Mining Machinery
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Module - 06
Lecture - 27
Underground Mining Machinery Loaders:
Rocker Shovel and Side Discharge Loader

So, we have been discussing about this Underground Machinery now and we talked about some of this, what are the different type of loaders; we talked about the gathering arm loader an old machine and still in some form it is being used in some of the places.

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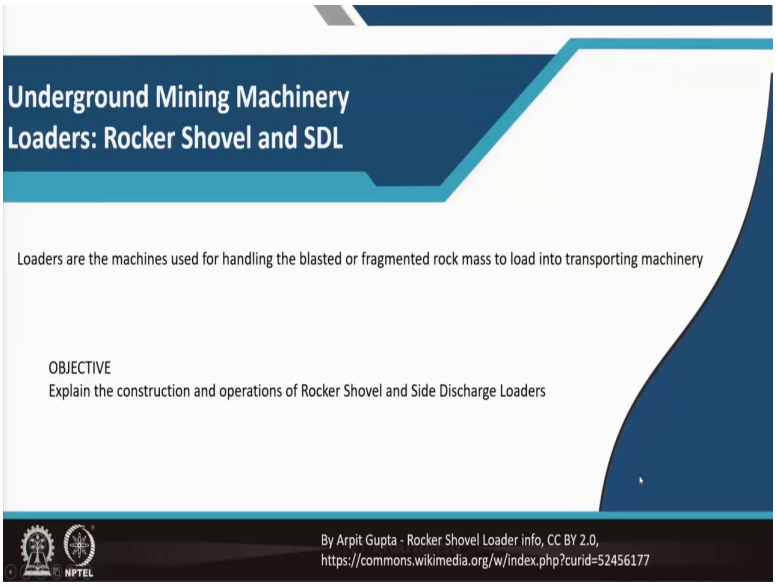

Today I will be discussing about some other loading machines or the loaders, which are exactly used in underground mines for fragmented or the, that your blasted rock mass. And in

that two machines we will be discussing today; one is the Rocker Shovel, and the other one is side discharge loader.

Side discharge loaders are being used in our Indian coal mines as well as these Rockers Shovel are used in many of our Indian metal mines. So, this machine, Rocker Shovel is also a very old machine, which is working from 1938.

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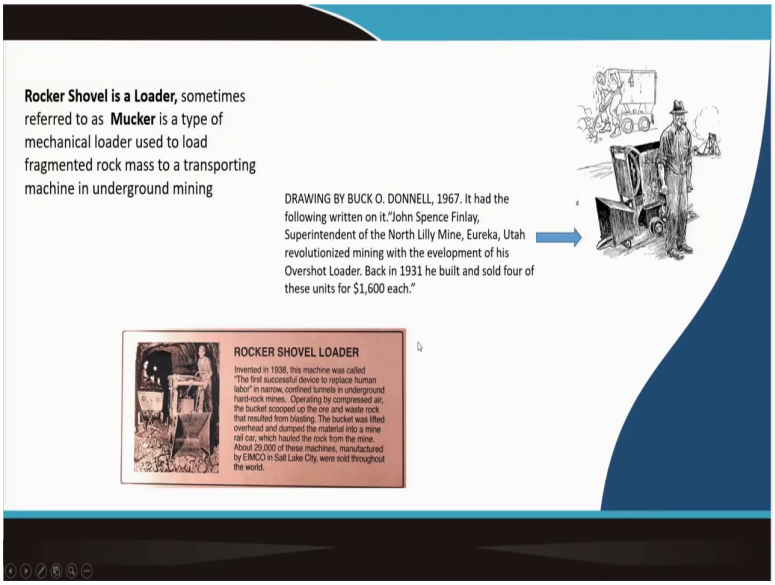

And as you can see here that in this figure, in the old days, the loader means that person was called loader. Even in India up to 1970s and early 80s, there were these loaders and in if you will be seeing that there is a designations, as a some people they were recruited as loader and their job was to use this shovel to load on this type of mine cars and tubs in underground mines.

So, there was exactly the in 1930s, the people innovations in the in abroad; particularly in America they started in a that Rocker Shovel this name was given there and they used to, sometimes this pile is called muck, that is why this machine is also called a Mucker. And this was the first mechanization in a underground mine and you can see this figure, a picture was depicted in 1967.

And where it says that, it is exactly the Rocker Shovel, the John Spence Finlay superintendent of North Lilly Mine of Utah that exactly they brought in 1931. And then thereafter more than 29000 of such machines were manufactured by EIMCO. You may be knowing that, this is another company EIMCO and that has got an Indian collaboration as EIMCO Elecon in Gujarat; this mesh, this company has constructed number of material handling systems in India.

So, this Rocker Shovel what it is exactly? This is a very simple device by which this bucket which you are seeing over here, it will be pushing that material will be loaded over here; after it got loaded, then it will be just by pushing a button over here, pneumatically operated.

These machines will be rolling these ones and going into the back and then the back there will be a trolley standing and there it will be loading; that is why it is rocking shovel and then it will be coming back. So, this machine was just as a simple mechanical system of lever and links and they are operated by pneumatic; that is your compressed air where first used in underground mines.

Particularly in underground coal mine this machine was very much used; because where you cannot use electricity for the, that is your that fire incidence due to the spark given by the switches, that is why the pneumatic machines do not have that type of problem. So, you are having a machines that is a, you are by a lever will be working with pneumatic pressure, such machines were there.

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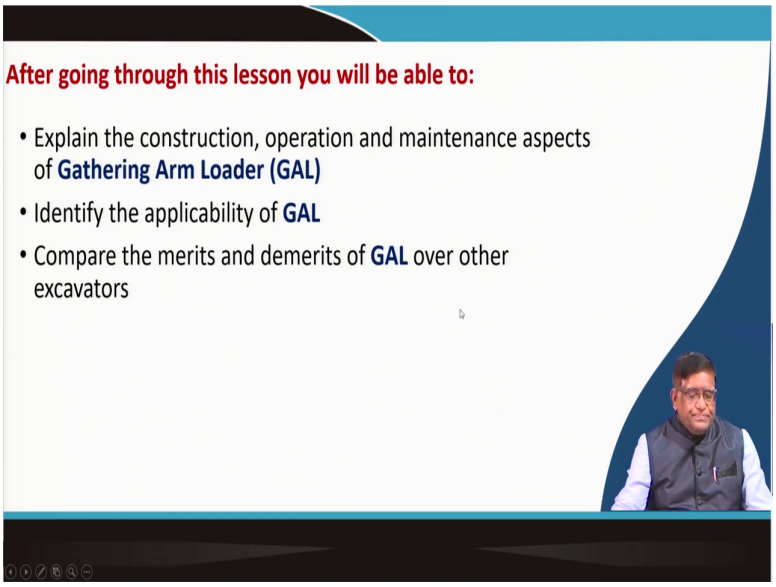

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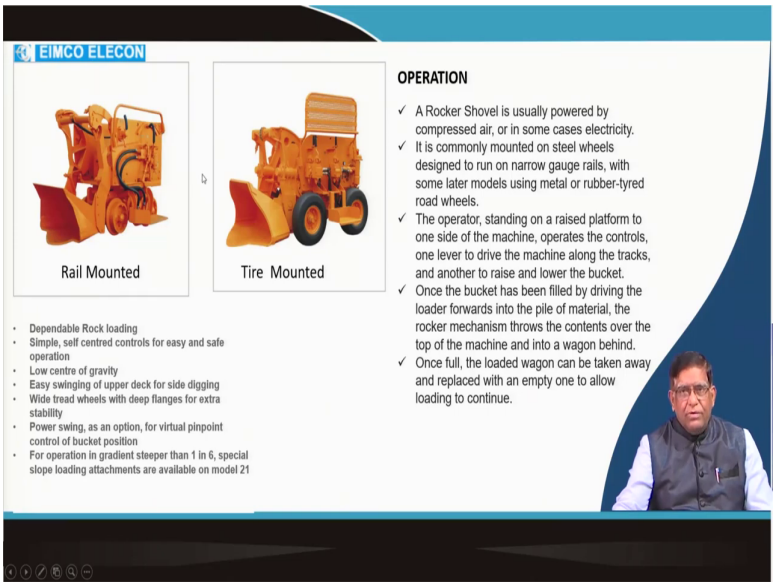

So, that we discussed about the gathering arm loader; here you are studying about these machines which is a EIMCO Elecon; they have manufactured these machines which has got a Rocker Shovel, which is this particular is a shovelling part and this will be working. You can see here is a one platform on which the operator can stand and then he will be operating these levers. So, by this operating this lever, this whole arm it will be going up above this once and then it will be discharging.

So, this is a simple machines, which could be a tire mounted or it can be a rail mounted and there is also a variation scroller mounted not much popular. Now, these operations, this movement of disc can be used by all; as we said these are all pneumatic hose and then there are the levers.

So, this is exactly the benefit of this, it is a dependable rock loading, simple, self-centred controls for easy and safe operation, low centre of gravity, so that is why it is a very stable machine. Then swinging of the upper deck for side digging, it can do that both side digging as well. Then wide tread wheels are deep flanges for extra stability; this can be the track can be made wider, so that it can give a better stability.

Then it is a, if your points that which is mounted over here with this, there is a very less wear and tear of the systems; they can make with proper lubrications. And then the gradient it will be working in 1 in 6; so that if the slope is more and then there will have to be taken care of.

Now, what is here most important is, the speed at which it will be moving; because depending on that speed, that material at what angle it will be projectile out and then where it will be loaded that is control. So, that is a, with a simple mechanical system, they develop this.

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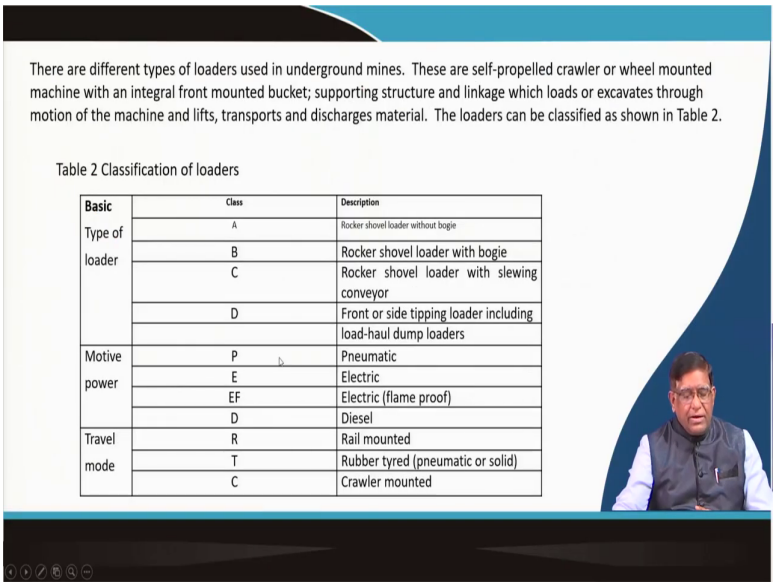

So, now as a loader, there are different type of loaders are there. So, exactly this rocker shovel, it comes under as a class A type of loader. Now, there could be some more additional attachments over there and on which it will be loading; depending on that load the transporting machine which is to be attached with the Rocker Shovel, there will be additional features coming and then the type of the machines will be different.

Similarly, the machines are also classified that, it can be pneumatically operated; in some machines, some places where there is no problem of this explosions due to fire damp and all like coal mine, you can use electric motor, electric system. But if that electric system can also be used in underground coal mines, if it is made a flame proof.

So, those are the provisions available, definitely it can be used with a diesel engine as well, because nowadays lot of development have come in diesel engines. But the special care need

to be taken in using diesel engines underground; because that the air the concentrations of the diesel exhausts if it goes high, it will be, exactly it will affect the health of the people who are working underground.

So, that is why depending on that, the machines type they have designated P, E, EF, D like that designation of the machines are given. Then moreover depending on that whether the rail mounted, rubber mounted or crawler mounted you can classify. So, there are different way of classifying these loaders.

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Now, you can see here that say, a EIMCO Elecon that the machines which this EIMCO produced in 1938; they have gone through different type of a developments over here. But today in this 21st century also, this machine is working and then this is the latest version of that machines which is shown over here.

So, this is exactly a 3000 kg, only 3 ton weight of this machine and it can work with a height of 2.18 meter; that means the what will be the gallery size on which it can be worked, because at the time of this projectile motion what will be the maximum point it will have to get, so that it should not hit the roof of the gallery, that is what it is the important dimensions in deploying this machine. It is capacity is 0.15 meter cube and then it can go up; this is say, at a speed of 1.7 meter per second.

So, these are the different features of these machines; it is a heavy duty generation of low noise, you can make it to work with a less noise depending on that how you have mounted and how you have exactly controlled the that is a metal to metal frictions, how you are reducing depending on that the noise can be made lower.

Then it is a the material of which it will have to be made; it should be selected in such a way that, their friction should not raise too much of heat or to should not get spark over there. Then this its speed, it should be working at a higher speed, large discharge angle and high hopper discharge height these are the features on which it can be designed.

Then this your, you will have to get that low headroom, so that it can work within a constrained spaces. Then this is the machine weight should be kept as minimum as possible, so that its handling and the transportation energy requirement becomes less. Then the gear trains that the drives and all; their gear should be selected in such a way that, it can give a longer life.

So, now, the how different axials will be fitted, these axials on the wheels how they will be fitted with the tire those things also designed. So, that means they intricate the features of this machine ultimately to give a very rugged or robust machines to work in underground.

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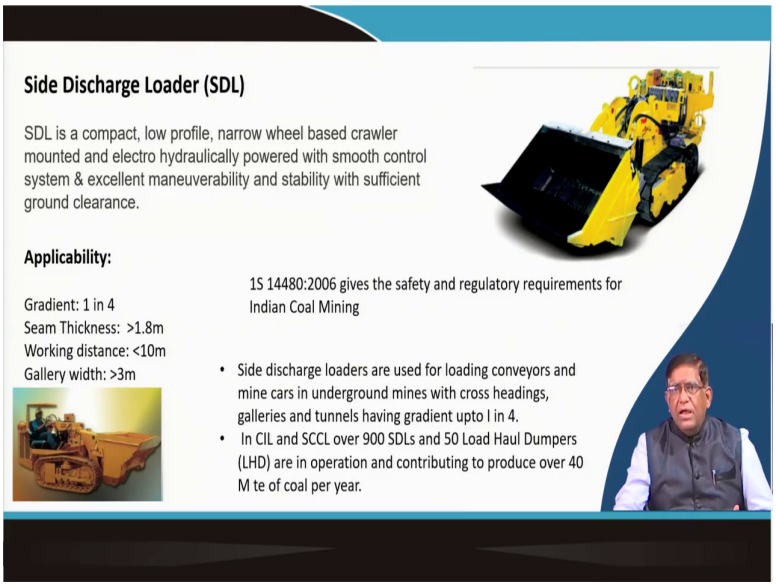

You can see here, that is the other machines other than this Rocker Shovel this; the next type of loader we are going to talk about is the side discharge loader. Now, when I talk about the side discharge loader; before that please clarify whether you have understood that, what is the loading machines purpose is.

The loading machines if it is to work in underground; it should be of low height, it should be easily manoeuvrable within a constrained space and it should be operating with safety that is most important thing. So, in a Rocker Shovel, it has got certain limitations; because of the type of motions it will be doing, it is going the whole, taking the material all over it and then they say you are guiding it by making it to fall through the projectiles.

Now, you understand that if there are different sizes of material which is collected and when they will be throwing over here; the trajectory of the material will be different. So, many a times there may not be the properly loading; so those type of problems need to be solved. So,

there were the different machines that came up; out of this, the next developed machine was a side discharge loader.

Now, this side discharge loader it is a compact, low profile, narrow wheel based crawler that is a narrow wheel. So, that it could be the; if a narrow base means, your gallery width requirement will be less. So, then it will be electro hydraulically powered that is; that means it will be having much smoother control, that hydraulic systems have got a very smooth control over the different motions.

And then the to drive that hydraulic system, there will have to be a wild tank; you have already studied in a that in our elements of machines when we discussed we talk about the different type of drive in a hydraulic transmission has got some benefits of its controlling, but there you know that you have to have a oil tank and from where a pump will have to be driven.

So, that to drive that power pump, you can give electric power; to bring electricity to underground, there is also if it is a underground coal mine, we will have to follow the restrictions given by the DCMS, that what are the safety precautions will have to be there.

That means, there will be for the underground power distribution system; how from the cable will be bringing the power to a gate and box, from the gate and box then through a trailing cable the power will be given to this machine. And for that it will be working the hydraulic system and that is why this machine is a, electro hydraulic machine.

And then what is most important thing is manoeuvrability. So, it will have to take turn say, it is taking the material; when it will be going either by going in a reverse directions or taking a turn, it will give and then loading in the side. Loading in the side means, that bucket will be taking the material and it will be discharging on the sidewise. So, we will be seeing about that; the thing is in underground that coal seam, it can be having a gradient.

So, this machine is very good, it can work in 1 in 4 gradient; very steep stream also it can work by. As you can see in the figure, this is our crawler mounted and this crawler mounted

also the travelling gear, they are designed in such a way that it can have a better grip. So, that of course, this you please note down that, IS Indian standard; not one it is IS 14480 2006, this standard gives that what are the statutory requirement for a machine which is to work in underground.

And in this side discharge loaders, they are used for loading conveyors and also mine cars in underground. If you see that there were a number of during the 70s and at the end of 70s, 80s, number of Indian coal mines also started taking this underground belt conveyor.

Now, in the belt conveyor, you will have to load it properly. Now, loading the material on the belt conveyor is a very very important; because if the material is not loaded properly onto the conveyor belt, then there will be the spillage.

And the spillage from the conveyor belt can exactly make sometimes that cleaning a big problem and then what happens? If the machine is that conveyor belt is not properly cleaned or that material is falling onto the return belt, we will discuss when we will be discussing about the conveyor belt transport that, it can take away of your many operating time.

So, that is why the machine which will be loading should be very efficient machines and the side discharge loader is a machine which can load onto the conveyor belt also. So, you have seen that this is a your, can we draw machine throw material by projectile to fall on a conveyor belt which is continuously moving? So that rocker shovel cannot be used for conveyor belt loading; but your side discharge loader can load onto the conveyor as well.

Now, in India there are number of about that is a Singareni coal field and Coal India that is limited; these two companies, they have got more than 900 side discharge loader and then they have got also another machine we will be discussing in our next class, that is a load haul dumper LHD. LHD and SDL's are the main machines, which in our board and pillar method of coal mining they are being used.

Now, of course an India now as, because underground coal mining is decreasing and they are not being able to come up to the productivity; there is a lack, there is a less use of these

machines. But these machines only converted our productivity from the underground coal mining was increased by deployment of these machines; of course there are other machines like continuous miner and all by which your productivity of the underground coal mining can be used.

But in a medium scale, a small scale coal mining underground coal mining, LHD and SDL's are still the most important machine.

Now, this the machines come as a modular design; I told you at the beginning first class also that is a, the basis basic features or the special characteristic of underground machinery is there, modular design, so that can be assembled underground. The main reason is they will be coming as a, some unit, some sub-assemblies; then they brought separately, brought down to the case and in the site it is erected.

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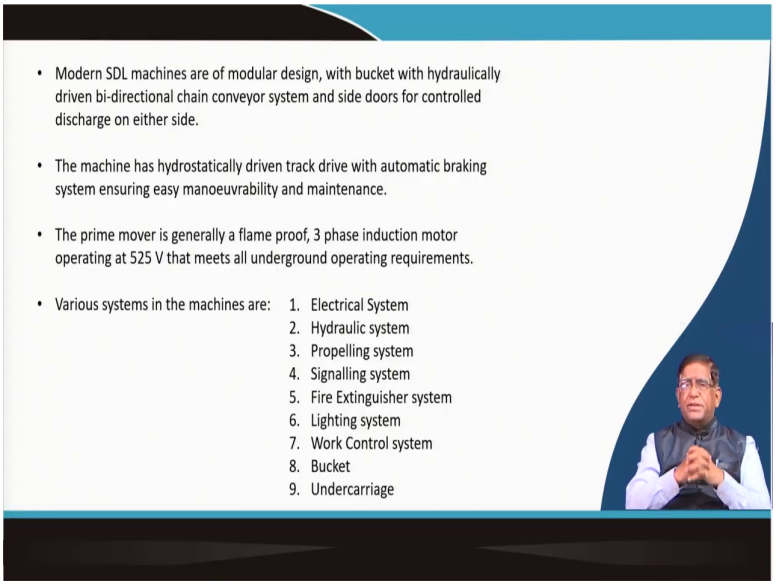

Now, there is a it is a, it this bucket of a side dishes loader, they can have inside the bucket there will be a bidirectional chain, by which the chain can move and then this material which will be collected in the bucket, can be taken out by the chain and then it can be discharged.

By that exactly you may not tilt the bucket too much to get it unloaded; because the chain will be doing unloading. Because if you have to tilt it by at a raised positions, you require a more height of the gallery. So, that type of systems have been there in depending on the mines conditions, you can have a bucket without a chain or with a chain.

Now, this is a, the driving or this machine is mounted on a crawler. So, that you can have better stability, it can work in gradient and that crawler is driven by hydrostatic by a hydraulic drive to the crawler. Then also this is a main motor by we which will be driving you know this hydraulic pumps and all; there is a three phase motor of sometime operating voltage up to 525 volt, these machines are working in things

So, there are a number of systems in these machines; when you go for studying this machine separately, you know that there will be electric system, there will be hydraulic system, there will be a propelling system by which this machine will be moving; we say that there is an undercarriage on which the machines will be travelling, that is a propelling system.

Then there is a signalling system that is your, you will have to communicate from that machine to the above ground and also there should be the people who are around there, so that you can give a safety instructions that by some sort of hooting and some type of some sort of your lighting. Light and this horn; sound and light are used for giving different type of signal from these machines.

Then also there should be fire extinguisher system; you are using hydraulic oil, though nowadays this is a mandatory that all the oil and oil hose and all which are made of this must be fire resistant. And that in spite of that, there should be a fire extinguishing system is a must.

Then there should be proper illumination in underground; of course this illuminations in underground is a big important area; particularly in underground coal mining, where we will have to this use very carefully as you cannot use electricity, it should be intrinsically safe for KC coal mine.

But in a way now we have at IIT Kharagpur, we have developed now that underground mine illumination system, where direct solar light can be taken up there by optical fiber, which has been demonstrated in Jhanjra coal mine.

Similar system can use also for illuminating the area where the such type of machines are working, which will enhance the safety. Then the work control system will be there; but the most important thing is the bucket and the undercarriage, because which will be working mainly.

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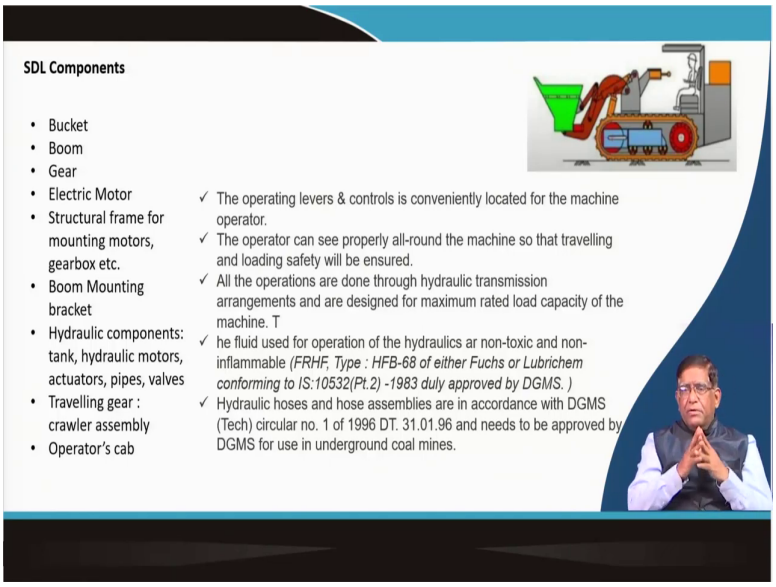

So, you can now summarize that what are the main components which will be there in any machines. So, whenever you have been studying, you know that there will be the bucket and then the bucket will be supported on a boom; then the boom will be supported on the super that is your the chassis or that, then this will be on a structures which will be having the under carries unit.

And there will have to be the operators cabin, operators controls will have to be there and the operator must be protected; there should be a proper protections for his head, so that the roof fall and all does not accumulate. The machines will have to have this adequate space for its that keeping the oil tank and other control devices, so that the machine should be properly balanced.

So, you have got an idea now what this machine is. And this operating levers and controls are conveniently located that, where from the operator should not have any difficulty; that is why it is called ergonomically designed machine. And the operator can see properly all around; from there he should be able to see at the back, he should be able to see at the side, because sometimes he will be going forward motion, sometimes he will be going backward motions.

So, his visibility should be proper. It is a low center of gravity machines, machine height is less; so he can easily see the ground also. Unlike in surface mining, where there is a very large blind area; here exactly very less blind area. And then all the operations are done through hydraulic transmission, that is your hydraulic control is the main thing in this machines; that fluid used for this operation should be very carefully selected.

That hydraulic oil which is used it must be non-toxic, it must be; that it should not give any fume or gas and it should not, it should be fire resistance. All these things are specified and you will have to select from that, you can see that your that Indian standard specification numbers are given which you need to see that 1057 532 and 1983.

When you will be working as a mine manager, you will be doing a lot of procurement job; while doing the procurement, you need to refer to that whether the machine supplier who is giving, they are really conforming to these standards or not. So, that is why you should have an open mind and at least if possible make a list of those standards, which are relevant and related to the use of machinery in mining.

So, now these hydraulic hoses and hose assemblies which are to be used in underground mines must be approved by Director General of Mine Safety in India. This is a very very important in mining operations, that is our all these things must be approved. If as a manager, if you procure some equipment thinking that it is a highly productive giving a very good productions; but you are using a, that is unapproved type of equipment.

In by chance any accident or anything takes place over there, then you will be losing your job and then also you will be subjected to some fine and also for in jail. So, that is a very very important things, it is well controlled industry in mining industry.

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So, now coming to this exactly the components you have seen that, this it can work in a gradient; you can see that this is a side discharge loader working on a gradient. You can see here how the operators cabin is there and in that we can have that your ropes; that is your rollover protection system over here, then your this whole motor which is kept over here is a flame proof motor.

Then there is a fire resistant and hydraulic fluids are there which will be operating these machines. You have got this foot guard that is your the proper type of crawlers are there; that

is the machine is a low center of gravity, which gives outstanding stability of the machine is very good.

And you can see that the hydraulically operated pistons and all it can lift one side, so that material can discharge. So, there is a the boom on which this bucket is connected; this boom can be raised to a dumping positions, depending on the what type of transporting machines you are loading into.

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So, these are the machines which is used. And then the main features that is your special features is, it has got a very good power to weight ratio; that is a what is the total installed power in the machine and then what is the total weight of the machine, that is exactly one of the characteristics by which you judge a machine.

Then it has got low heat generations; while operating up these machines that should not generate very high heat, so that the operating fluids and all, the temperatures should not go increasing. Then the center of gravity low is for the stability region. Then low specific base pressures; that ground bearing pressure it should be low, how it can be done?

By giving a proper width of the crawler, so that the total weight coming on to the floor of the gallery, it will be less. And then it should have a fail safe parking brake; whenever you are applying these things that you are staying the machines even if in gradient, the machine should not automatically move.

So, that is why there is a parking brake; that means when the there will be an interlock, when you want to operate the machines; then without that is a, if you stop the machines, then the parking brake will be automatically put on. So, that type of systems are there. So, that will have to be proper lighting system; there will have to be certain emergency stops, also there should be a heavy duty construction should be there.

And then the protection of the sprocket from that, exactly there will be working in a dusty conditions, so that seal on the, this different motors, gearboxes will have to be proper. So, we can say that, this machine is a low profile machine; it will have be having a flame proof electrical system and it can work also in underground gassy coal mine. So, that is what is a most important thing.

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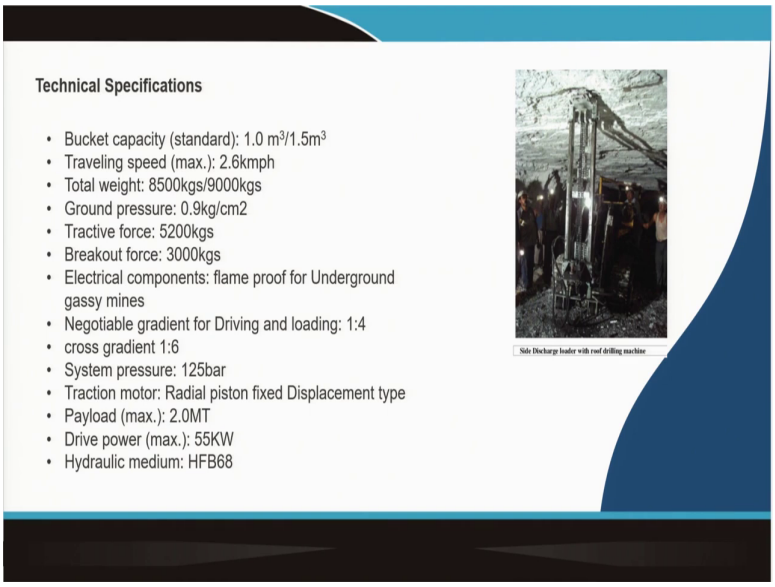

And you know that these machines can be sometime improvised that, machines can have attached it a roof bolting machines also; that is when the machine is working, collecting the material that it can give, it can drill upward holes are done by which you can just anchor, so that the protection of the roof can be given.

So, this roof bolting mechanisms that bolt that drilling, the drilling for the putting of this bolt can be attached with this. So, these machines can in that way it can perform, that is it will be also protecting the site by doing that additional features can be added onto it. And as I have already said that, this capacity can be 1 to 1.5 meter cube of bucket, travelling speed is 2.6 kilometer per hour, total weight is 8.5 to 9 ton.

Then the ground bearing pressure is only 0.97 kg; it is exactly a man human who foot can give about 0.7 kg per centimeter square. So, that is just like little more than human being that

much pressure will be coming over here. Then the tractive force which it can generate is 5.2 tons of weight and similarly the braking breakout force equivalent to your 3000 kg force.

Then your electrical components are must be flame proof. So, the system pressure, the hydraulic system which will be working with a pressure of 125 bar and then it has got that, the type of motor which are used is the radial piston type of; this has particular specifications of the shower EIMCO machines that.

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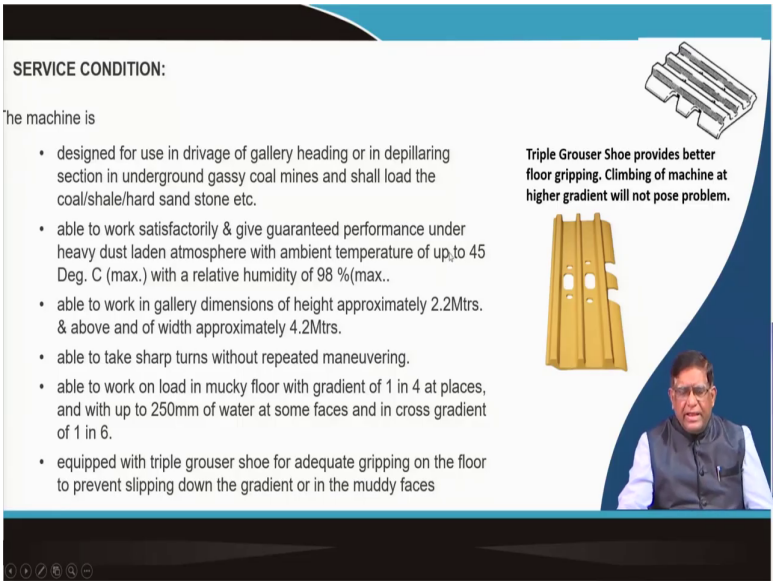

This machine is manufactured by TRF Tata Robins Fraser that at Jamshedpur, there is a factory on which this that our, this type of SDL and LHDs are manufactured by Tata Robin Fraser. There are couple of manufacturers, there EIMCO has got these machines. I think BML also capable of producing these machines in India.

So, there is a capacity of developing these machines and only thing is we need to now modernize it, so the next generation of such machines it comes; it will be coming with your manliness operations, automated operations and then also that is your with a diagnostic or prognostic system by which the mine manager will be knowing that what is going over there.

So, this is a service condition of the machine is for, it is working in the driving the gallery or the pillaring actions in underground coal mining; you might have studied in the board and pillar mining mechanizations, how these machines are very important. It will be exactly that gallery dimensions that is very very important; depending on the rock mechanics and geo-mechanical problem property, when you have designed the gallery, that will dictate whether you can use these machines or not.

And then this machine is a highly manoeuvrable; it can take sharp turn that possibilities are there. So, this exactly the there is a grousers that the crawler, so that it can have a better grip; that is call your triple grouser that, the track shoe it has got three type of this grouser plates, so that the step that is it can work in high gradient also.

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That this type of crawlers that is where there will be a triple grouser track, it is going over here; we have got the sprockets and then there is a idler. Sprocket is why which one is driven, which is given by the hydraulic drive is given over there. So, this track shoes and the track rollers; there are two type of roller, one roller it state is there at the bottom and there is also a carrier roller at the top.

So, you have studied these things in surface mining machinery crawler, the same thing is like that; that is only this track mounted machine has highly, that is your powered by hydraulic axial piston motor, that is hydraulic axial piston motor how it works, you will have to study a little bit of your own work. So, that the drive and then what type of braking systems are there; you need to study about, that automatic disc brake.

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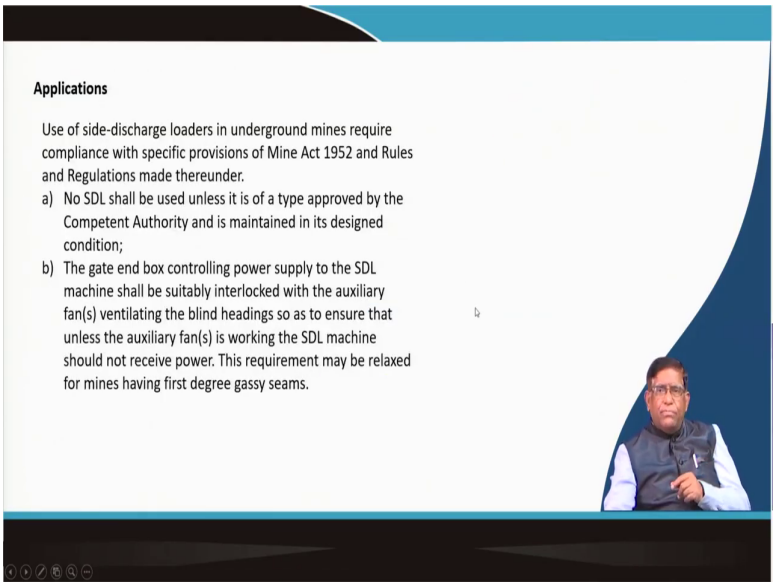

You please develop a write up how does an automatic disc brake work; because in the, we earlier discussed about the machine elements. Similarly, the applications of this is there in your underground coal mine will have to follow the rules; particularly in the mines act 1952, the rules and regulations are given for it should not be used unless and until it is an approved type by competent authority, you must mention that.

And that the type of electric systems which will have to be used for this purpose also is stipulated, you follow it.

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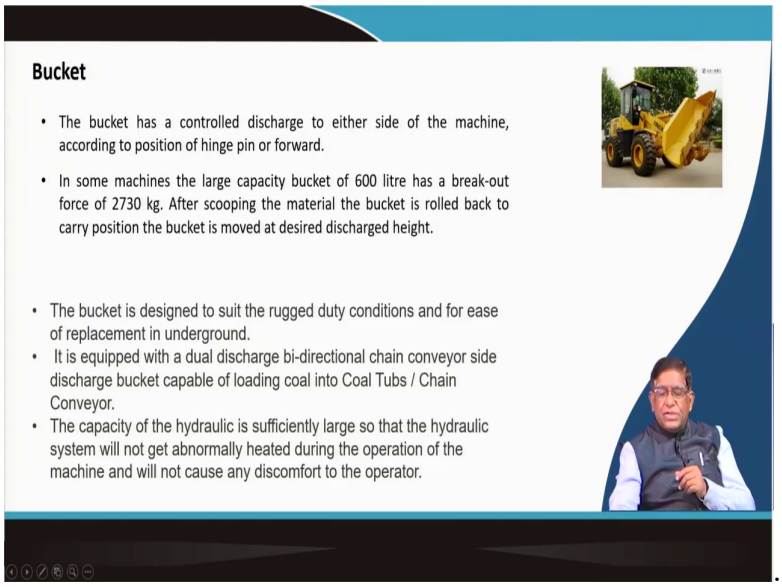

The bucket, you can see here is a special type of bucket, either without a chain you can see here, one side is open; you will have to while it is collecting, it is there as a reverse directions gradient will be there. So, that while loading, while bringing it over there, the material should not fall; at the time of falling, you can give by raising by one and the material will be discharged.

And in some where there will be a chain conveyor at this bottom of it and that chain conveyor will be taking out the material. There in agriculture sector there is another side discharge loader for spreading the soil or spreading of the fertilizers or sometimes in a sawmill or even in the sense if you take the sawdust and that sawdust to be distributed over a ground.

Then there could be a machines which it can be a conveyor belt will be there and that machine material will be spreading sideways; you can see number of things up there.

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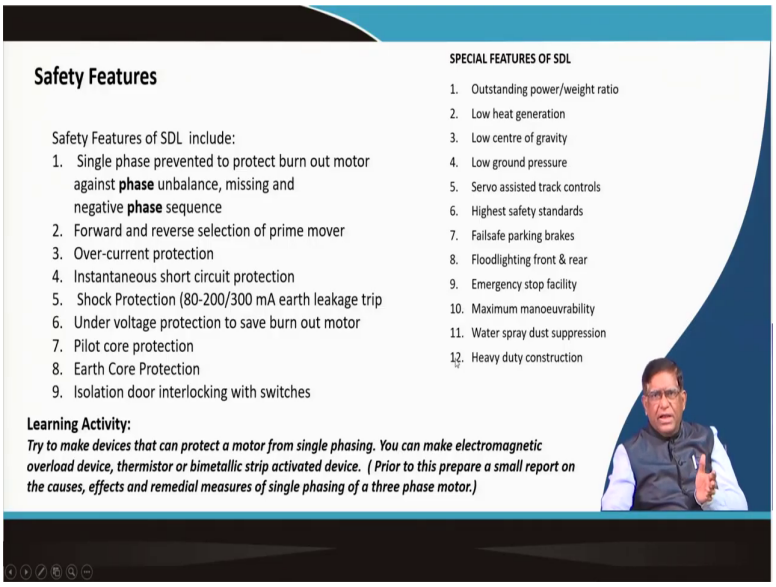

So, that there are different safety faces, safety features are there. As you know that this is a three phase motor as I said; now there is one problem may come is called single phasing. That means, it out of the three phase if any one of the phase is getting out; then there will be overhead and in that time, this could be leading to a lot of other problem.

So, you need to know that how that single facing should be protected, how it will be detected; those type of basic things must be clear in your mind. So, that is why I have given you a learning activity; so please try to make devices that can protect a motor from single phasing.

You have studied in your early second year basic paper electric motor, you know that exactly a single phase motor and the three phase motor, their differences you must make a list of it. And then in a three phase motor, how exactly the if one phase is out, how the current in the other two phases will go high and when that high current flow; then your I square R loss will be very much more and as a result there will be high heat will be generated.

Under that the motor can get damaged, insulation can get damaged and lot of problem may occur. So, to protect that, you may have exactly a thermistor based or a bi metallic strip based or a electromagnetic overload devices can be created. A very simple laboratory scale model can be made by yourself as an hobby on your some three or four Sundays you can use and device something, that before that study about this and make a report.

So, do this learning activity and then it has got other protection devices like forward and reverse selection and prime over, it can give a over current protection system; it has got a instantaneous short circuit protection systems. Try to find out what are the principle of this particular protection systems and how it work. So, this will be once you know for one machines it will be applicable for all other machines.

So, it is just a matter of how whether for knowing about the safety features, you will require about 20 hours in one week; if you can spare it out, make a report on the general safety features in machinery, you will be able to do these things. So, there are other special features on SDL, that is basically the special features it is a low heat generation, low ground pressures.

That is your fail safe parking brakes, flight lights, then emergency stop all these things you now make a list of the features by studying the manufacturers leaflet, whether you can use it from EIMCO Elecon or you can use for this Tata Robins Frasers or any other things you can search over there, some of the different machines are they are used in abroad.

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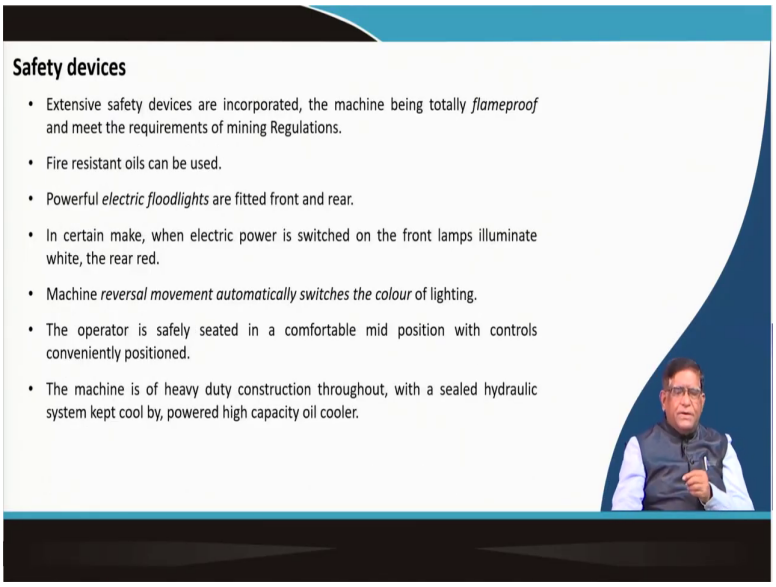

Now, this they as a safety devices, they have got a very powerful flood light; they have got excessive safety devices expensive extensive safety devices are incorporated in this machine so that no accidents take place and no fatality to human being or damage to the machines take place and for that, the fire resistance oil I have already told to you. Then there should be your, the type of light which will be used can be considered.

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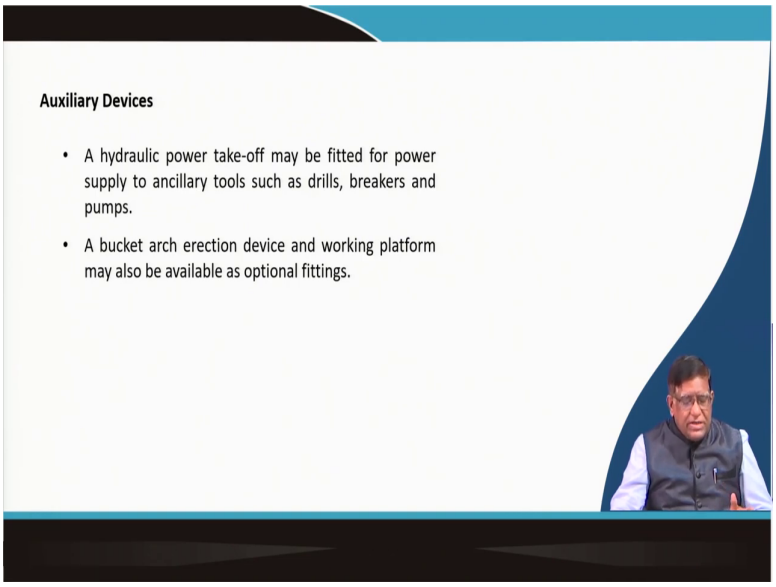

So, there are many auxiliary devices are also there for the machines, by that will be vary from make to make.

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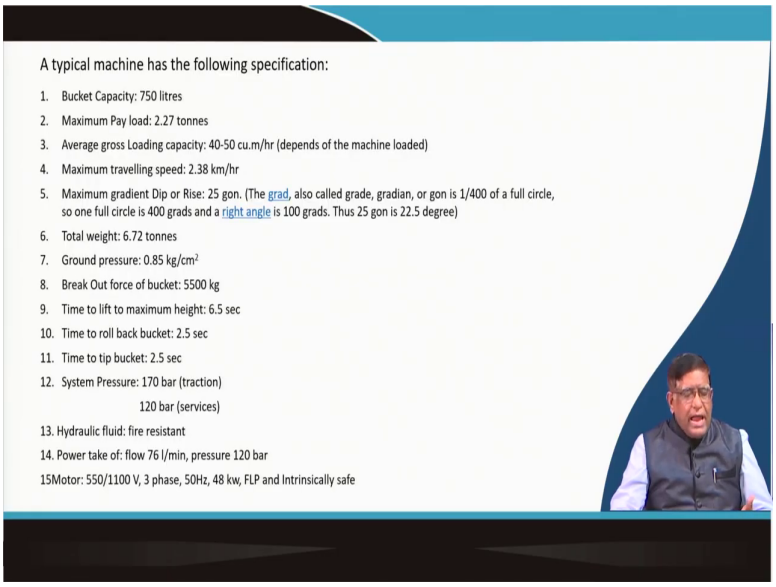

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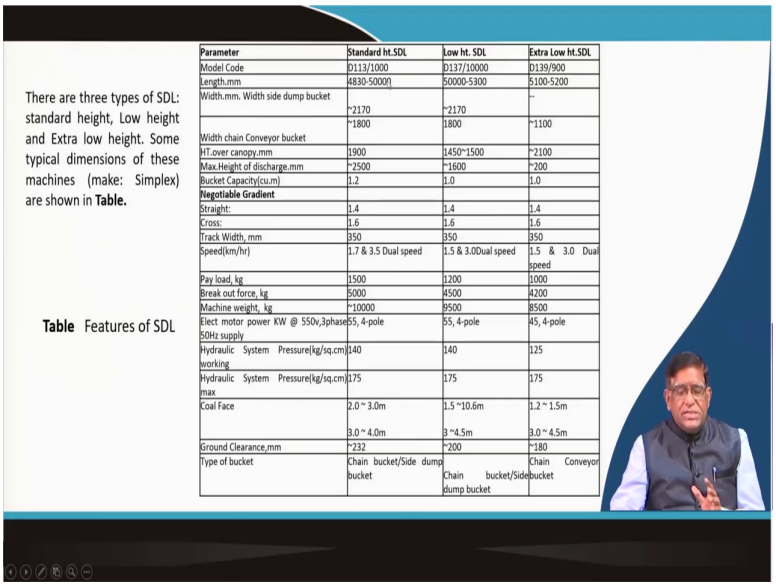

And you try to find out that these machines there could be a standard height, there could be a low height, there could be an extra height side discharge loader; the make to make this things will vary the dimensions, but you should be able to have a general idea about what are the different dimension and specifications of these machines.

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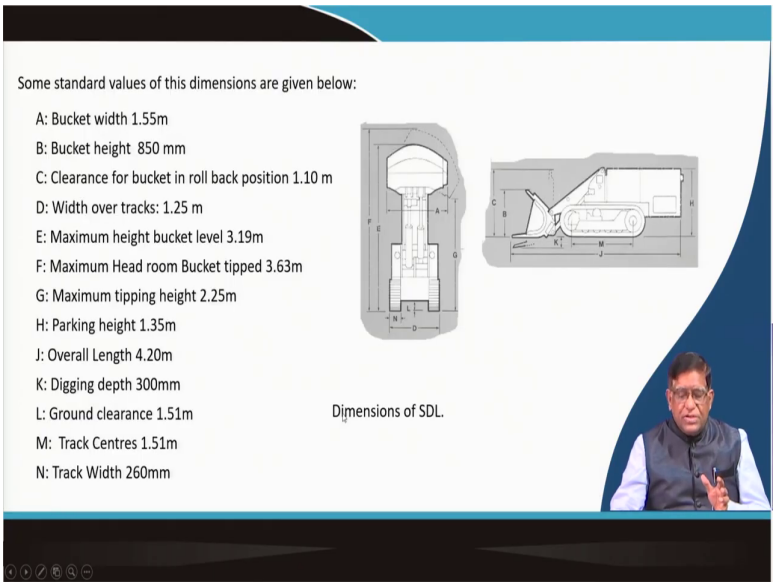

The dimension wise you can see, if you see the top view, it will be looking like that; the most important is that what is the total length on which it will be working, what is the total width it will be working and what is the total operating height it will be having and these dimensions it vary from make to make, you make a study of that.

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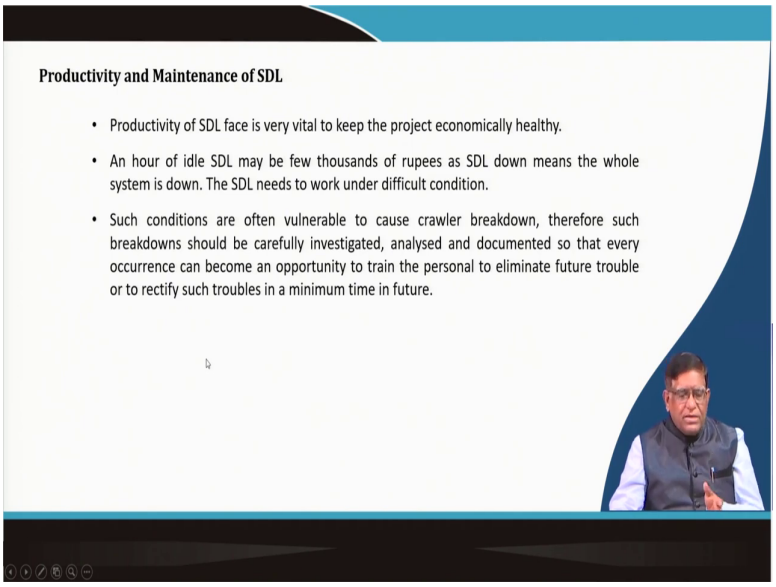

And the productivity and maintenance are done very important thing and they can have it by different type of situations; you will be having a different type of maintenance problem. But there is a that a checklist given by the manufacturer need to be followed, how you will be starting on how you will be putting off.

And when you are that that change shift changeover is there, how the operator will be reporting about the machines, how the log book of the machines will have to be written those are the management system, which you should be conversant with.

So, that many of the what are the major type of problems which come if the crawler chain breaks or sometimes your the break is not working, sometimes your the machine protection

systems are not working that need to be checked and it should be brought under some plan preventive maintenance.

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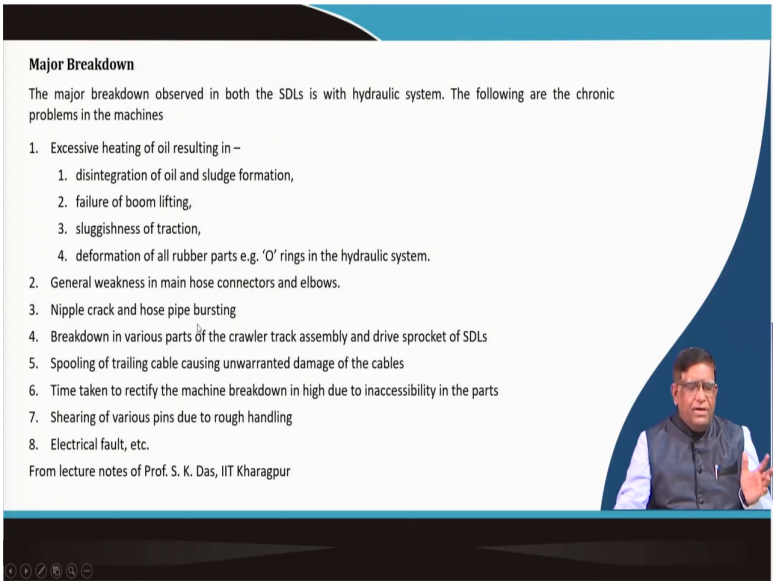

Sometimes that some of the major breakdown take place. So, your job is to exactly study some case studies of failure of these machines in the minds that is normally what you do. And during your mind visit, during your practical training; you need to collect the this breakdown time series that, how exactly the history of the machines, how the that your inventory history of the machines, what are the spare parts being used.

Those type of information should be brought and then systematically studied, so that the machine performance can be improved.

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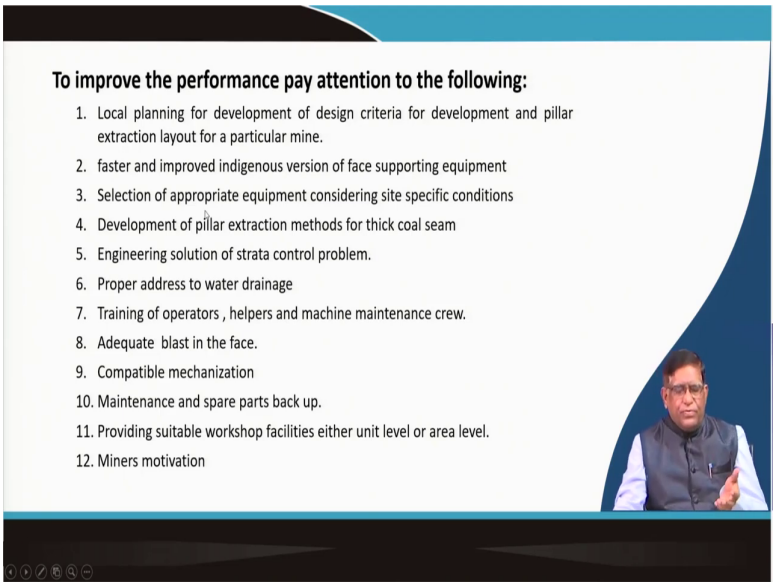

And then the machine performance improvement could be your other systems on which it is loading that should be compatible. So, that is a you will have to do this machine study along with the system study; then only you can ensure that how the maximum performance will be there. But as a engineer, your motivations and your involvement will have to be more, so that you can motivate the worker to working with this.

But the most important thing is your rock mechanics and strata knowledge should be very good. So, that if there be any strata problem, particularly the roof fall problem; if your side collapse fall problem or if there is a problem in during the blasting, then these machines will be trouble.

And you can find out even I think very recently within last two years back, there w ere a big accident, when exactly under a roof collapse a side discharge loader in underground coal

mine, there was a fatal accident; number of such accidents reports you can read in the net or you can search from different sources.

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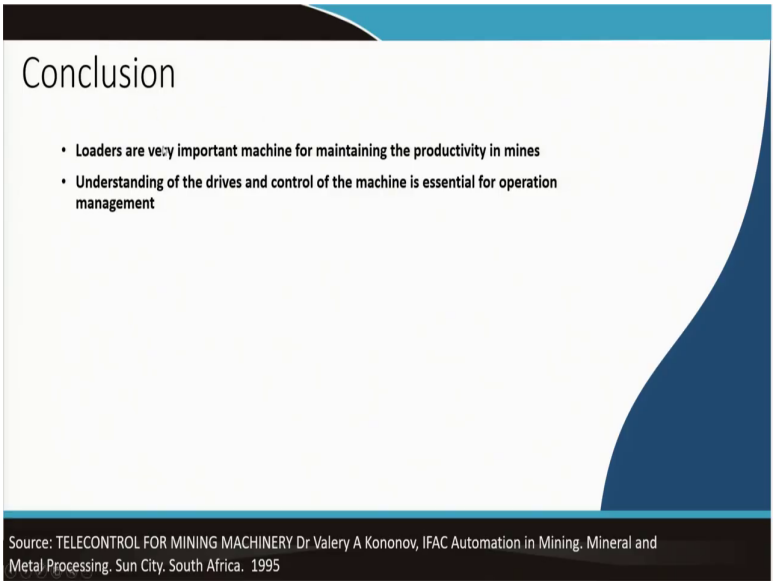

So, to conclude over here that, this is a underground mining machinery; particularly the loader is a very very important for the maintenance of the productivity. And then you need to know about the operations and the construction of the machine, so that you can prepare a how to control and how to operate with it.

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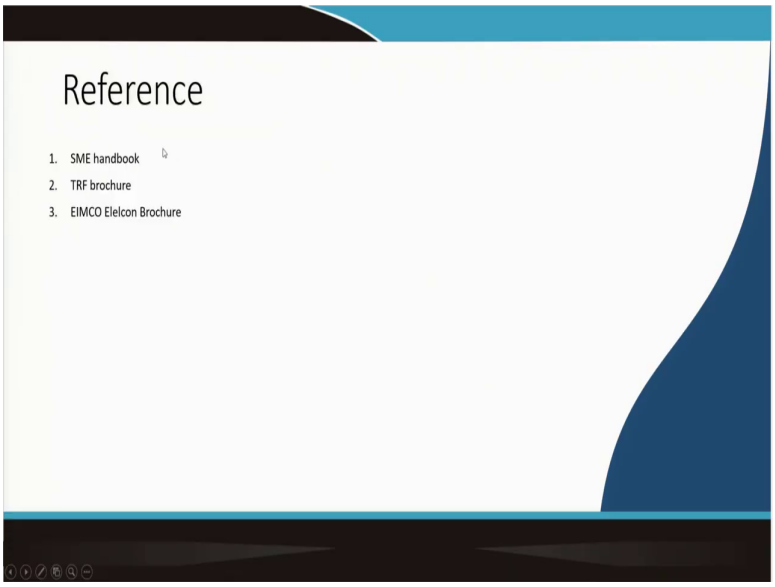

So, there are different in SME handbooks and there are different my companies manufacturers booklets, leaflets; you will have to see and also lot of studies have been done on the mechanical engineering and electrical engineering of underground machinery. I hope you will study about this and do that exercise which I have given as a learning activity.

Thank you very much.