Mining Machinery
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Module - 01
Lecture - 02
Introduction to Mining Machinery – Part B

Welcome back. In the last class, I introduced you regarding the Surface Mining Machinery and that overall spectrum of mining machinery. Today, I will be telling you about this Underground Mining Machinery.

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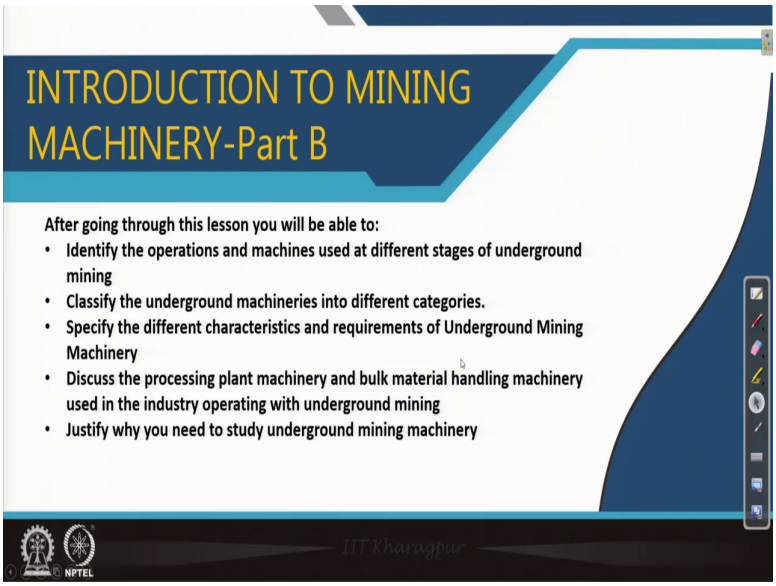

And, today's objective is after going through this lesson you will be able to: identify the operations and machines used in different stages of underground mining; classify the

underground machineries into different categories; specify the different characteristics and requirements of underground machinery.

Discuss the processing plant machinery and bulk material handling machinery used in industry that for operating with underground mining operations, and you will be able to justify why do you need to study underground mining machinery and then which way you will be planning and what strategy you will be making for your learning.

So, the basic things after this class you should be learning how the different informations regarding mining machinery need to be collected.

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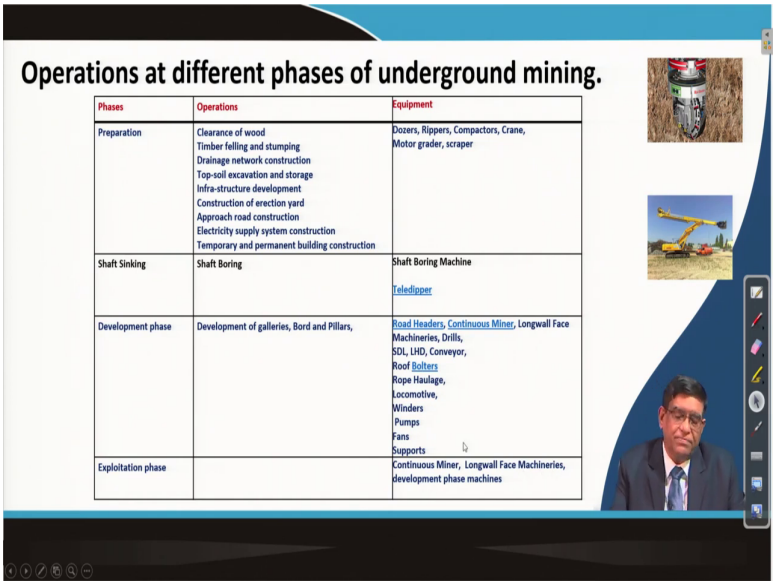

So, this underground mining operations they have cut also different phases like in surface mining I told you in the last class, but here the operations are your preparation operation then

there is a shaft sinking operation when you are entering to the underground mines by making a vertical well in that case that is called your shaft sinking.

And, then in underground development phase say preparing the underground of a particular site to access to the mineral deposit because as you know the deposits are lying under the our top surface of the soil in a different way it can be a massive tabular deposit or it can be a vent or it can be lens, then how to get access to that that is the developmental phase and during that time you will have to prepare this your underground space by providing proper supports and all. So, those the operations at development phase.

And, then of course, the exploitation are the main production phase. As in the site preparation job the operations are same as that of your surface mining and you use the same type of civil construction machinery like dozer, ripper, compactors, crane, motor, grader and scraper.

At least you know these name – rippers are exactly you are doing just like a ploughing you have got a with a dozer a ripping teeth are connected. With that rippers you can exactly scratch the surface of material. Compactors you have seen the road making machines, similarly cranes and then motor graders are used. Scraper are used for collecting the top soil and then depositing it over there.

Now, for the shaft boring machines are different type of specific machine which are used for shaft sinking purposes there are teledippers. Then for the development purposes you have got this road headers and continuous miner; your for in coal mining long wall coal mining you will have to develop the space by driving the gallery with your by road headers. Then you will have to have special underground drills, side discharge loader, load haul dumper, conveyor, roof bolter.

Then there will be different type of underground transportation system by rope haulage or loco motive then for reaching the that collected material in mine carts or tubs through the shaft we have to have a winder for raising and lowering the cases into the mine shaft. Then

there will mine fans and there will be mine underground roof supporting machineries and also there will be the pump for dewatering purposes.

So, wide range of things will be there and then whether you are using a continuous miner for mine winning machines or you are using a shearer for that as a long wall face machineries at different phases. So, these are the underground mining phases.

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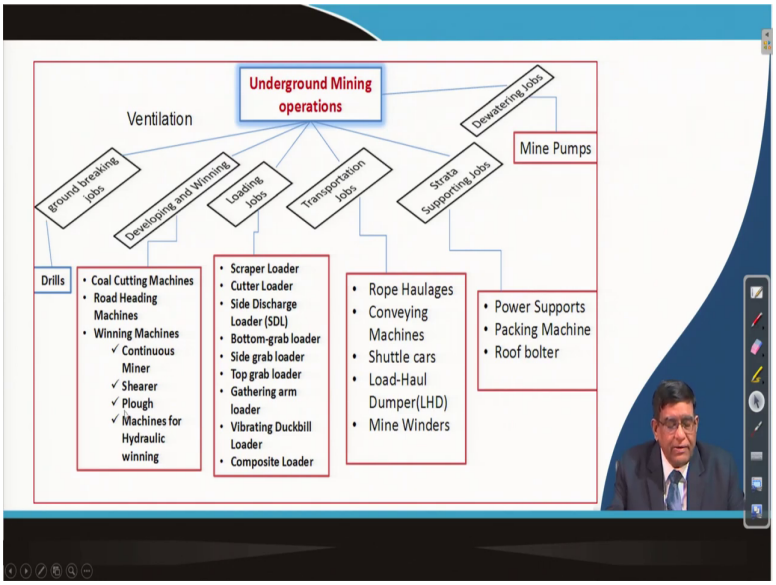

And, as I told you earlier also that these operations can be done by different machines like underground drills they have got you may be hearing one name called drilling jumbo that drilling jumbos are used for underground rock breaking. Now, for the developing phases for the in coal mining they used to use coal cutting machines now these coal cutting machines are now obsolete, but there are road heading machines which are working even more than 60 – 70

years different type of road heading machines have improved. Only this today's machines are coming with a more capacity and better specific control, easy maintainability and all.

So, you continuous miners, shearer, plough is another machine that used in the underground coal mining they were used in not in our country then machines for hydraulic winning there are hydraulic mining monitors were also a separate type of specific mining machinery they developed.

Similarly, for that win material cutting material will have to be loaded to a transporting things. This can be done by scraper loader, cutter loader, side discharge loader, bottom grab loader, side grab loader, top grab loader, gathering arm loader, vibrating duckbill loader, composite loader, wide range of loading machines are there. Loading means if you are doing underground blasting by doing the drilling that blasted material will have to be scooped and loaded.

And, that is in metal mining different type of loaders are used in surface in underground coal mining different types of machines are used. So, the mining machinery is very very specifically tailor made design for the particular operations in a particular type of mines and you remember that depending on the type of rock the design and the characteristics and requirements of machines are different.

So, for example, when you are using a dump truck for raising coal and the dump truck for taking your iron ore the same type of truck, but there will be if it is a same power horse power engines you are using you can see that that engine will be able to take that the volume of coal will be much more than the volume of iron ore for the same capacity truck.

So, definitely the car body the truck body will have to be of different design. So, that is way your the draw machines for cutting rock like granites and all will be all together different there you will be using diamond the cutting chains and all which is a totally different type of mining.

So, depending on the type of rock which is existing the strength of the machine, the type of the machines because that when if you are doing a interacting with your teeth of any bucket or cutting tool they will be varying differently with different type of rock. So, that depending on the loading job you will have to have different loader.

The transportations can be done underground by rope haulage as a specific this is a very old method still applied in many of the coal mines. Then there is a conveyor belt conveying machines are there which got now developed; earlier that only a troughed belt conveyors are used, now it is people are using this pipe belt conveyor which is of much advanced.

Similarly, for continuous miner the transportation is used by shuttle car. There is a low profile dumper or load haul dumpers are also there and the winders have got transporting the things vertically in a shafts.

So, that shuttle supporting we have got the power supports different type of power supports are available there is a also there are packing machines as well as roof bolting machines. There is a shotcreting machines, there are different types of machines for that and dewatering job is done by the mine pump.

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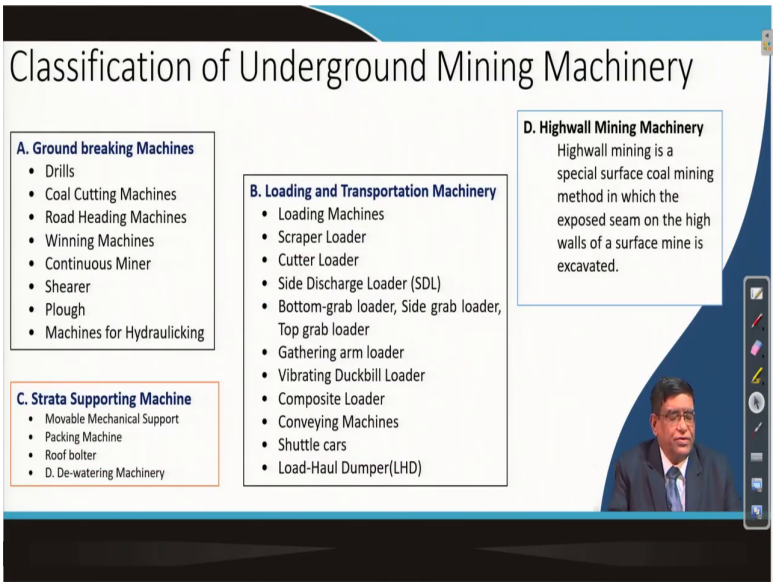

So, now whole these things you can see here as shown in a very specifically how different type of machines are there and then also we said that in the last class there is another class of machine called high wall mining machinery. In the high wall mining is a special surface coal mining method in which the exposed seam on the high wall of a surface mine is excavated.

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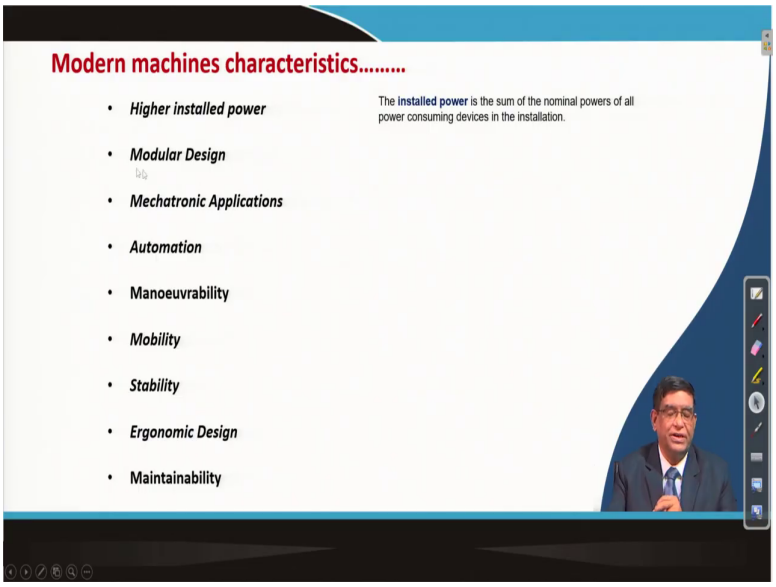

I told you also briefly that what are the machine characteristics particularly higher install power that is the sum of the nominal powers of all power consuming devices in the installations in a machines there are so many motors, so many devices are there in one machine if you just sum up the total power required for all the motors that is very high in case of any mining machinery.

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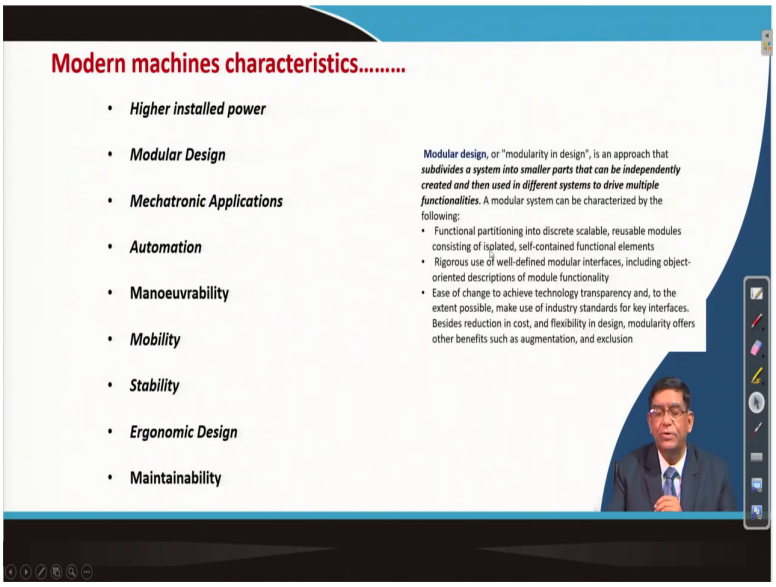

Then the modular design also I told you that it is then approach that subdivides a system into smaller parts that can be independently created and then used in different systems to drive multiple functionalities.

So, a modular system can be characterized by basically a functional partitioning into discrete scalable, reusable modules consisting of isolated self-contained functional elements. So, that is why it can be very easily maintained and replaced, so that down time of the machine for any maintenance operations will be reduced and that is component which is not working that can be taken out and can be repaired elsewhere by a sophisticated manner and a spare unit can be put it over there this is also.

And, then a modular machine that can be erected because in a company's manufacturing plant itself those components are already sub assembled and then this main assemblies are brought over there and then connected together.

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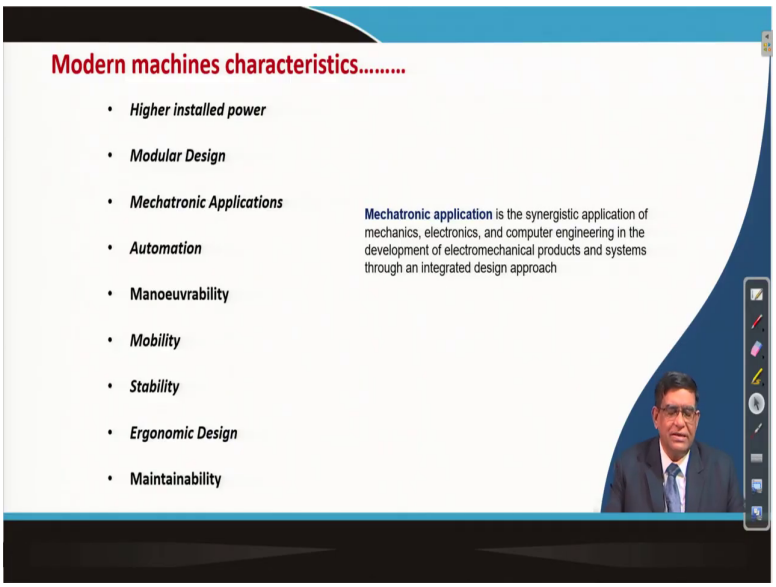

Similarly, in the mechatronic applications I have said it is a synergetic applications of mechanics, electronics and computer engineering in the development of our electromechanical products and systems through an integrated design approach.

So, what you do there exactly you keep and watch on how the machine is working at any type is any particular component, is behaving badly, if it is having over stressed if there is any warning of any impending failures. So, those are use of mechatronic applications.

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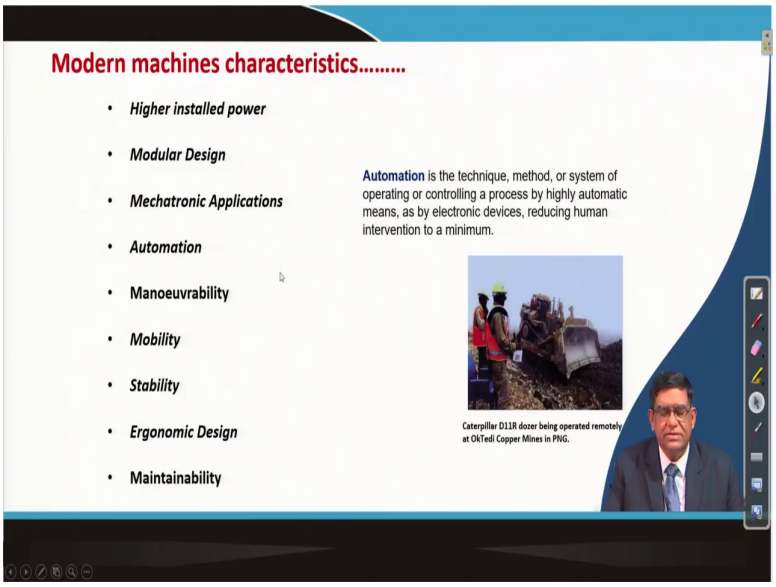

Automations thus that is a your system operating and controlling process of highly automated manner.

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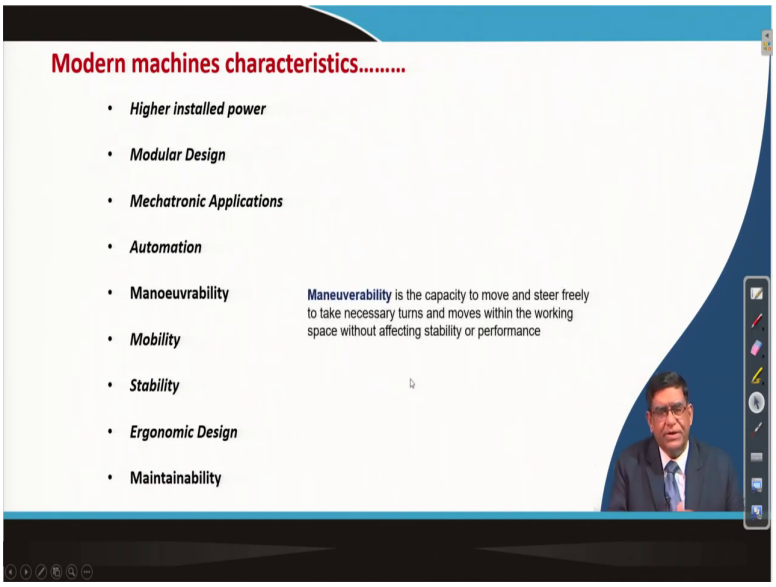

Similarly, we have in underground operations there will be very less space. Within that space we will have to steered, we will have to put it over there.

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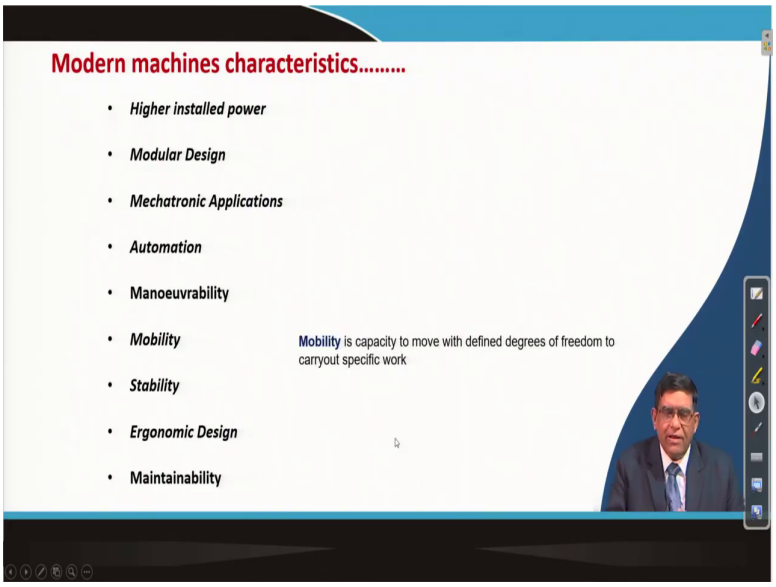

Similarly, that in a under a very constraint area that is your have you have to work on in a tunnel type of arrangements. So, the machine will have to be moving over there their mobility.

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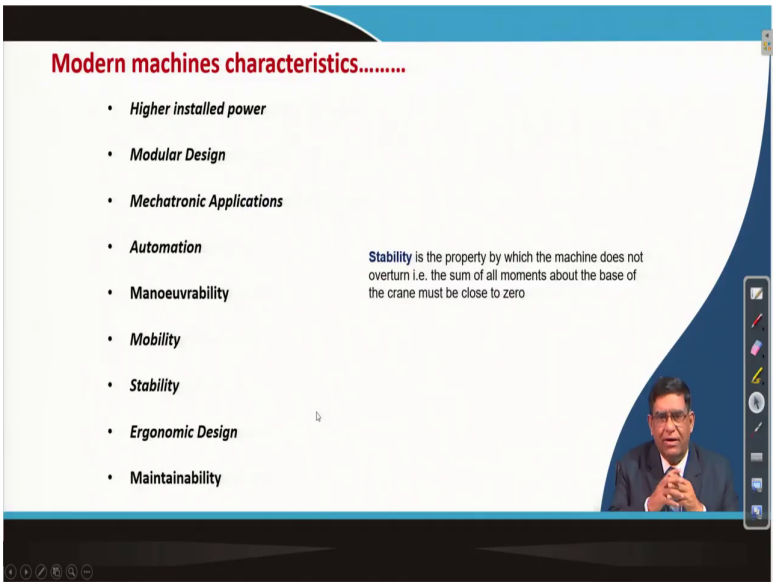

And stability of different type of problems will have to be looked into.

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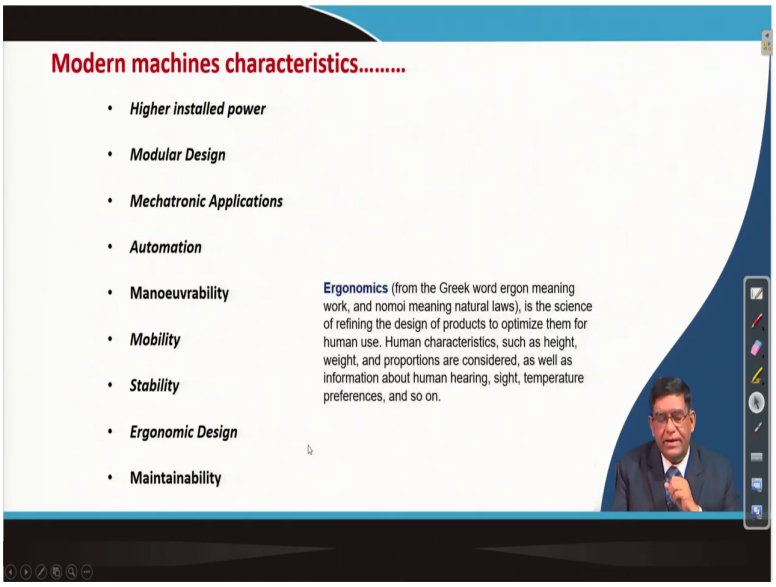

Similarly, these machines when you are working in underground mines it is a very high humid conditions. The air is also sometimes less that is your the ventilation system how it is working and also that air is laden with lot of dusts under that conditions the persons operators will have to be working in a very comfortable manner.

Sometimes there could be underground mining machinery in which the operator cannot have a operator cabin to sit down sometimes in a very thin seam operations the operator will have to lay down and then he will have to operate the machines. A very thin seam mining operations are very critical, but those type of special machines are also available

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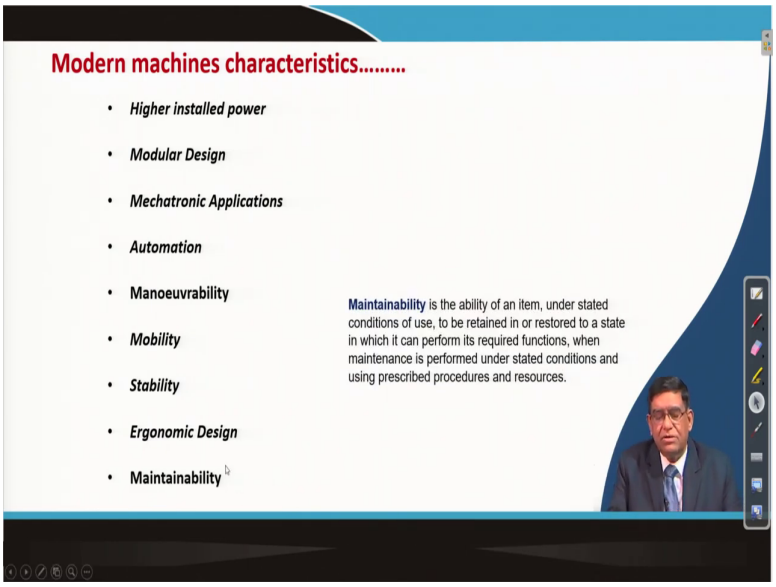

But, the main thing is that this machine should be maintainable; that means, under given conditions of use if there is any problem it problem must be resolved and the machine will have to come back to its original.

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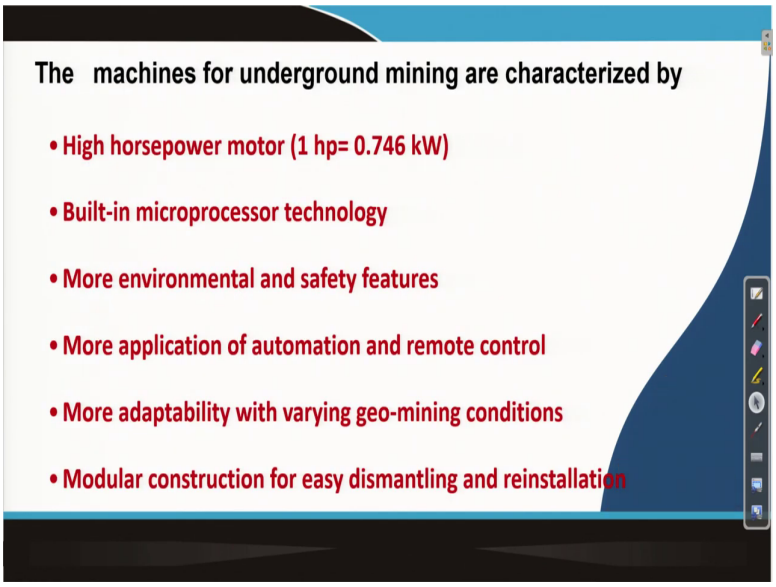

So, for an underground mining machines are characterized by very high horse power that is and then built-in microprocessor technology more environmental and safety features, more application of automation and remote control more adoptability with varying geo mining conditions, modular constructions. These are the things which are there.

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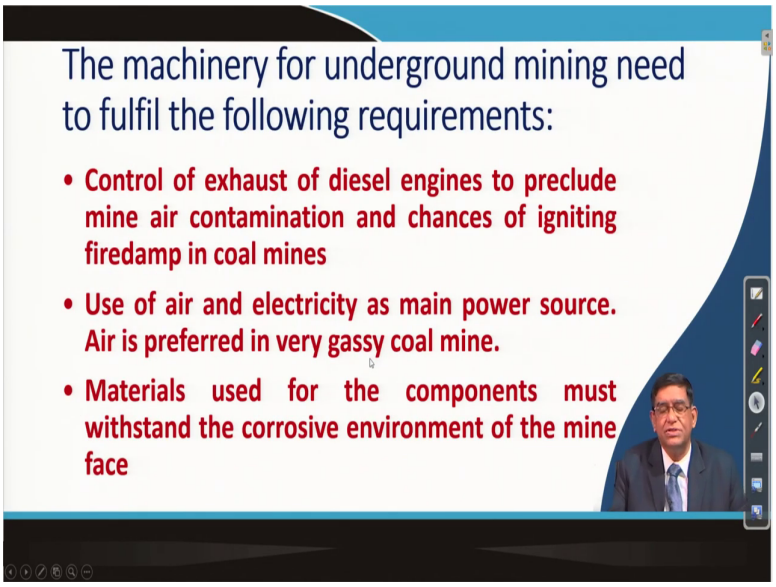

And, then requirements are also control of exhaust of diesel engines to preclude mine air contamination because if the if you are using in a underground coal mining where the coal dusts are there and where there could be gas that is your fire dump that is a air and methane mixer which are highly inflammable.

If you are using a diesel engines their exhausts if they are coming out with a hot particles they may create an explosions in the underground coal mine. That is why the diesel engine which will have to be used in such conditions they will have to have a proper exhaust conditioner, so that the exhausts never bring any hot particles outside.

Similarly, in underground sometimes you cannot use an electricity because in electrical while making your switch on-off at that time you may have this spark that spark may ignite and fire explosions can take place in an underground mine.

So, what will have to be there and here in underground coal mining lot of machines were used by using power of compressed air exactly the air compressors were used at the top that that compressed air were sent through this pipe and then they use to do the operations. Say compressed air operated drilling machines compressed air operated machine support machines were also used earlier.

Now, materials used for the components must withstand the corrosive environment in the underground mine because it there is a water and then there is a sometimes these mine water could be acidic because of the type of rock which you are having because by leaching of those your positive ion make the their pH value of the water very less, under that conditions the metal parts of the machines may get worn out because of the corrosion.

So, we will have to take special care, a special type of alloy or the material will have to be used or protective coating will have to be given, so that the machine can operate better way.

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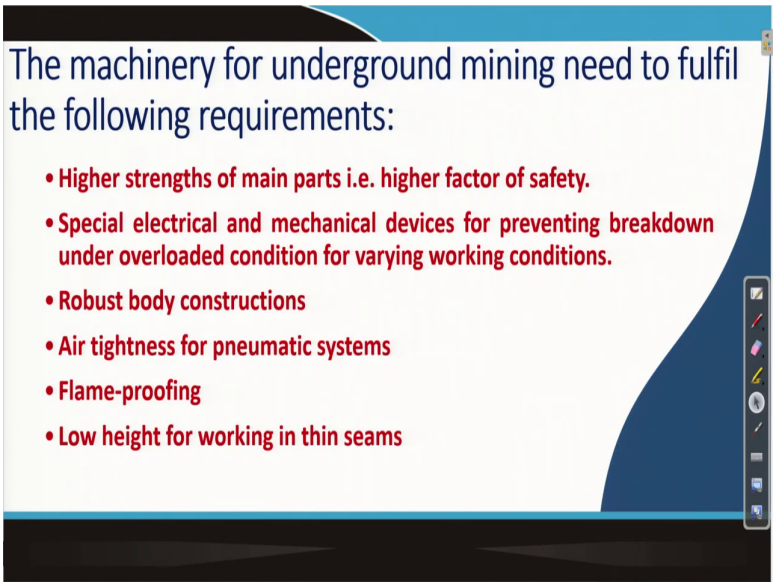

Similarly, the higher strength of the main parts high factor of safety will have to be taken into consideration. Special electrical and mechanical devices for preventing breakdown under overloaded conditions because of that exactly you will find that when you are designing a winder a case is being lifted that the where ropes will be used we will be taking the factor of safety as 7.8. Sometimes it is by regulation it is maintained that if you are using those ropes for lifting people the factor of safety could be 10. So, there is so that no accidental situations arise.

So, that must be made very robust in underground situations because there cannot be any compromise with safety and in underground environment the flame proofing is also very very necessary that say conveyor belt if you are using that is it should be flame proof that mean it must not be able to it is will be fire resistance it must not catch fire. So, the underground basic

problem is there is a very less space constraint. So, under that space constraint the machine will have to work.

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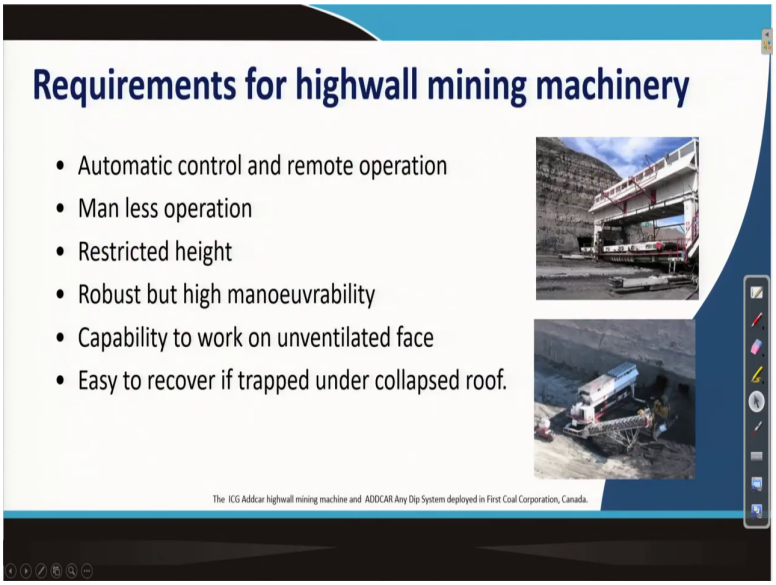

As you can see that the high wall mining you can see in the figure that there is a high wall that is surface mining was carried out and then this overlying strata below that some say coal or mineral is there now you cannot have that a proper you do not have any lease for that area you cannot go.

But, from the floor of the mine you can make a hole inside and collect the material by a special machines called your this long wall, high wall mining machine and there may have a augering actions they can go in and by a screw conveying type they can bring it or they can bring as a add car a particular machines will be added one after another and then it will be

going inside up to 200 meter and take the material and come back. So, there will be number of ripped will be living this is a special type of mining and special machineries are there.

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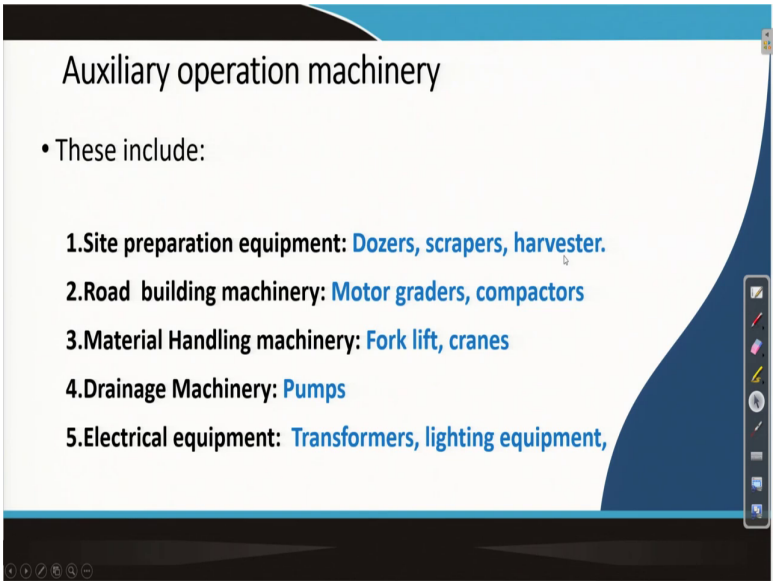

Now, when we say about the auxiliary operations means for doing the surface underground mining operations you will have to prepare your infrastructural facility for that these machines are there. These machines are same as in your surface mining you use.

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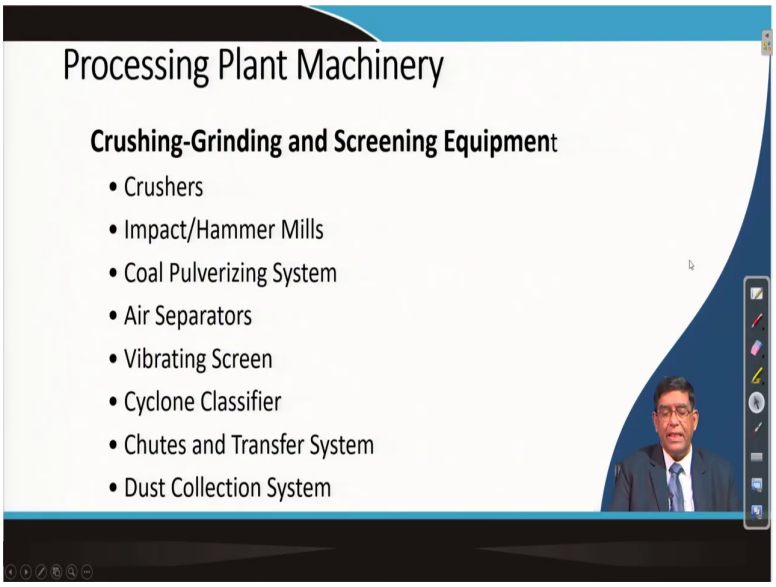

But, for the processing plants you have got a wide range of machines mainly the crushers because the rock which is blasted by your explosives those loose material will have to be crushed to fines. So, there will be primary crusher, secondary crusher and tertiary crushers by which they will be make a pulverizations and then they will have to be separated out there. There will be different type of screens for vibrating screens will be there. Then they will be in a weight medium platform that available minerals can be separated out by using classifier.

And, then you will have to transfer the material by you can have a chutes or transfer systems. Then during the processing purposes lot of dust will be collected. So, you will have to have machine so, that collect the dust and you maintain the air dust concentrations which in the plant as per legislations.

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So, these main handling equipments are your different type of belt conveyors, there is a screw conveyors also there are apron feeder, vibrating feeders, feeder means by which you are feeding or loading the machines to the materials to another machine. Say for example, if your conveyor belt is running on the conveyor belt how you are exactly bringing the your other bulk material on to it that will be done by feeder.

Similarly, you may have this another set of transportation is by hydraulic transportations; that means, you may grind the materials to a certain level and then you will be mixing with water and that pump when the valuable mineral mixed slurry it will be pumped into a pipeline and the through the pipeline it will get flowed to a place. And, wherever there is a gravity is there the material will be going down by itself and that type of transportation system is called slurry transport system which is also used in many of this mines.

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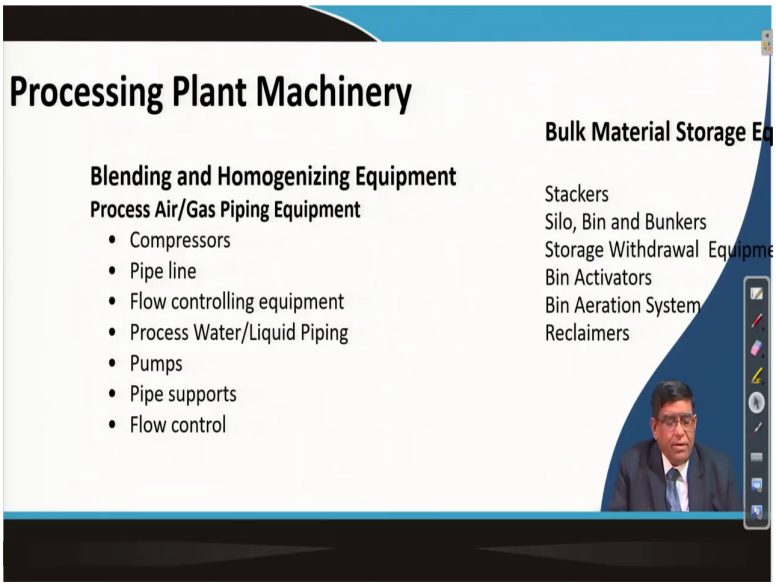

Now, these the main job of this processing plant machinery they will have to do a blending operations as required or as demanded by you the design of the particular phase depending on the geo mining conditions which prevail over there.

So, this there will be number of such type of auxiliary machines, but one more important category of the bulk material handling since is the storing machines, stacking machines. So, these whenever you are transporting the material by a conveyor belt. From that conveyor belt the material will have to be transferred to ground or to any storage place and for that you can store it in silos bin or bunkers and then to load the unload the material from the conveyor belt to those is used by stacker.

And, there are many things when your bin; that means, material in the bin when you store it may get a block it may not come out because of that you will have to have some additional devices, so that the material flow from the bin is continuous and is maintained.

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Similarly, bulk material storage equipment you have got this stackers, silos, bin bunkers, then from there how exactly you will be withdrawing those type of systems are also employed. And, then you have got the reclaimers; that means, once you have made a store, from that store how you are collecting the material.

There also you have got a wide range of machines called bulk reclaimers which can be a bucket wheel reclaimer which can be having a barrel type of reclaimer we may have a bridge

type of reclaimer wide range of this bulk material handling machines will be there in associated with underground mining.

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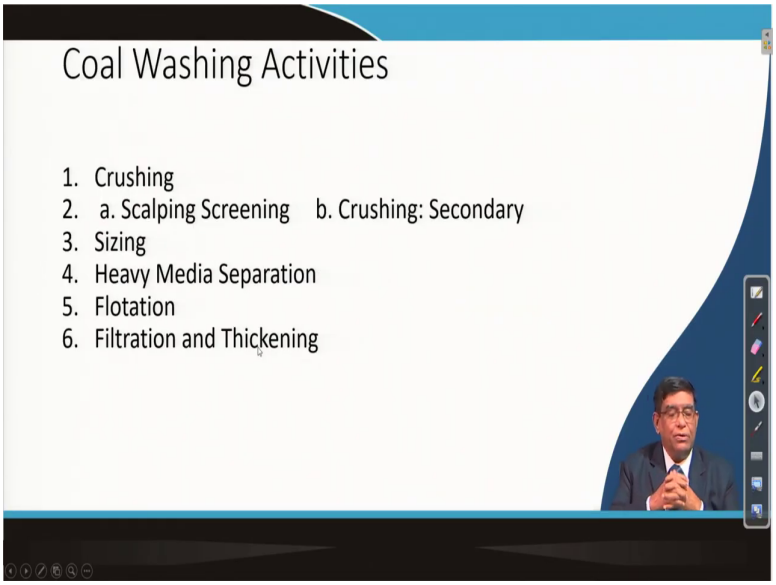

So, also we have got in case of coal mining there is a coal washery or coal washing activities are there and for that you have got a different type of crushers. There is a scalping machine, there is a sizing machines, there are heavy media separating machines, flotation selves and then filtrations and trucking.

These operations are done by machines by different way there are lot of patterns available in which way they have done and the manufacturing of those are a big business all over the world .

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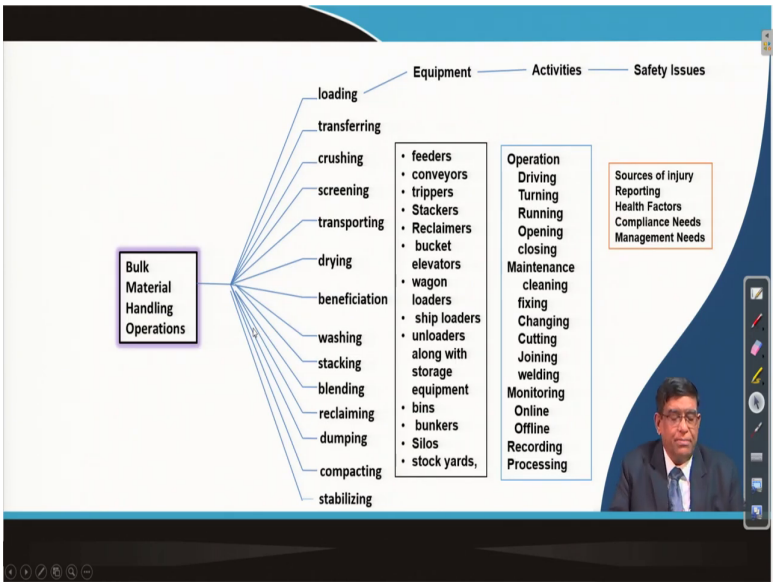

So, coming to this the bulk material handling operations in any miner mining industry is loading, transferring, crushing, screening, transporting, drying, beneficiating, washing, staking, blending, reclaiming, dumping, compacting, stabilizing so many actions. For doing these actions we have got different equipment, that equipments as a feeder, conveyor, stackers these equipments they do number of activities.

Now, say for example, the activities or operations may be driving activities, turning activities, running activities, may be a cleaning activities, may be cutting activities and they can be monitored by online or by recording or processing. So, these equipment and activities go together and then exactly safety and productivity is maintained, but if there is an issue then it must be properly reported and its health factor and the compliance requirements, management requirement need to be properly logged kept in that office.

So, as a mining engineer when you will be operating in any mines you will have to take a proper accounting of that how the machines are exactly selected for which operations and are they being optimally used. That optimal utilizations for you maximizing the capacity of the machines are very very important and for that a scientific investigations of the machinery is there.

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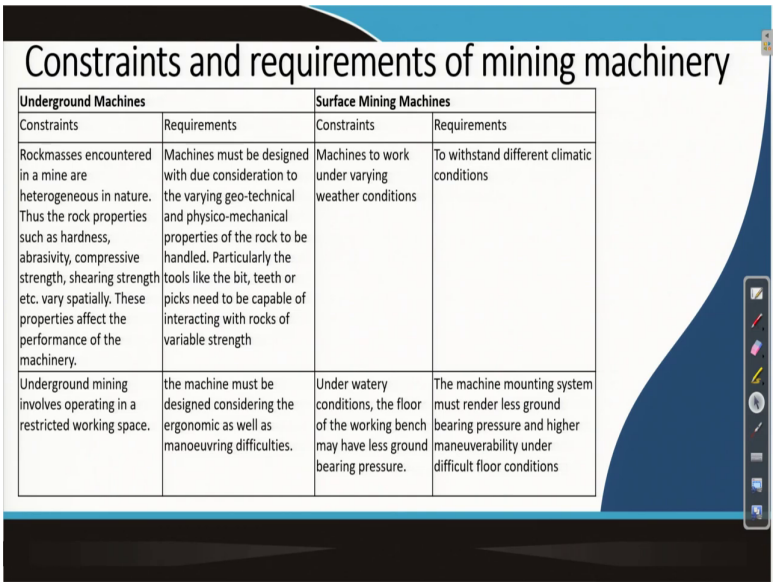

So, if a underground mining operations they have got different constraints and that is why they have got a different requirements. So, this table you will have to fill it up as your assignment that is your what are the main constraints in the underground mining machinery. So, that constraints can be your rockmasses encountered in a mine are heterogeneous in nature because you are never find a simple homogeneous type of material in any mine.

So, when you are doing this heterogeneous systems their interactions with the machines working tools may be different. As a result you will have to take a decisions at exactly which way you will be managing the machines. So, now in that constraints in surface mining is different. That is why you will prepare a table that what are the you things you consider as a constraints.

In underground mining say in underground mining involvement of this operating in a restricted area and in underground in surface mining that is exactly the surface maybe having less ground bearing pressure. So, that is say it cannot have a proper movement of the machinery. So, both for underground and open cast mines surface mines you have got different constraints.

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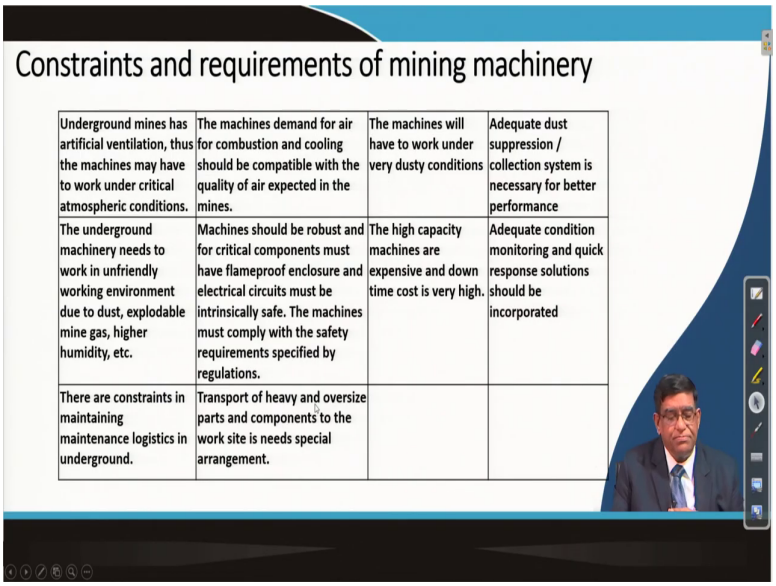

So, once this constraints are understood then you can find out that what type of machines will be required say underground mines have a artificial ventilation. So, that is why the machine demand for air and combustion of cooling should be compatible with the quality of the air expected in the mines. If you design a machine that require very high cooling because of your very high friction somewhere it will be difficult.

So, you will have to go for some anti friction bearing, so that the lubrications and all can take up the heat. So, for so that is type of so that the component do not get detoriated. Similarly, the maintenance constraints that is the machines cannot be access properly because of it has the size constraint machines are designed in such a way that, but to open or particular component out for maintenance become a very big problem because in a very confined space they will be working.

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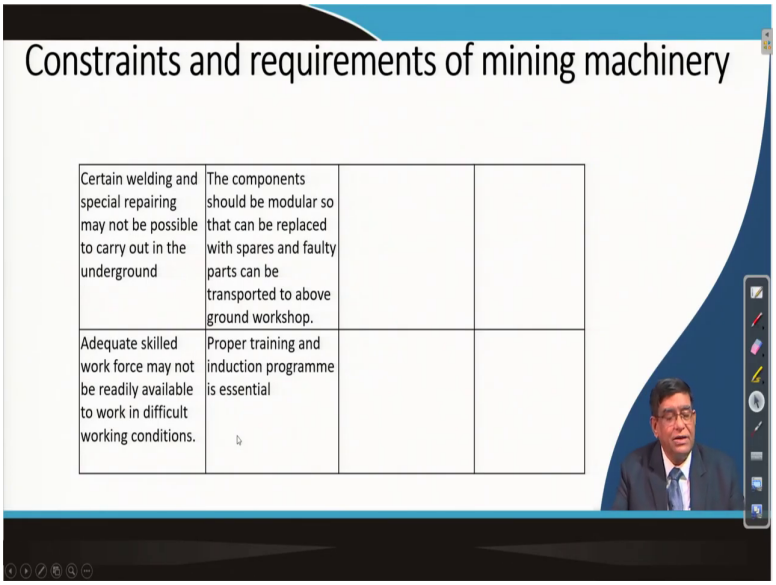

So, like that you can find out that is your what are the different type of requirements. For example, the adequate skill of the work force may not be readily available for doing that very specific case and very sophisticated machines to operate because many of the mines will be in a very interior area people are not well educated under that conditions you will have to find out that in which best way you can train the operator to do the machine.

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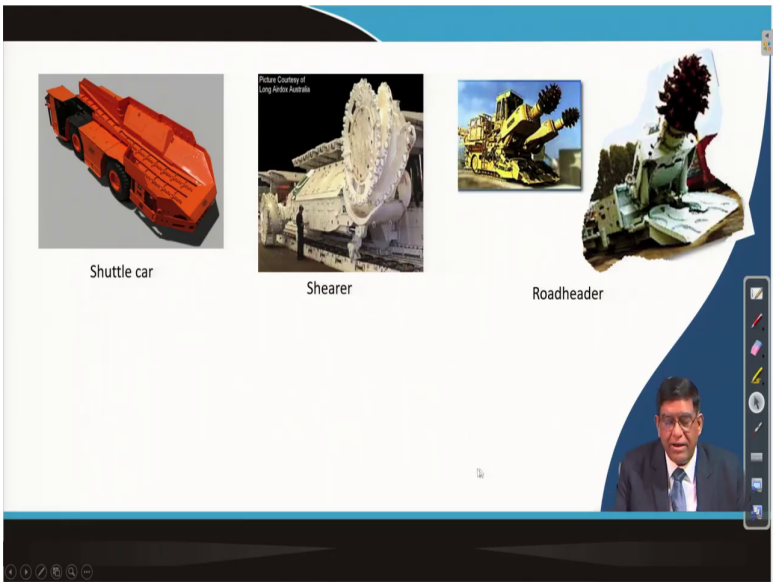

So, that is the different requirement and you can see here the wide range of machinery you can see this is the shuttle car used in coal mining, a shearer which is used in a coal long wall, coal mining, a road header which is main for performing the underground galleries or underground roadways are made by that.

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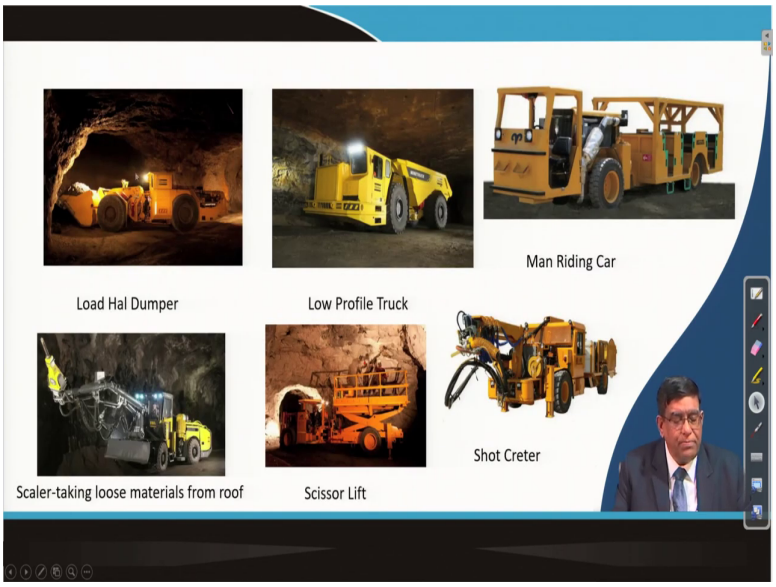

You can have this load hal dumper, that is used in underground metal mine also. And, this low profile truck that in underground space whatever is created within that the truck is there and this truck will have to be lifted to this the unload the material from here even sometimes in underground because of certain reason.

So, these type of low profile trucks are there. The man riding car is another one that how will be carrying the man into the mines. So, in metal mine the floor another conditions are proper there you can have a tyred machines and all. But in sometimes in the coal mining you may not have a tyred vehicle like this.

You will have to have a rail mounted machines and rail mounted main riding system or sometimes there may be a totally different type of transportation system for mine and that is called your man riding machinery. So, those things can be separately learned.

Similarly, there will be a scalar that is if you have to maintain a tunnel or maintain a particular underground space if any loose material is there on the on the [vocalized- noise] roof and all it will have to be taken out for that the scaling machine is used similarly that is a you are having a competent rock where you are having say 20 – 25 feet high space can be maintained over there to inspect and do that operations in the roof they can use a scissor lift like this.

There are shot creter machines which is for roof support purposes they use the shot creting method for that also machine is coming. Similarly, for the this roof bolting purposes new machines have come a lot of machineries have developed like this.

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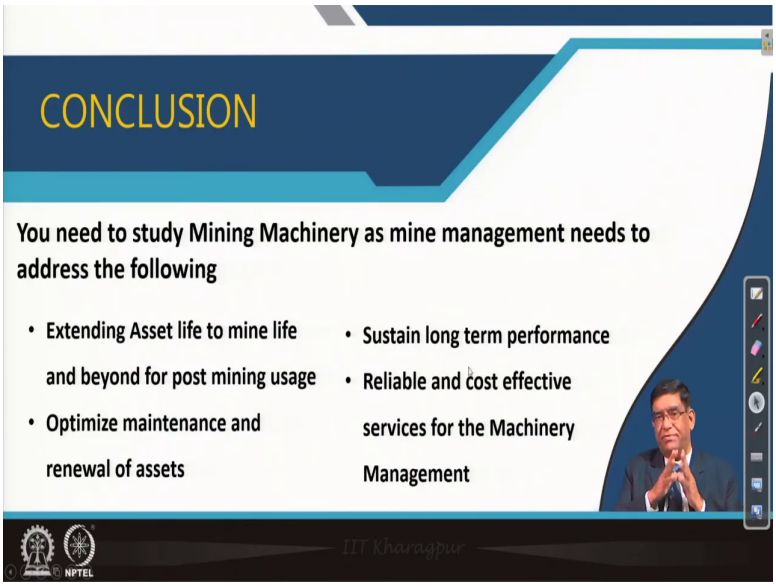

So, one thing is there these machines are also have got those unit operations and then they are made of certain machine elements, whether it is underground mining machinery, whether it is your surface mining machinery a machine is made of machine elements.

So, in this before making a detailed study of the machines you will have to learn or know that what is a machine management and machine management in which you will have to do as a mining engineer to work in the mines; that means, you will have to extend the asset life beyond the post mining usage.

If you can extend the life of the machine you can reduce the capital investment you can improve the profitability and the financial health of your company. And, then if you will have to optimize the maintenance, so that you can derive maximum out of it.

So, sustain long term performance is a must we must get again the reliable and cost effective services from the machinery will have to be there. So, mining machinery management will have to be done by mining engineer, but for that a mining machinery involves a mechanical engineering and electrical engineering, electronics and that is your mechatronics applications and then the machines will have to be deployed for different jobs and need to be managed.

So, a mining engineers perspective you will have to learn the mining machinery in such a way that you know the intricacies of it, you know the mechanical engineering parts of involved in it, you know the electrical engineering for the power part of it, you need to know also how it can be controlled and what are the parameters to be measured and then the data will have to be collected from that machine.

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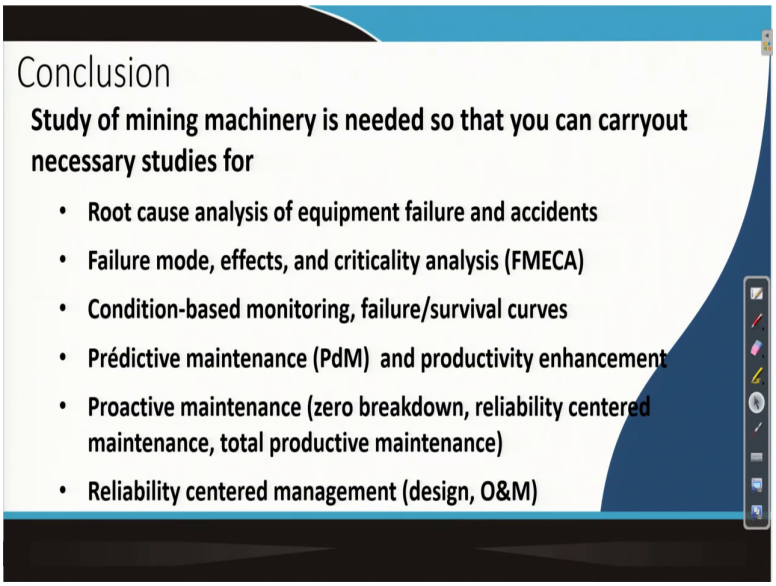

So, this is where exactly you will have to do, so that you carry out necessary studies for in a your objectives or your mindsets for the mining machinery study should be that you can carry out root cause analysis of equipment failure and accidents which are very common in mining industry.

You will have to know their failure mode and effects and critical analysis, how these tools are used with the machinery. You will have to know how condition based monitoring failure and survival curves can be created and how on that basis you take a mining decisions.

Then the predictive maintenance, that how you can predict a probable failure and accordingly you maintain so that the failure does not take and productivity can be improved. And, then what is exactly a proactive maintenance, how will you go for a zero breakdown and a high reliability and this reliability centered maintenance can be improved for a total productive maintenance is another concept which will have to be use with the machinery.

And, there is also many original equipment manufacturers they give this a what is the reliability centered maintenance, how we can get the machines the maximum service out of it. So, those things will have to be there.

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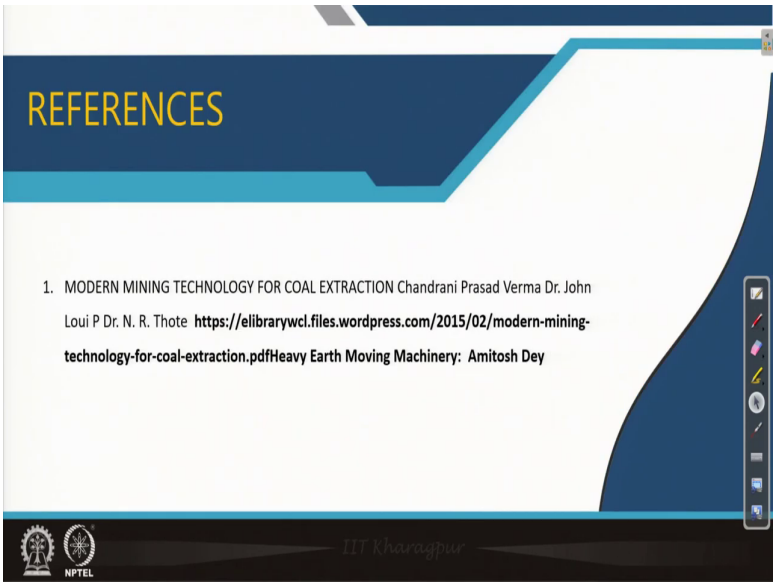

There are many books and things like that this particular site I have given which is Modern Mining Technology for Coal Extractions. They are the our same for a scientists have very well summarized about the (Refer Time: 34:38) machinery. And, also the Earth Moving Machinery of Amithosh Dey give the basic things over there, but during the study of each machinery we will be giving you the references of how different machines will have to be studied.

But, most important here is you get yourself ready to learn mining machinery for a mine management point of view, how the knowledge of machines will be improving the productivity and safety of the mines.

So, without the knowledge of mechanical electrical electronics they are how applied for a specific mining job and that is why this subject has got both your research oriented, your

knowledge oriented as well as your academic things that you please do that exercise which have been asked to do on the basic introductions and get yourself set ready.

In the next class, we will be discussing; what are the main machine elements that are used in different mining machinery. So, before going to the detail of mining machinery we will be studying the machine elements and that way we will be proceeding to study the other parts of these machines.

Thank you very much.