one this conveyor belt after it has gone to the end they take a turn and then that means there will be a swing and then going back and then the return also is coming in this form. So, one thing is there you can even in the return side you can bring material over here. In some places it can be there so for example sometimes if you are having locations for the transportation of some grain may be there and then from the mines if you are just taking think of that in Punjab.

Sometimes you may think because they are in the field all the straws, (()) (18:17) they are burnt and then they create the air pollution. So, if it can be made that is exactly you are having such type of conveyor belt they will be taking out all the cut material pulverized and take it to a paper mill and in that near the paper mill and if there is a fertilizer or other things those things can be taken back to the agricultural field.

Sometimes that when take the rise from their main stock to the silo rice silo can be there I do not know whether that in Punjab or in Haryana where more rice is produced or the wheat is produced whether they are big silos if those silos can be loaded by that from that agricultural field they can take it over here and then they may have this return belt taking up those some of the find that is the husk if it is mixed with certain other organic fertilizer.

You can spill over to the ground over to the agricultural field. So, that means the rice transportation to the mill and their silo and from the mill taking out the rice that is your husk and other waste material to put it into the agricultural field such type of systems can be used. So, those techno economic feasibility of such systems will have to be studied and developed by you, but here in this figure you can see it is for an aggregate mining which is there in England in (()) (19:46) they have developed this.

It is just only in last year they were enumerating such type of system that 2006-2007 when this was the technology being talked about now today it is being applied everywhere. Similarly, when we used to tell about this pipe belt conveyor in early 80s in Australia and Japan people were designing it and in 2006 it has come to India. So, now this is a system which is already getting applied in many places.

I hope that in coming 5 years, 10 years some of the installations will be coming if we can make it a more cost effective.

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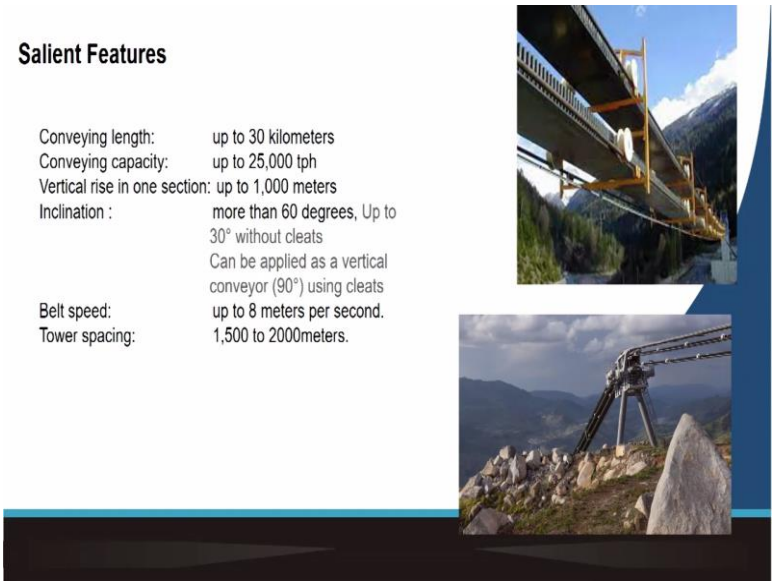

So, you can see what are the salient features of this system? This system can take up to 30 kilometer even more can be designed. It can take 25,000 ton per hour that is your such a huge capacity. So, that means when we are now having a mindset Central Coalfield Limited they are having mines of capacity 40 million ton per year they can produce. Now that if we are having a super that mega thermal power stations in a mega thermal power stations even if it is 20 kilometer, 30 kilometer away.

It can be connected by this or in the whole country our thermal power stations depending on the thermal power stations we can think of the India Bulk Material Handling of Coal maybe the whole country maybe having 100 or 200 big coal depo in that depos is from there centrally we may have the number of such type of system because they will not disturb the lower ground terrain will be free for all other activities.

The pollutions will not be there and it will not use the diesel and then it can make a total scenario of Indian that is your fuel supply agreements of the coal producing country and mine and thermal power station linkage can be altogether. I hope sometimes that NITI Aayog and all can be taken up these type of things by some of your engineering and research work can be brought to light by that.

So, there are scopes, but it can go inclination up to 60 degree even if required you can give a cleat on the conveyor belt you can take up to 90 degree also and transportation rate is very high how you are giving 25,000 ton per hour because it can go up to a 8 meter per second that speed see this is normally you will find and in a thermal power stations and all for your boiler feeding and all the way the conveyor belt is being used it is hardly 2.5 meter, 3 meter per second speed.

So, it can go in a very high speed and in our country most of the places other than the coastal area wind velocity is not very high and only during the storm time and all. So, we can make this type of system at a sufficient height also. So, there is a lot of scopes for this technology in our country as well.

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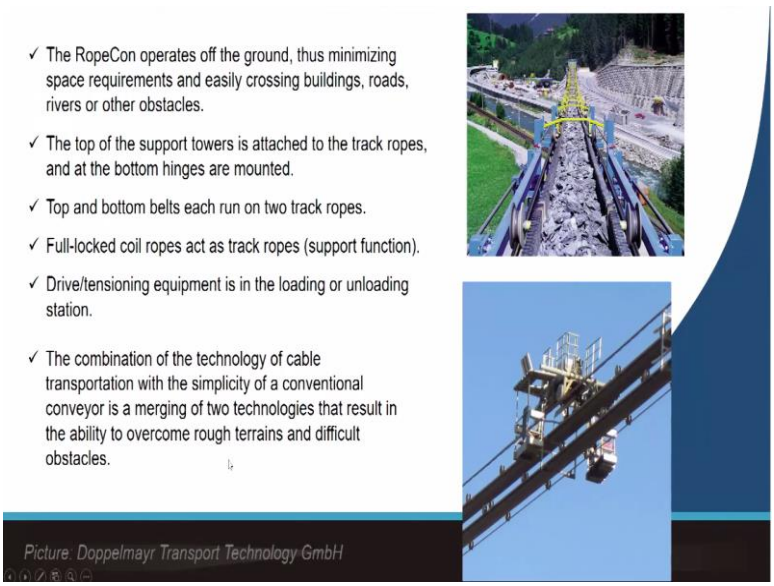

So, as I said it operates and off ground you can see that how materials are being carried you can see this. Now you can see here by the side the trestles they are having those another ropes on which such type of carriage which is for the maintenance and surveillance and serving. This can be moving over here at a height, this will be just moving you can travel over here and do it whatever work you want to do.

And this require very less maintenance because they have got very less moving parts because there is not many moving parts. So, maintenance is also not required. The top of the support tower is attached to the track ropes and the bottom is hinged over here so that is you can see how both the things are supported like this then the top and bottom belt each run on the two track ropes.

Both the things are having the same type of traction mechanism now that your full locked coil so that the friction is less, drive tensioning equipment because these ropes at the end where the driving station is there will have to have a very good tensioning of the rope and for that different type of anchors are there. If you can remember the name Allied Gold; Allied Gold is a company who were first developing in Sainsbury.

You can see in YouTube some of the very good video of Allied Gold company of Poppin Penguin where they are operating that was the Poppin' Penguin Island Simberi Island in which these type of system there you can see they are very nicely shown how the tensioning arrangement at the end near the drive stations will be there. So, the combination of the technology of cable transportations with simplicity of a conventional conveyor belt is merged here in this technology and has given number of advantages.

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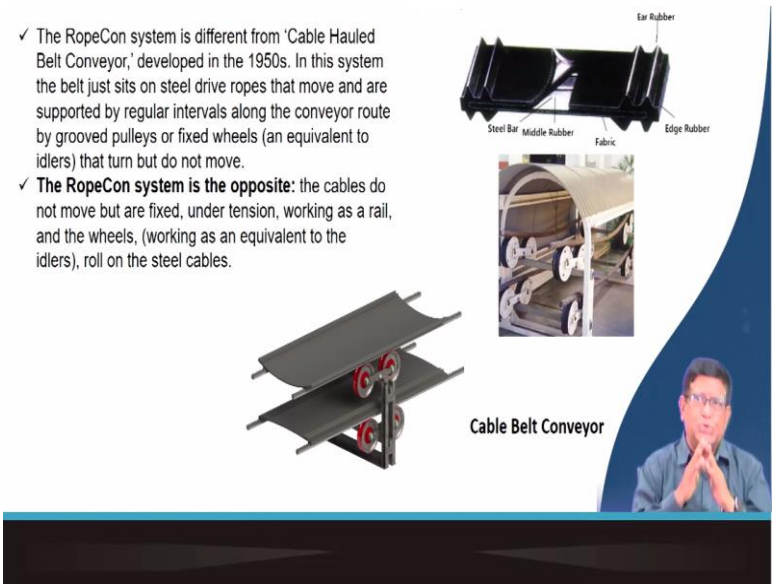

Now one thing some of you may be already knowing about that in India we have got a cable belt conveyor. I think in our introductory classes sometimes I have told you about the cable belt conveyor of Panchpatmali mines at NALCO if anyone of you are there if you go to that

Koraput district of that Odisha there Panchpatmali, Damanjodi we have got this National Aluminum Corporations they have got the cable belt conveyor installed in the 80s.

So, that time whatever were introduced it is still working very effectively, but there this conveyor belt is different you can see that there are shoes over there and this conveyor belt they are having a grip with this wire ropes and then this wire ropes are moving that your wheels are fixed at the supporting frame we are having the wheels and on the wheels these ropes they are moving on a SHEV and thus that SHEV and SHEV is driven by motor.

So, these are all moving rope that means the ropes are now having more frictions at the support frames, but in a RopeCon it is difficult there the belt is having the wheels and the rope is stationary. As a result the advantages coming over here now the whole conveyor belt that is driven by the end pulleys just like in your conveyor belt you have seen the drive is given by the end pulleys.

So, that is the combination of that exactly two different type of systems. So, sometimes you can find out what is the advantages and disadvantages of this two system? One is a cable belt conveyor another is a RopeCon. So, you should study about this.

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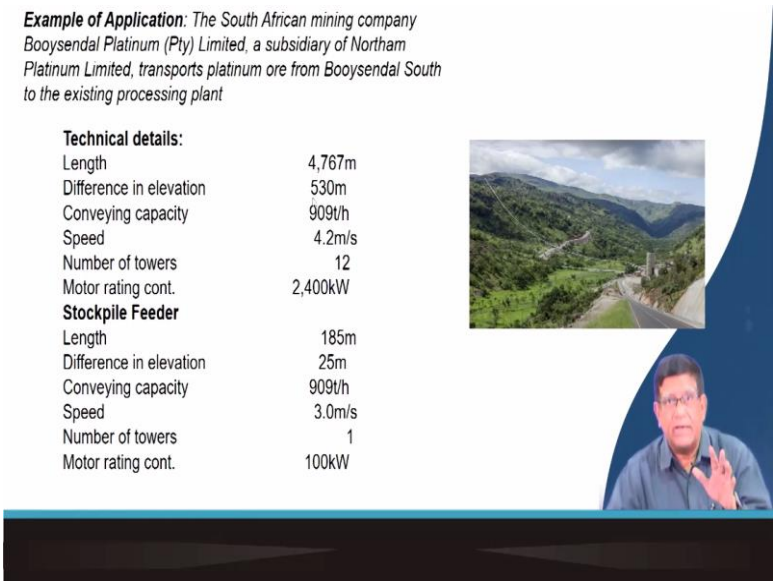

And there are some examples you can see here this is in platinum mines that is in South Africa there is a place called your Booysendal there this platinum mines they are taking this whole from the hill of mines they are taking to their processing plant at a 4.7 kilometer they

are bringing and they are bringing down up to 530 meter. Similar type of situations are there in India if you go to in Karnataka in humpy side.

There are many that is your in your humpy side there are lot of iron ore mines at a hilltop and from there carrying to the railway siding systems that is also sometimes even 400 to 600 elevation down where of course we designed some route for pipe belt conveyor, but because the pipe belt conveyor is still little bit cheaper because this technology has not come, but sometimes I feel that though we recommended for the pipe belt conveyor that RopeCon could be much better.

Even as I told you in 2008 I was giving of course we are not a consultant or we have not given the trust that our academic have got a very limited role in India, but we were telling in 2008 that from taking it to the Syria mines of sand their material to take it if they take a processing plant at Manoharpur or from there if they want to even for exporting at a Paradip Port from the Barbil area some of the iron ore if it is exported then taking that maybe 120 like that kilometer.

But if that also can be taken by such type of conveying system I think after that I discussed some of the officers they took it up and I think with the R and D division of sale they did a study during 2008 to 2010 I think that now retired Mr. Harekrishna Mahanta of that time they could be able to give some of you, you can contact and see that what happened to the sale initiatives, but this was initiated in India.

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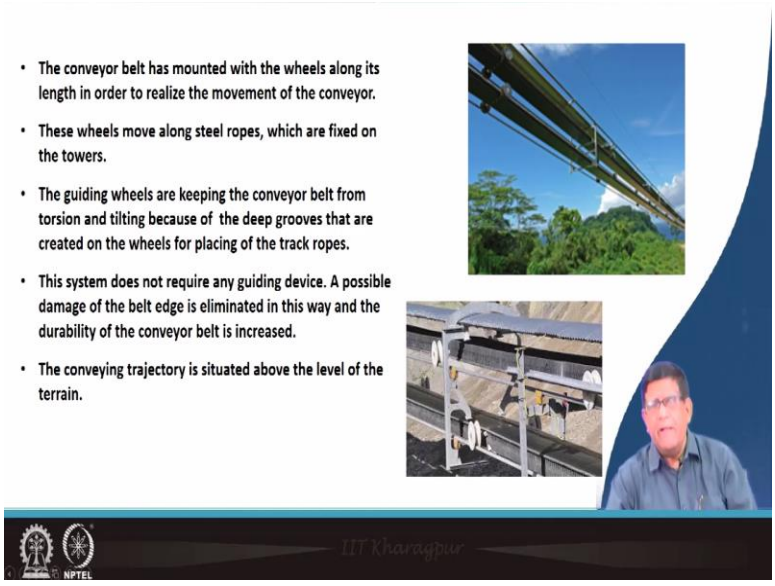

Now the conveyor belt has mounted with wheels as I have said already that wheels move along the steel ropes then the guiding wheels are keeping the conveyor belt from torsion and tilting that is exactly we can make the systems in such a way that there will not be any problem for torsions and tilting will not be coming this system does not require any guiding devices because it is a flat mounted on this fixed rope and the systems can work very nicely.

You can see over here when you are doing at a low level within that some of that when we talk of our transporting within the mines from the mines to the railway siding every simple system like this will work and it can be very easily it can be designed to make in a cost effective way only a systematic feasibility techno economic feasibility study need to be carried out. Now this system it is a combined system.

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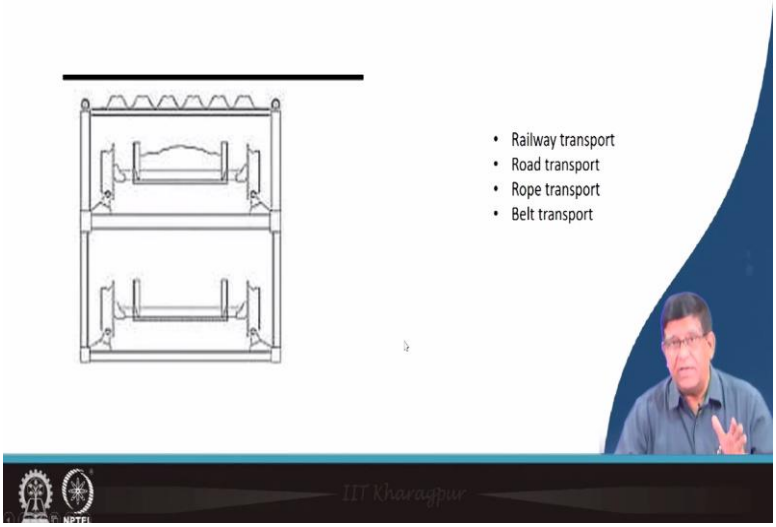

We can see here that how your transportations of this because of the wheel it is going to give you a lot of advantages, it is exactly much better than any of the railway transport, road transport and then belt transport please make a comparative study of these two.

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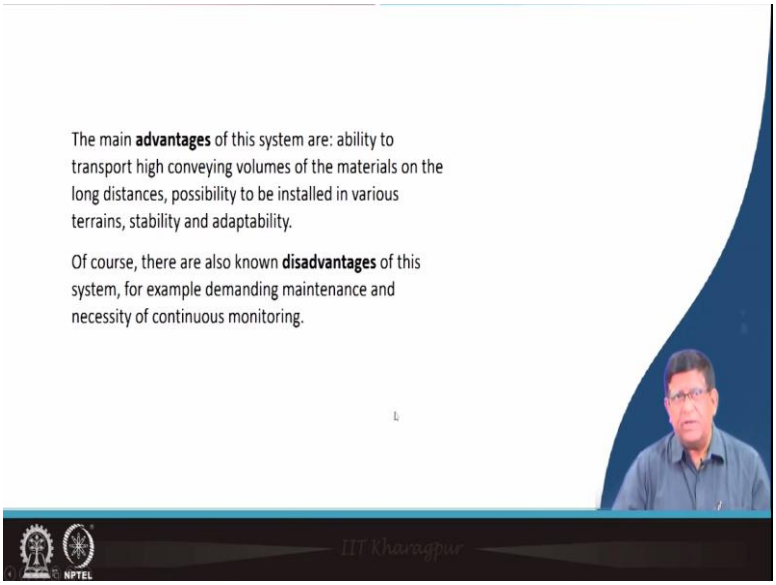

Now, there are lot of advantages these advantages it can carry a very high volume and the disadvantage is that it maintenance and continuous monitoring will have to be having a special arrangements.

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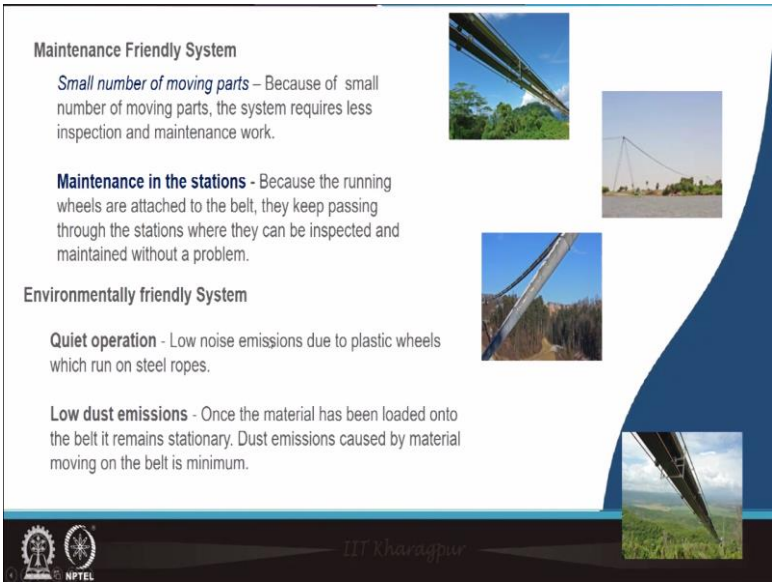

So, as an advantage you can say this is a maintenance friendly system less moving part than it is also it can have the maintenance only at the stations ed stations you can have the maintenance. It is an environmentally friendly because it is a very quite and also it does not release lot of dust.

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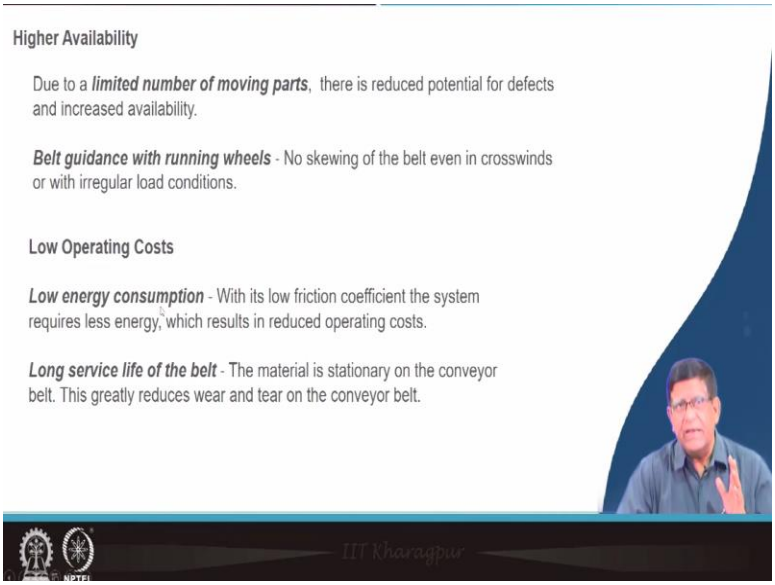

Then it has got very high availability because there are less moving part so there will be less filler. So, there is no need of any guiding and all that things just like in a conveyor belt you have that belt sway switch you will have to have all the time monitoring your sleeps and all everything there is a costly affairs. Now that is why because its energy consumption is also less and the total distance carrying distance or you can take the aerial distance only.

So, you need not do that terrain clearing and all these becomes very easy. So, overall the cost is going to be much cheaper and if you think of a lifecycle costing assessment there is another methodology of study is there. You should do a lifecycle analysis of such type of system and if your mines is having say life more than 15 years, 20 years this could be a very good economic system we need to study.

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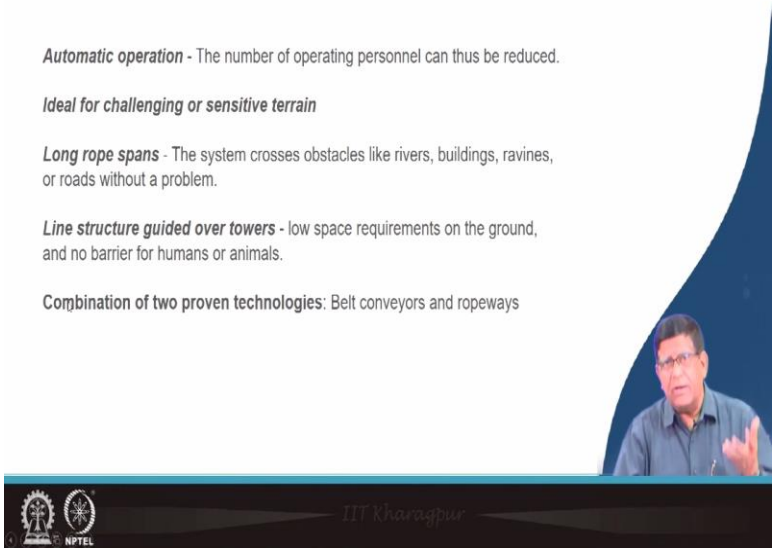

Then operations can be automated and it can have a very good monitoring systems can be there because long span supporting. So, total cost on the supporting frames in conveyor belt there you need to get every meter support and here only you will be doing a support at 1.5 to 2 kilometer so total cost on the supporting in a conveyor belt, the frame then your roller and then the whole monitoring, manpower and all everything if you take and then this total cost of having those towers supported things maybe we need to study maybe economic.

Then line structures guided over tower so all things become very convenient for operation and both the technology at belt conveyor and ropeway they have got already the technology is known, experts are available only we will be make their weeding; weeding of the rope experts and the conveyor experts.

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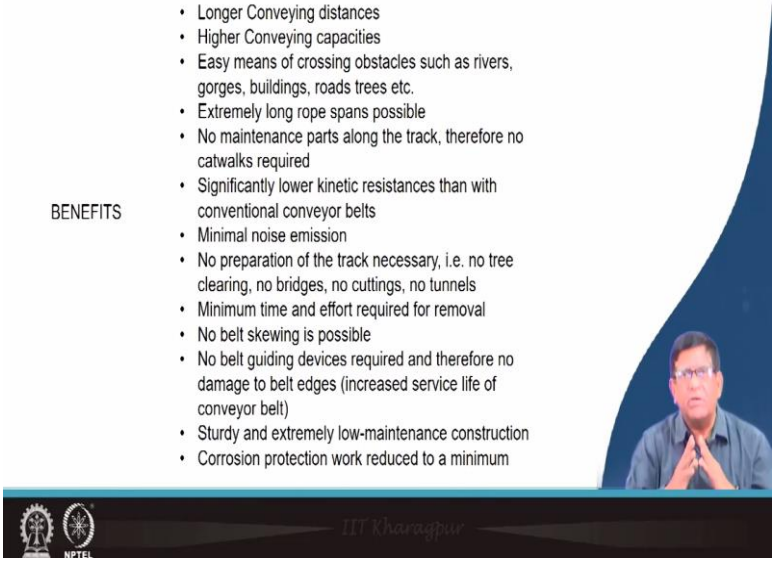

And the ingenuity over here can give a lot of benefits like longer conveying distance, higher conveying capacity, easy means of crossing obstacles, rivers and all there will not be any problem, you have this one trestle here the other trestle material will go over. So, it has got a lot of (()) (33:23) over the township it can go. If you see there is a one such type of RopeCon system most probably in Australia where it is over the town it has gone in order to feeding to thermal power stations. I will have to confirm and verify that.

But it is there you can search in a Google maps also you can see over there then no maintenance parts along the track that is significantly low kinetic resistances with the conventional conveyor belts then minimal noise emissions, no belt skewing is possible, belt will not get turn and shifted that is your belt training problem does not come in conveyor belt

you have to do all the time training that means your alignment need to be checked here those things are not there. So, there are lot of advantages are there.

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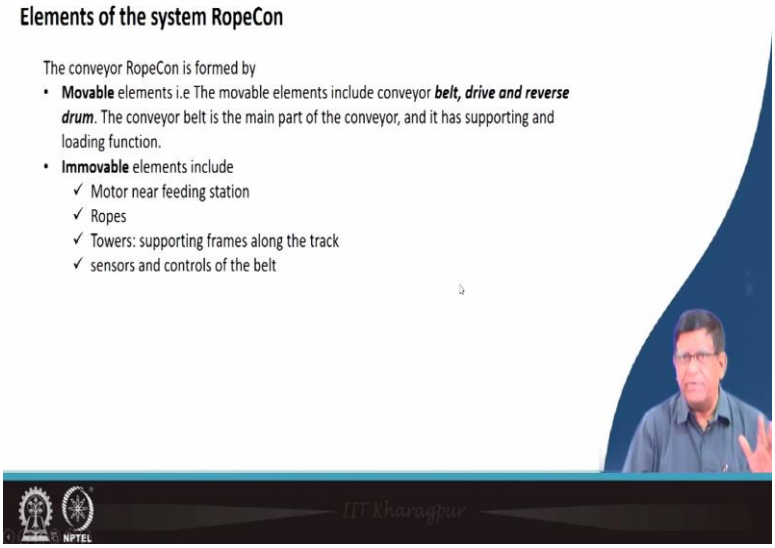

And main element as I said it has got some movable element and immovable elements. Movable elements are mainly the belt and the drive and all will have to be done over there.

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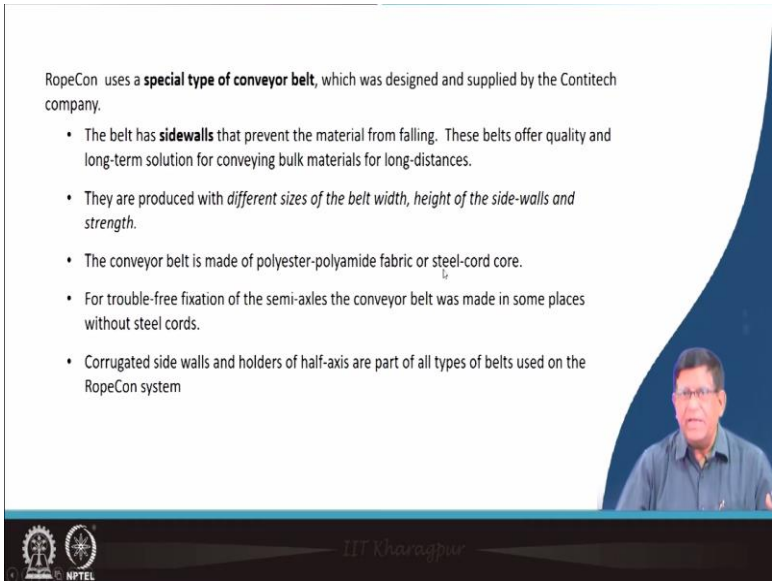

So, this is a system which has got only the conveyor belt will have to be a special type we will have to design in India we do not have a proper gold manufacturer, but maybe if that political wheel is there and then the Coal India Limited join with Dunlop our belt manufacturing company. This manufacturing can be taken up that is your we would Make in India move and the amount of experts available in our country on the rubber technology with the belt technology we should go for here.

As I told earlier we do not have that manufacturing of the large diameter tire because if this system is also taken move than to manufacture those type of conveyor belt and then in manufacturing large diameter tire in India some of those manufacturing company can have, but provided the mining industry take the decision that this is the amount of the business which will be coming if the macro planning of our economic planning is done such type of industry maybe viable.

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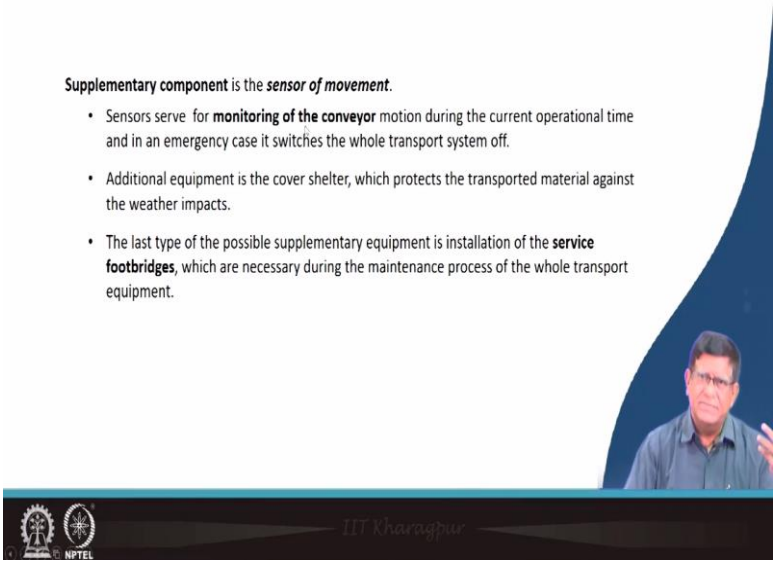

Then supplementary component is the sensor movements those are the things that sensor are for monitoring the conveyor. Here as a bulk material handling and transportation engineer you will have to find out with the electronics and instrumentation departments with the other and (()) (35:57) develop your clear review that what type of sensors can be there and then only when you know the technology you will be knowing that how different data will have to be collected and how it could be modeled over there.

Otherwise those heights of people telling about that artificial intelligence, machine learning and all will be just your wastage of some of the technical manpower into that is non technical operations. So, please go through this try to develop a small model and see here discuss with your electrical counterpart that how the drive system will be given.

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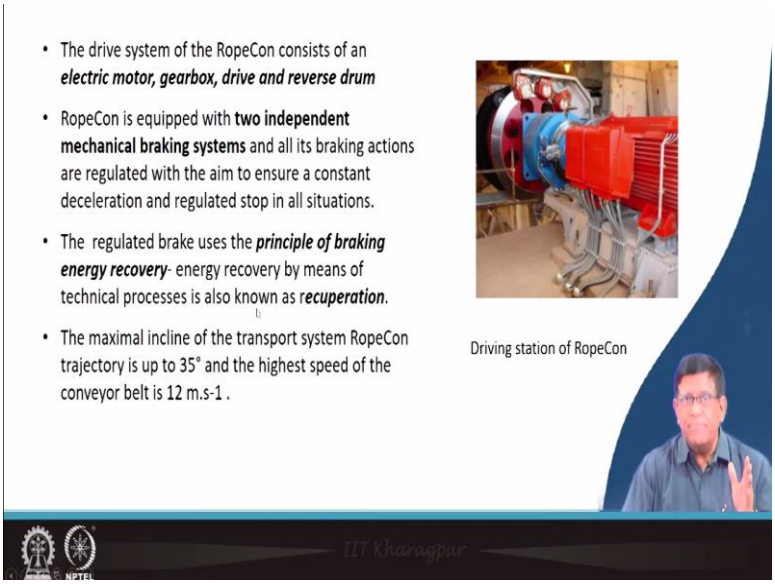

The drive of a RopeCon whether we will be doing it with a greatly with SC motor that speed control and all will have to be done digitally so that is your all the advantages of DC motor can be brought with the SC motor by properly converter and inverted systems over here. So, these part also is a study which can be initiated the most important thing is how will be having the brakes and the controlling of the total drive systems of this conveyor belt will be there.

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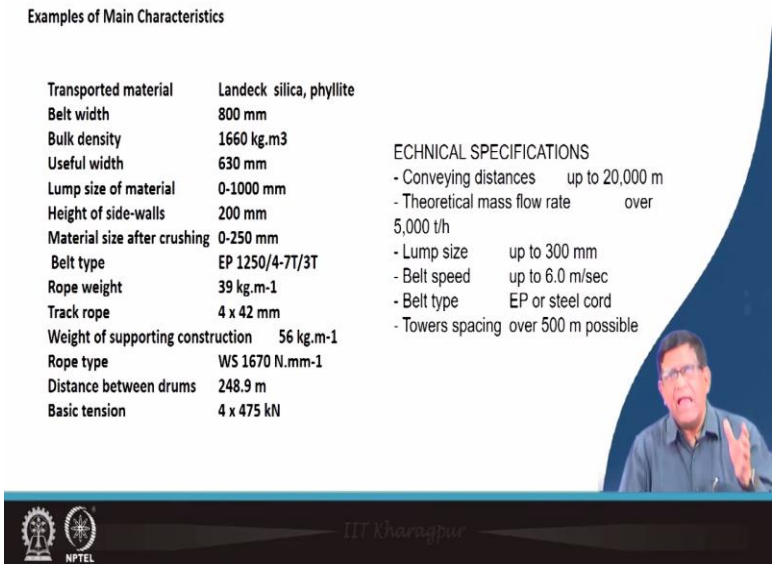

Now there are examples there are many places these are there I have given you this list check over here so that if you take out some numerical that if you create some problem and try to solve how near you go to the whatever has been established there you can verify whether you are doing in the right track or not. So, you take up any problem say you want to transport

material from say Kiriburu mines or Meghahatuburu mines to their processing plant by that collect the real life data.

And for that you do the calculation and see how near you are there with the design and your design. So, you should do certain case studies like that.

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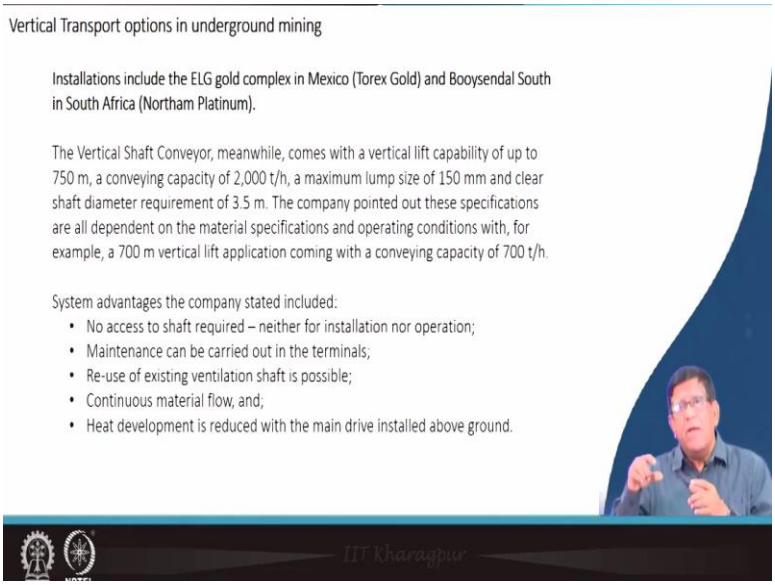

Then another most important thing is there in our underground mine capacity cannot be enhanced because from the underground mines evacuation depends on the welder and in the welder we have got some diameter is fixed and that is why we have got the cage and skip that have got to very limited capacity. So, even if you are using a very high productive machinery share or containers miner in the underground mine from there the material to be taken up with the shaft will not be possible.

Now, if there is a conveyor belt of course that will be bringing over there, but then also the material transport and then maintaining your pit to play out for getting this whole material to take it to the washery there is some issue, but if we think of that one of the that is your upcast or downcast shaft if it can be provided with such type of systems that is from the phase this whole thing will be going.

And then during the vertical free time period it will go vertically or we can have that is your inclined shaft can be made through that material where it will be coming after coming over there it can go to the trestles and take wherever you want 20 kilometer, 30 kilometer no

problem. Even it can be that (()) (39:18) type of mines where mine pit and then the thermal power station is not far.

Then of course they are already they have got the conveyor belt, but in their future mine and all if they go from there instead of the conveyor belt sometimes this can be thought of which can give a much more advantages.

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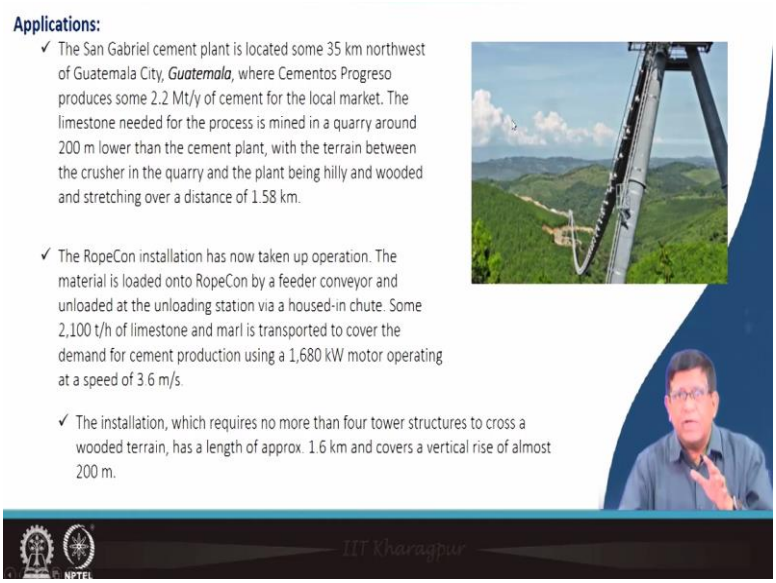

Now there are various applications are there please search that in Guatemala they have been using it for limestone transportation. You can see the terrain and all that thing that in India or any country where there will be a truck haul for taking up the forest will never remain like this, but with that system which is put over here no dust is going to get your stomata or the leaf holes will never get obstructed, the health of the trees will never get damaged in this type of area.

So that is why when we talk about that environmental friendly mining we just do not believe in just taking an environmental study and measuring the air pollution and telling that this is the report that is the thing. If you want to do environmental friendly mining with the transportations will have to bring technology. So, I request that do not elude by studying the air pollutions and all, but we need to do that for avoiding the air pollution we will have to incorporate technology and see their visibility and applicability.

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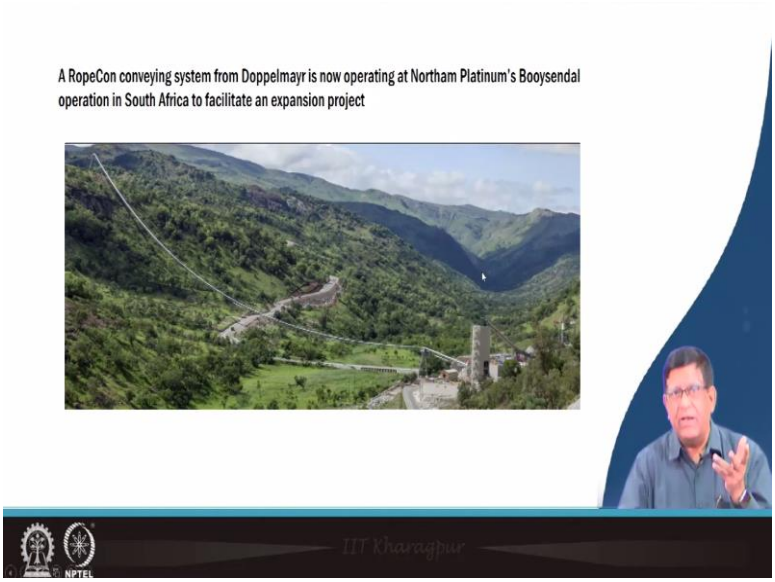

So, this is again I have shown you already platinum mines.

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So, there are lot of references are there please go through it.

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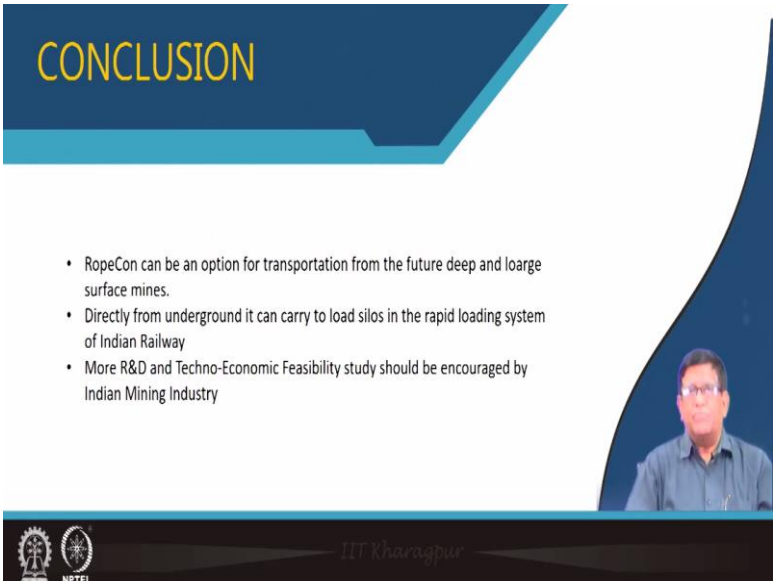

And RopeCon can be an option of transportation from the future deep and large surface mines. Directly from the underground it can carry to load the silos in the rapid loading system of Indian Railway and then they are more R and D and techno economic feasibility study is required maybe towards the end of the course I may be introducing you how to do this techno economic feasibility study because unless and until our technical learning is embedded with the techno economic studies and feasibility this learning and knowing has got no use.

So, my dear friends I hope you have understood now what is RopeCon and please develop your own learning activity. Thank you.