Surface Mining Technology
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Lecture 22
Excavation By Ripper – II

Let me welcome you to the 22nd lecture of Surface Mining Technology. We are continuing with our lecture topic Excavation by Ripper, this is the second lecture on that. We have already started the introduction of the ripper part in the previous class. And this class will discuss the procedure of operations with the ripper, and we will see the details of the applicability of the ripper in different cases. So, let us continue.

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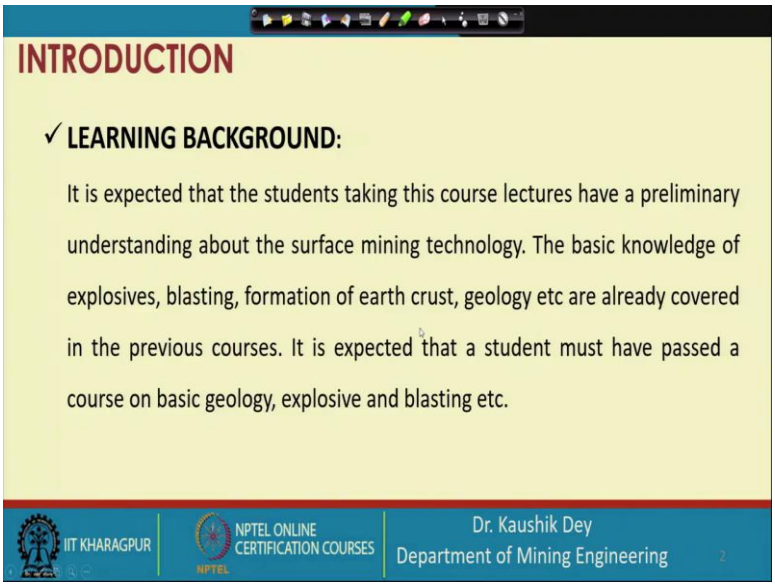

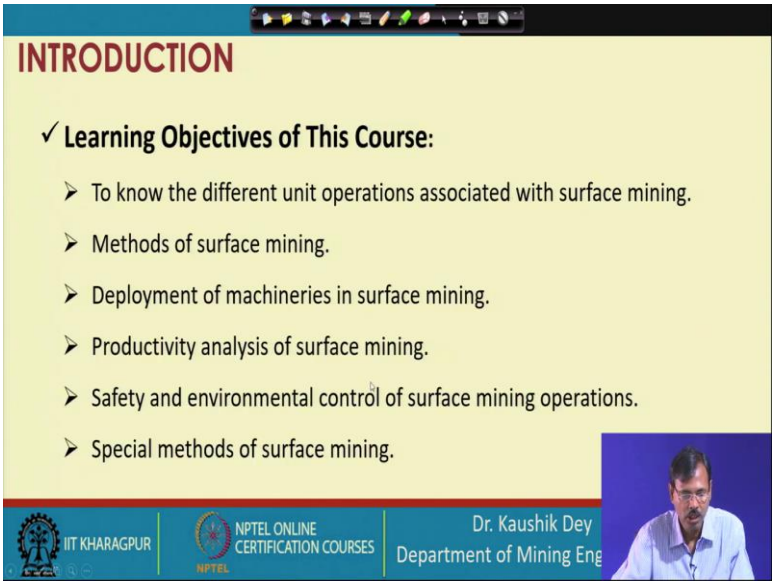

So, this is the learning background for the Surface Mining technology course; this is expected that students who are continuing this course should have this learning background. The learning objective of this surface mining technology course is given in the slide.

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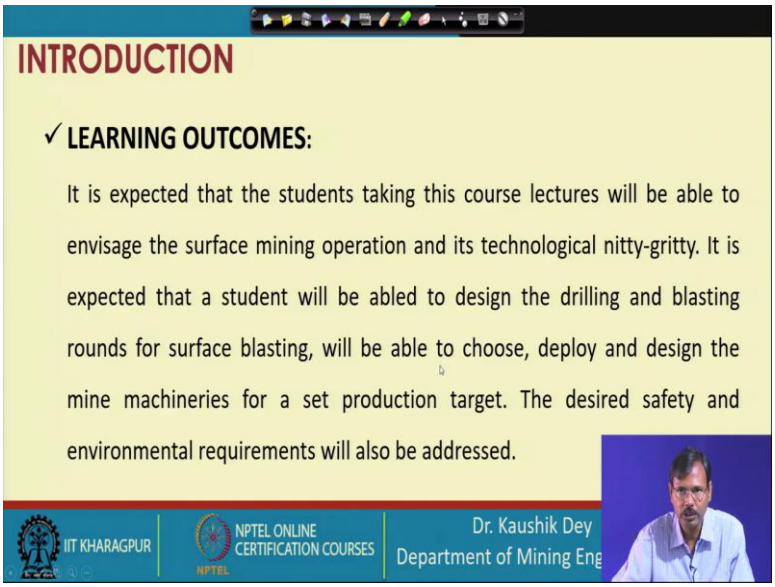

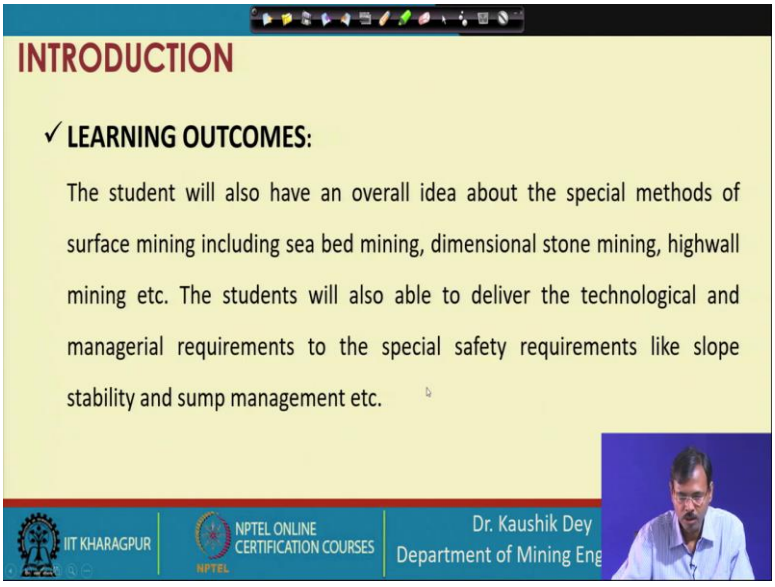

And there is the expected learning outcomes of the Surface Mining Technology course.

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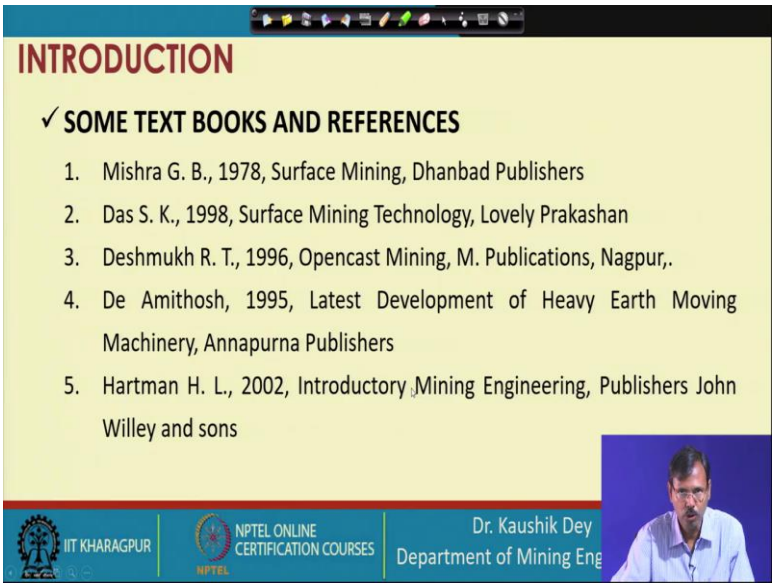

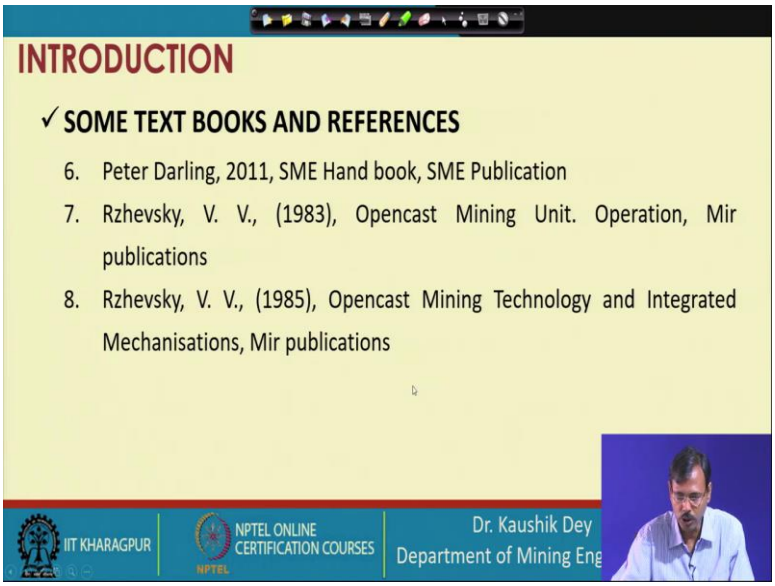

And these are some of the textbooks, and reference books generally expected the students will follow.

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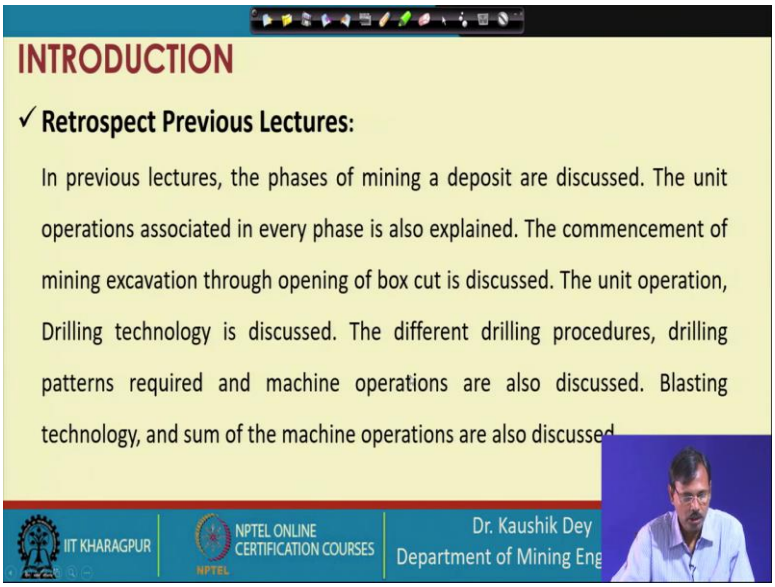

And let us retrospect the previous lectures. Before starting the research, the lecture topic excavation by ripper, we have covered the current status of surface mining in the world. We have covered the different phases of a mining deposit through surface mining. We have covered the opening of surface mining through box cut and the different unit operations associated with a box cut. We have also discussed the drilling technology required for carrying out blasting in surface mines.

We have also carried out the tutorials for the drilling technology for performance calculations and cost calculations. We have carried out in detail the blasting technology required for surface mine excavation, especially from bench blasting, and we have carried out tutorials pertaining to the cost of blasting. And after that, we started ripping excavation by ripper. Ripper is basically a blast-free technology that is applicable mostly for soft rocks.

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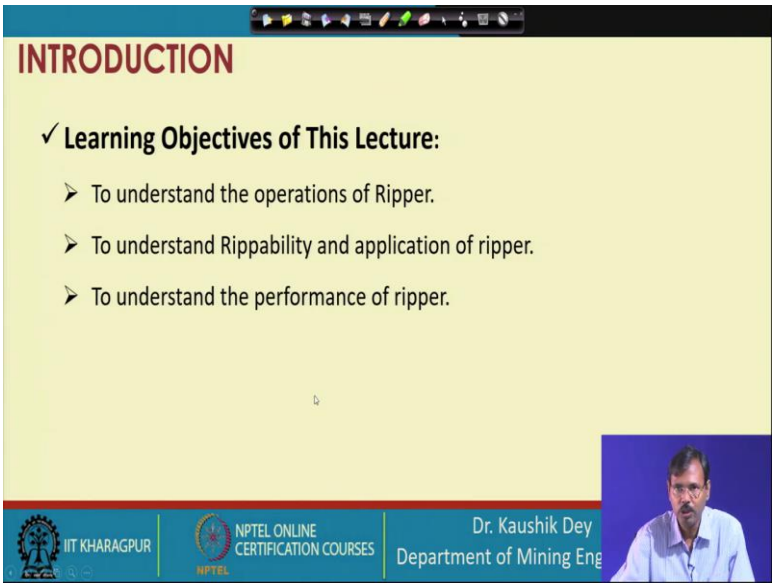

In the last class, we discussed the introduction to the ripper. We have seen how the ripper is excavating the rock bed. And we have also found the different parts of the ripper. And the objective of this lecture is to understand the operation of the ripper, to understand the Rippability and application of the ripper. This will be covered in this class, and understanding the performance of the ripper will be subsequently covered.

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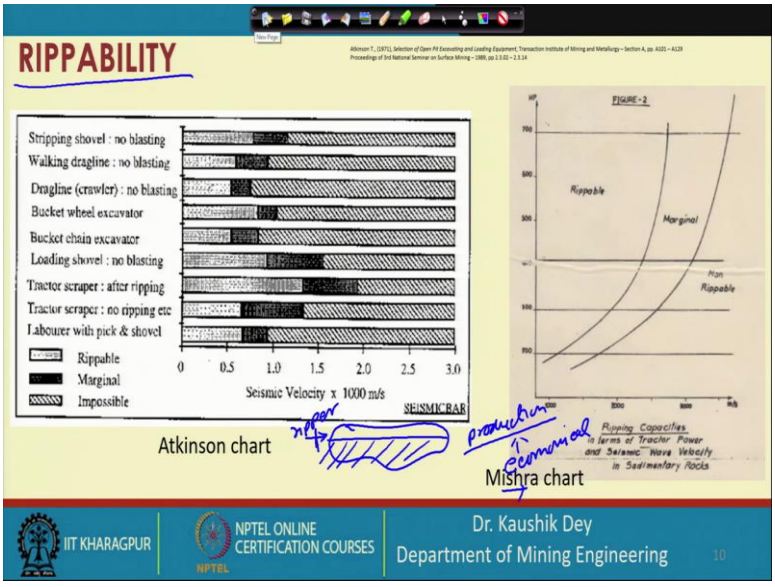

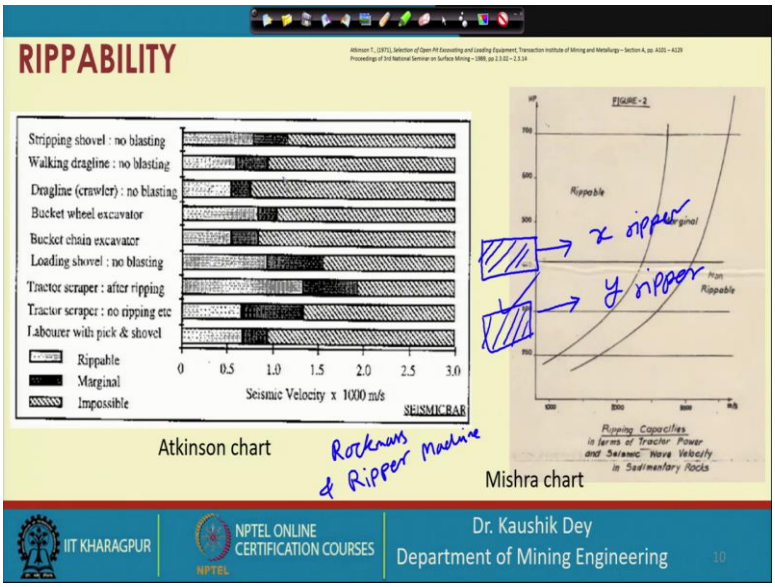

So, let us understand the term rippability, the rippability means, the rippability means, it is telling how easy rock to be ripped. So, if there is a rock bed is there, if a rock bed is there if we are deploying a ripper, then how easy to rip this rock, means, what would be the possible production, what would be the possible production either it will be economical or it will not be economical that is called rippability.

Now, it is easily understood from this that it is an interaction you can say between the rock mass and ripper machine. I am telling this because it may be possible that a particular rock mass may not be irreparable by x ripper but if I am deploying the y ripper, which is a very heavy-duty machine that may rip this rock. So, this is the interaction between the rock, rock mass, and the ripper. Then based on that, we can decide whether this is rippable or not.

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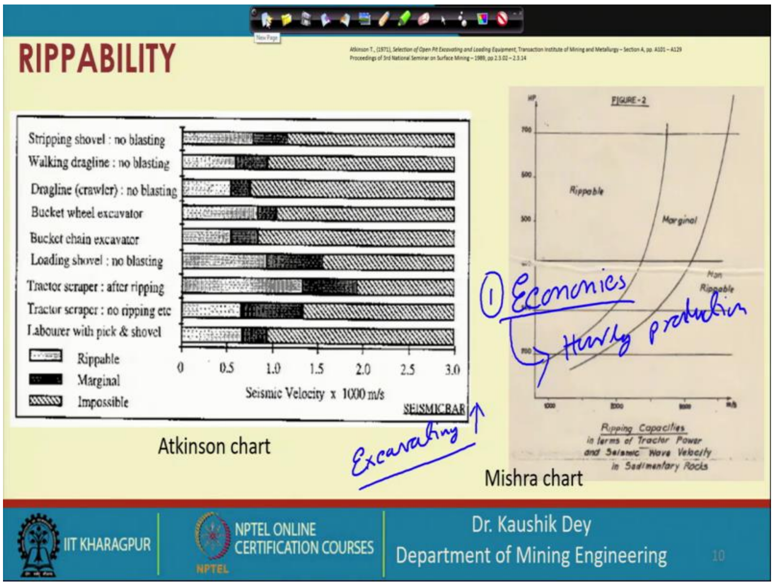

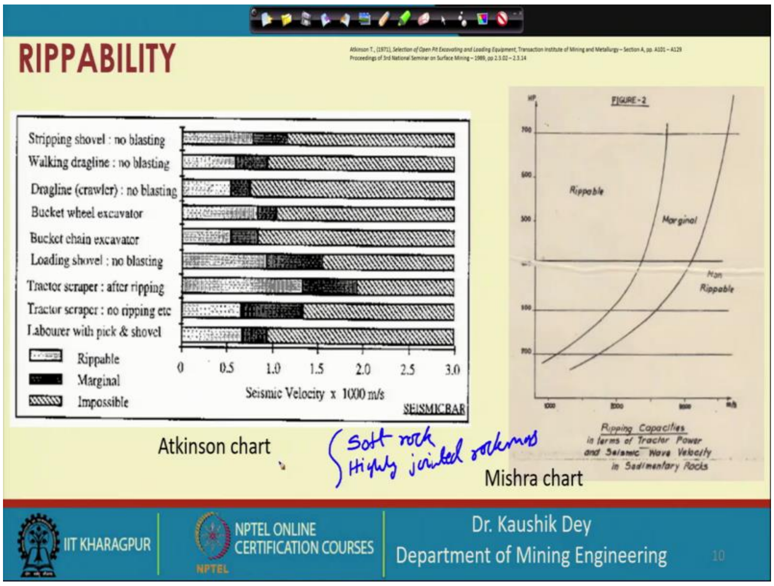

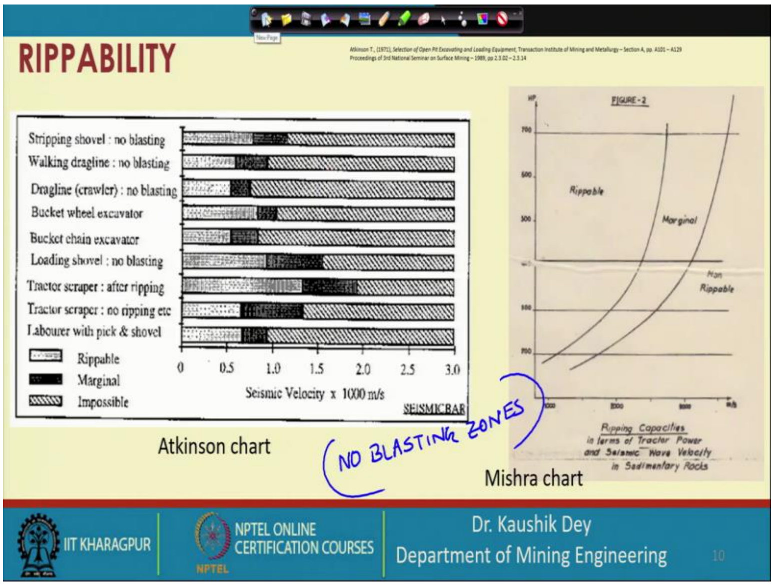

Along with this, another factor that is very important to remember at this stage is economics. Economic means, if the material we are excavating is having, generate a good profit. We must spend some amount of procuring a higher ripper or the excavation cost that means, the hourly production rate if that is less also, then the mine will remain profitable, then we can go for using this one.

But in general, as our drilling and blasting cost is not very significant, the ripper is applicable either for soft material or a soft rock or for highly jointed rock moss, which are very easy to excavate or where the blast is ting is prohibited. That means, no blasting zones. So, the ripper is applicable for these conditions, where either the material is soft, or the material is highly jointed or the no blasting zones or blasting is prohibited in those cases ripper is in general applicable.

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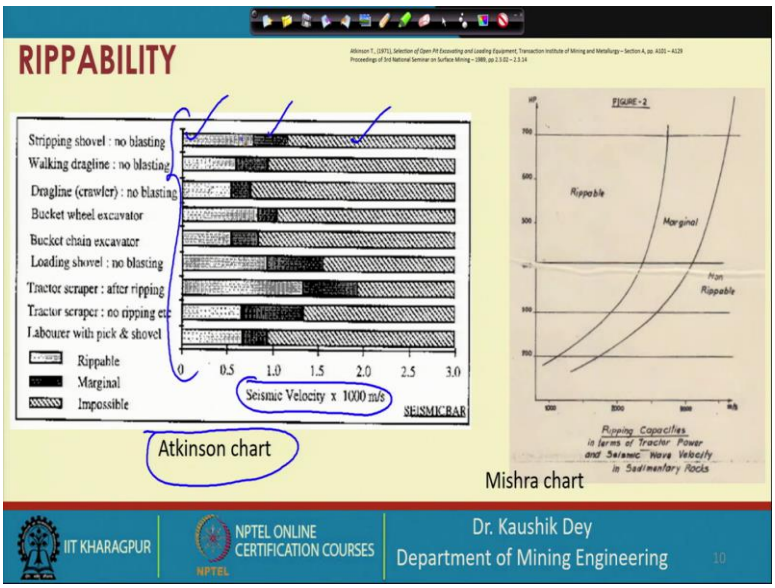

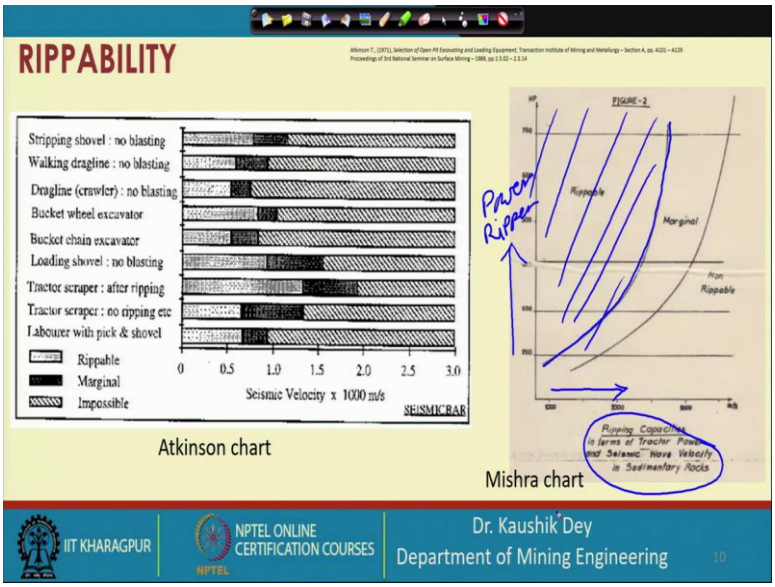

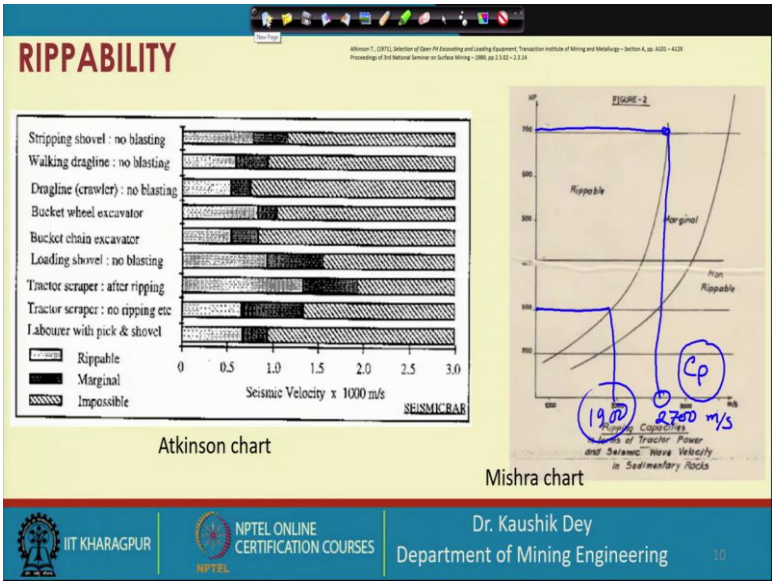

So, this is very, very important, but before application of that, we have to look into the applicability of the ripper which means rippability. So, this is the first chart given long back by Atkinson which is completely based on the seismic velocity and you can see if the seismic velocity is ranging from this then it is considered stripping shovel can be applied this is marginal, we do not know whether it is, it is considered as economic.

This is marginal, whether economic or not is not known and this is not economical is considered this is for walking dragline, this is for bucket wheel excavator, this is for bucket chain excavators and like this way it is basically dictating where which machines can be utilized for different conditions it is shown here. A similar way based on the seismic velocity of the sedimentary rock mass this classification is given where it is considered this portion in this zone the rock mass is rippable if we are having a rock mass whose in situ seismic

velocity is ranging between this and this is the power of the power of the engine power of the ripper.

So, that means, if we are increasing the engine power, that means if we have a 700 hp engine power then the rock up to 2700 meter per second seismic wave velocity that means P wave velocity, seismic wave velocity up to this is rippable economically this is given by this chart. So, if it is 300 hp, if it is up 300 hp, then it is 1900 you can consider. So, this is one guideline given for applying the ripper in determining the rippablity of the machine.

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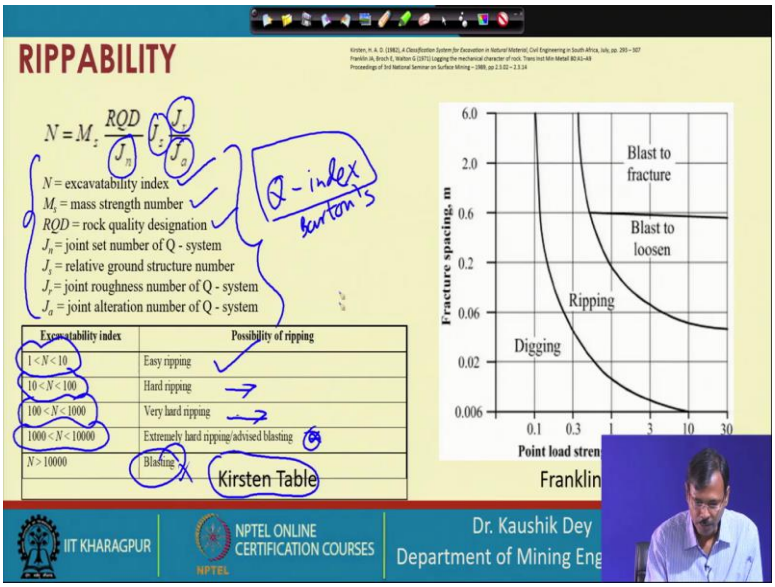

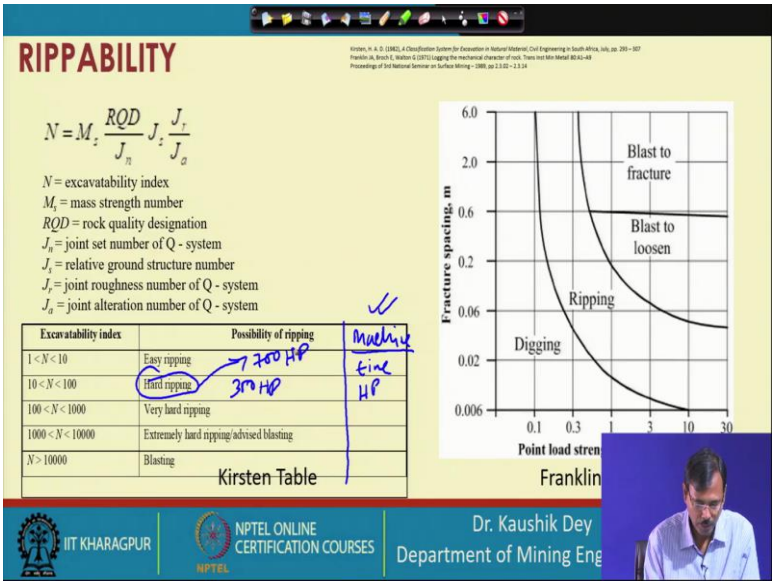

Similar rippability is also given by Kirsten. This is based on the queue index, based on the Q index of Barton et al. So, this based on the Q index it is given, it is N, is considered as the

excavatability index, MS is the mass strength number, RQD is the rock quality designation, and these are the joint sets, number of the joint set.

Then, this is a relative down structure number Js, Jr is the joint roughness and joint alterations, and these are all based on the Barton's Q index, Barton's Q index. And with this system, if N value is estimated between 1 to 10, it is considered the very easy to rip; if the N is considered between 10 to 100 it is considered as the hard to rip and between 100 to 1000 it is considered as very hard to rip, 1000 to 10,000 it is extremely hard ripping condition is considered and above 10,000 there is no ripping only the blasting should be used as per the guideline given by the Kirsten.

So, this is very important, but the whole concentration here is given on the rock mass properties, but this table is silent about the machine properties. So, what could be the size of the tine, what could be the engine power. So, machine properties are not discussed. So, it may be possible which one is coming into the hard ripping condition for a 300 hp engine that may go into the easy condition with a 700 hp engine. So, all these considerations are not available in this Kirsten guideline.

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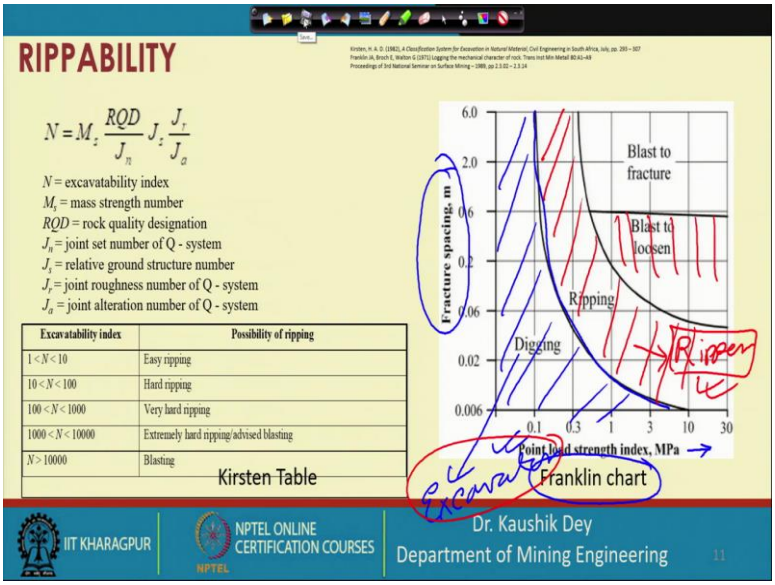

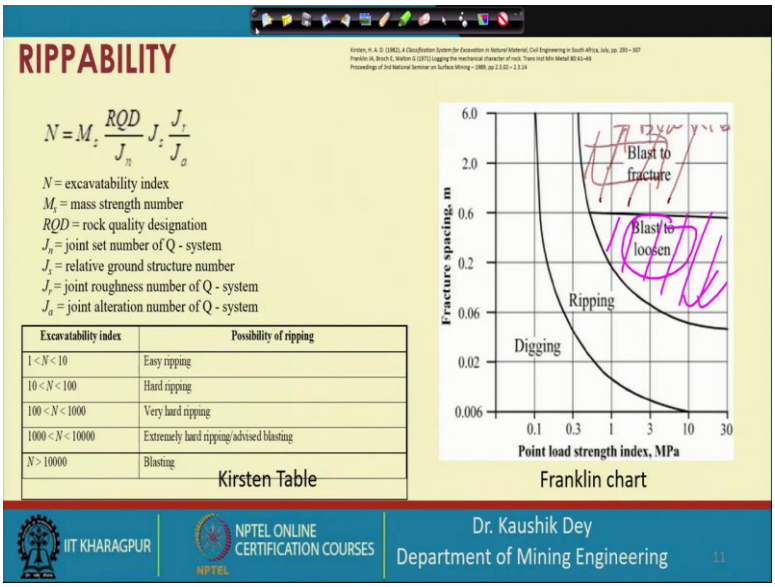

And Franklin has proposed a chart for the excavation system; it is also based on the rock properties and rock mass properties. There are no machine properties considered here. So, this is also a generalized one where missing properties are not discussed. Furthermore, here, point load index is considered in the rock properties, and in rock mass properties, fracture spacing is considered.

And it is found in the fracture spacing, and point load index are bearing like this it is diggable will by the excavator. So it would help if you did not go for ripping. Also it is similar to a soil condition or something like that. So that is why it is considered as, so that is why it is considered an excavatable or excavator digging condition.

If this is in between these two, the advice of the Franklin is not to go for excavating this one; instead, deploy first a ripper to loosen the material. And then that may be followed by an excavator or maybe a scrapper that may take out that material, or it may be dosed and allowed the loader to take that one. So first, the ripping is carried out, and if it is coming into this zone, then simple blast, then maybe a simple blast to loosen the material followed by the ripping or excavator operations may be allowed at this position.

But this is a very hard rock condition. This is a very hard rock condition. Only the applicable technology for this is considered to be the blasting; no other technology is possible in this case. So this is the rippability chart provided by the Franklin, and very commonly, this is utilized prior to the decision on whether the ripper should be deployed.

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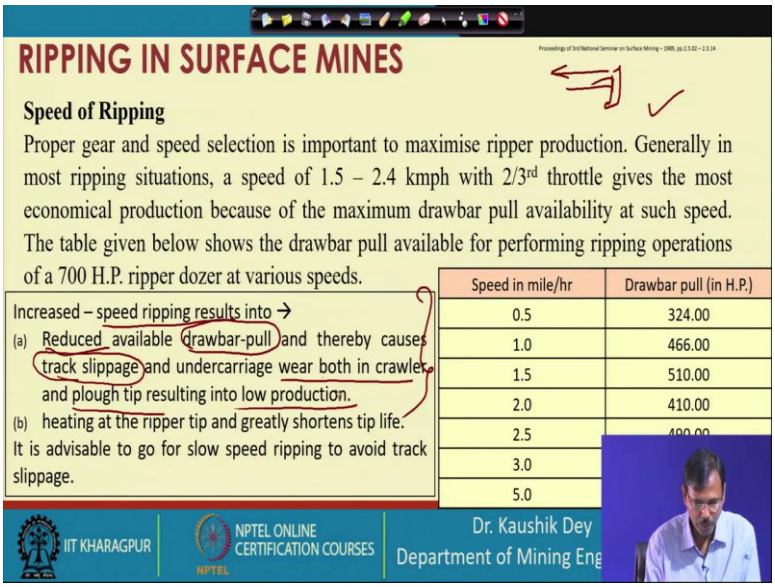

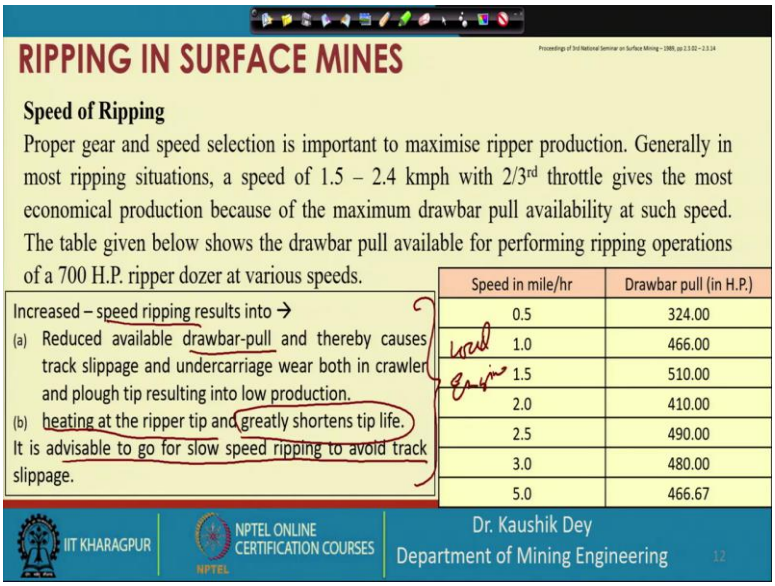

If you are, if you have deployed the ripper finding that the ripper is applicable in that particular mind, based on its geo mining condition, if you are deploying that one, you are interested in a number of other parameters which you will achieve. So first one is the speed of ripping because it directly dictates the ripper's performance. So, this also depends on the operator’s sufficiency, the operator need to select the proper gear and speed, etc.

And it is observed that this is the general speed that is 1.5 to 2.4 kilometre per hour thus in general speed is achieved. In most of the cases, this is the speed given depending on the drawbar pull this chart, in general the manufacturer provides this type of charts. So, this is the chart provided by the Panchpathpali mines, where the rippers are commonly used. So, this chart is, can be followed from their experience.

This is the speed and increased speed ripping generally we want to go for more speed so that we can produce more but, reduced available if we go for, because we are having a single-engine if the engine is mostly applied for the increasing the speed then the drawbar pull is reduced and thereby cause the tracks slippage. So, that will also go for wearing and tearing the crawler plough tip and resulting in low production.

So, the choice of right speed is also very, very important. Suppose, you are trying to excavate up to this and you are trying to increase the speed then what will happen, this has to come out up, so the proper, proper production will not be achieved. So, that has to be, that has to be a look into try to choose the proper speed.

So, operators should have the sufficient efficiency to choose the right speed at this point where the proper drawbar pull has to be given and the ripper's speed has to be maintained. Second, the return ripper tip will be heated up, which may shorten the tip's life if the tip will basically have erosion.

So, that is why this part is very, very important. It is also advisable that slow ripping is okay, but it should not be too slow also the proper that is load onto the engine. Proper load onto the engine has to be maintained in this case. So, a systematic load must be used for excavating the material.

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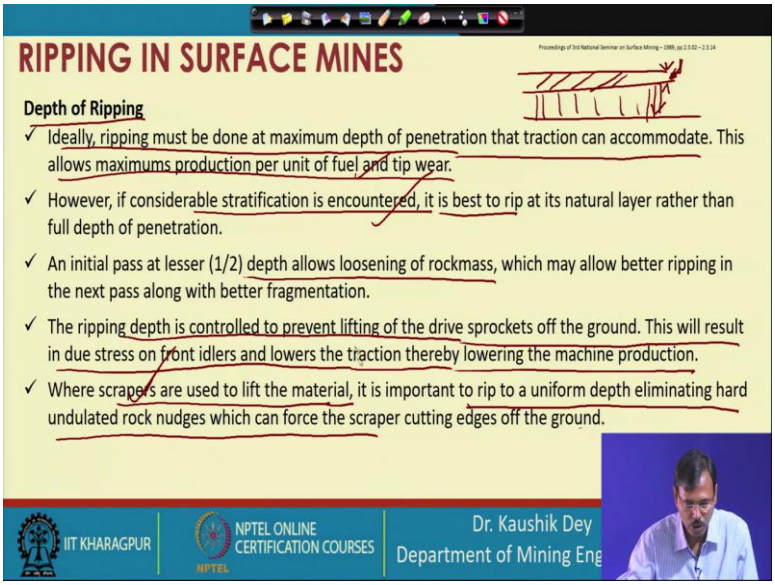

Second is the depth of ripping ideally, the full depth and maximum depth of penetration can be accommodated and should be utilized, maximizing the fuel efficiency. But stratification encountered is very important, and based on that, the ripping has to be carried out. That

means if you are having a layer thickness of this one, it is better to follow the excavation up to this step to take the material layer by layer and this depth for the material of this layer. So the stratification should be followed that is a better option because this will give the more, less load onto the machine.

It may be possible that one or two paths may be used to loosen the rock mass. Ripping is controlled to prevent the lift of the drive sprockets off the ground. This will result in reduced stress on front idlers and lower the traction, thereby lowering machine production. The scrappers are used, the scrappers are used to lift the material, and the uniform depth should be maintained to eliminate the hard undulating rock nudges that can force the scrapper to cut edge off the ground.

So, undulation is not wanted if the scrapper is used, if the dozer is used, then that is possible, but if the scrapper is used, because it has very poor dodging capacity, in that case, a good floor is, in general, to be provided, because rock nudge should not be left for the scrapper.

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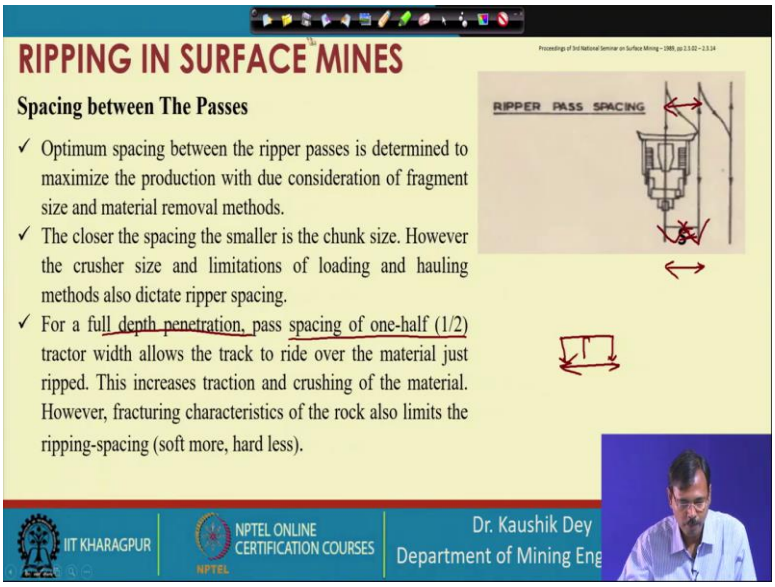

This is basically giving the spacing between two nudges in our first class in the video you have seen, this is also depending on the number of time we are having if it is a single tine, then the portion it is taking out and this portion it is taking out that has to overlapped in such a way so that this nudge portion can be taken out. But if you have a multiple tine, this control complete width can probably be taken together. So, this is very, very important in general full depth, for full depth penetration half spacing, half tractor width spacing is utilized if you are having a single tine ripper or maybe double-time ripper. So, this is the spacing between two passes.

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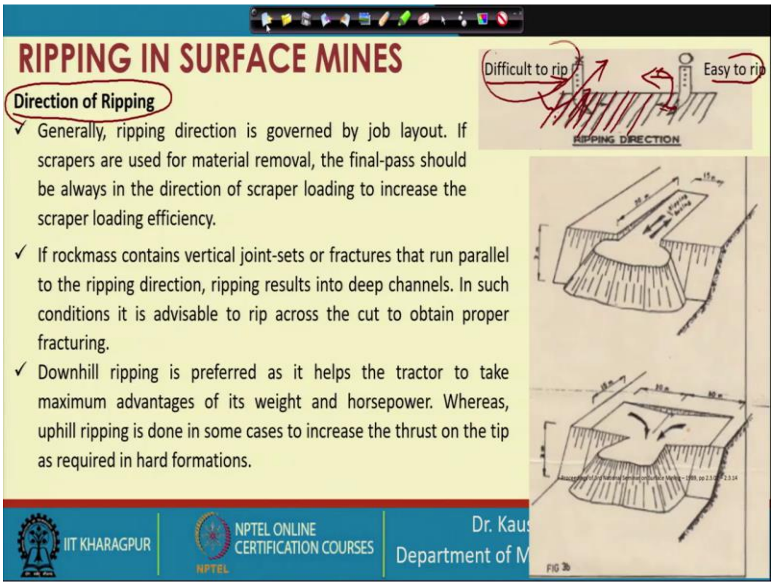

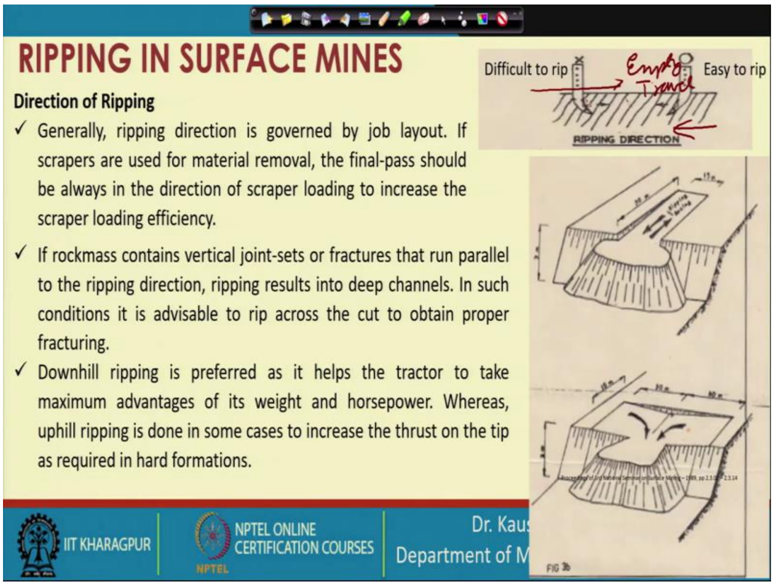

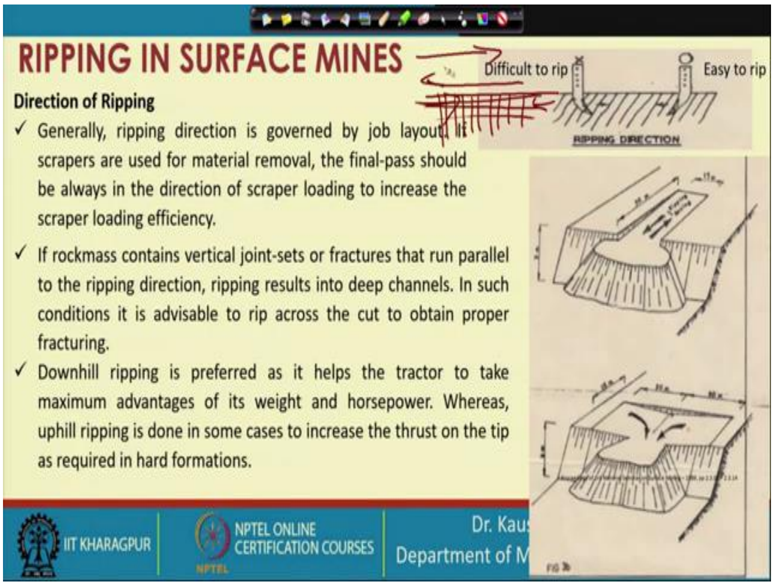

Then the direction of ripping is very, very important. Say, if you look into this, if our stratification or the presence of joints are like this, then the ripping from this direction, from this to this direction is much, much easier, because it is taking out this rock mass is already in this direction, stratified in this direction. So, it can hold a good grip at this, it is self penetrating type, and this can sear the rock very easily in this direction.

But if the ripper is tried to move from this direction to this direction, after this first penetration in the next penetration, the ripper will try to move upward following this angle of the joint set. So, this is a difficult condition to rip. And that may be avoided in that case the ripping may be carried out, ripping may be carried out from this direction only and from this direction to this direction the empty travel of the ripper has to be carried out as we have seen in the last video also.

So, this is generally the practices, but you can have both sides ripping if you have a stratification like this only or stratification like this only. So, in those cases, you can have reaping from both sides where the multiple clits are available like coal, coal bed etc., you can have the ripping from both sides and that is possible. So, there is no empty trouble you can rip from this side in that case. Also, you can rip from this side. So, the ripper will return, and again the ripping can be carried out in the opposite direction.

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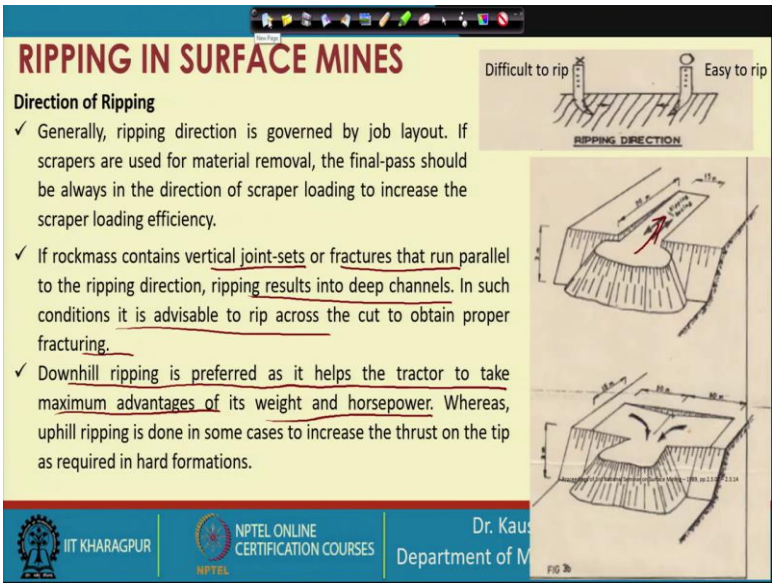

Ripping is a little bit difficult in the upward direction, which is the gravity problem. Otherwise, this is not always true. Depending on the joint sets, fractures result in deep channels. So those tests are to be considered. Downhill ripping is preferred as it helps the tractor take the maximum advantage of its weight and horsepower. So it is only possible if the ramp etc, is carried out or it is just following the deep or deep direction of the deposit, then only it is practiced.

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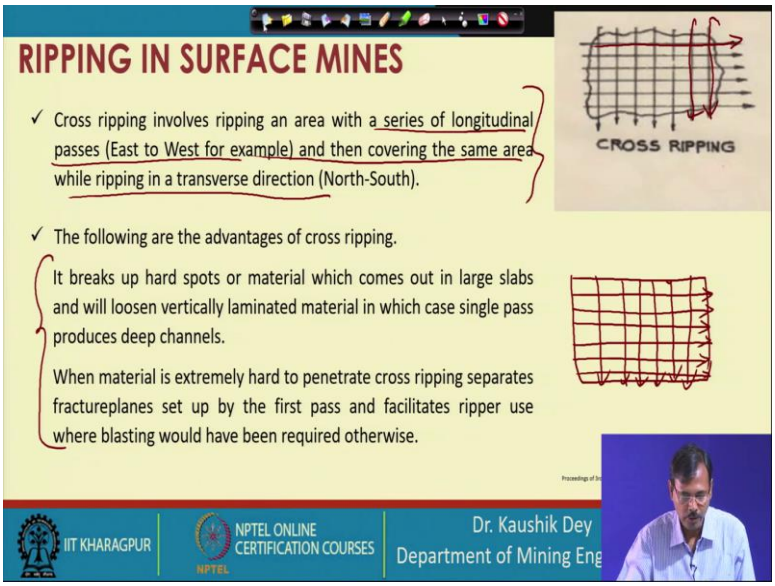

And this is called cross ripping. When a strong rock is required enough to lose the material, the ripping has to be carried out in this direction also, and then the counter ripping is carried out from this direction also. So, for very strong rock, cross ripping has to be carried out, and

in that case a series of longitudinal and then covering the same area, the transverse direction or also the ripping has to be carried out, this will sufficiently lose the material either for the scrapper or for the dozer.

So, these are basically the advantages of cross ripping, but you can understand if it is carried out cross ripping is carried out in that case, though no additional production is achieved, your ripper is basically deployed twice on the same position. So, it is just basically the double costly this cross ripping.

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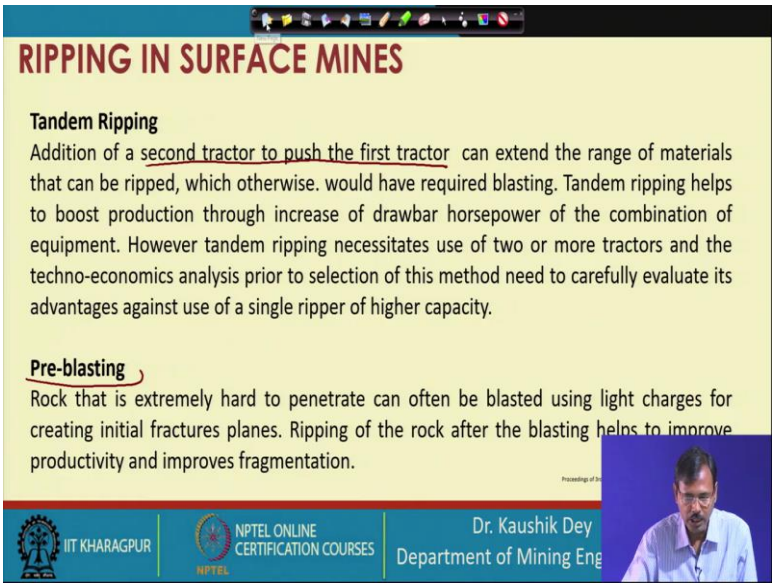

So, there are other methods out there: tandem ripping, where the second tractors used to push the first tractor is called tandem ripping. The way we have seen the scrapper was pushed by the ripper. So, that is basically the tandem pushing that was given there. So, this is the tandem ripping. Sometimes, we go for a light pre-blasting to lose the material to provide an initial softening of the material prior to deploying the ripper onto the same.

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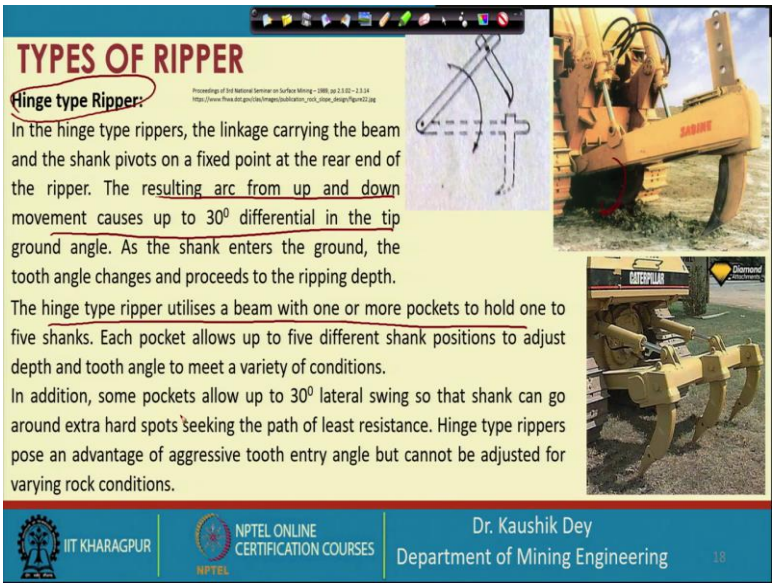

There are different types of rippers available, or you can classify those rippers first one is called hinge type. These is the first initial rippers that are used here. Here, the hinges are dropped, and it penetrates the ground with itself. So, this is called hinge type ripper, which basically moves at an angle. So, this is the hinge-type ripper. This result and arc in up down maybe 30 degrees. This hinge-type ripper utilizes a beam. It may be a single tine it may be multiple tines also. Moreover, this is very easy to manufacture, and very easy to control.

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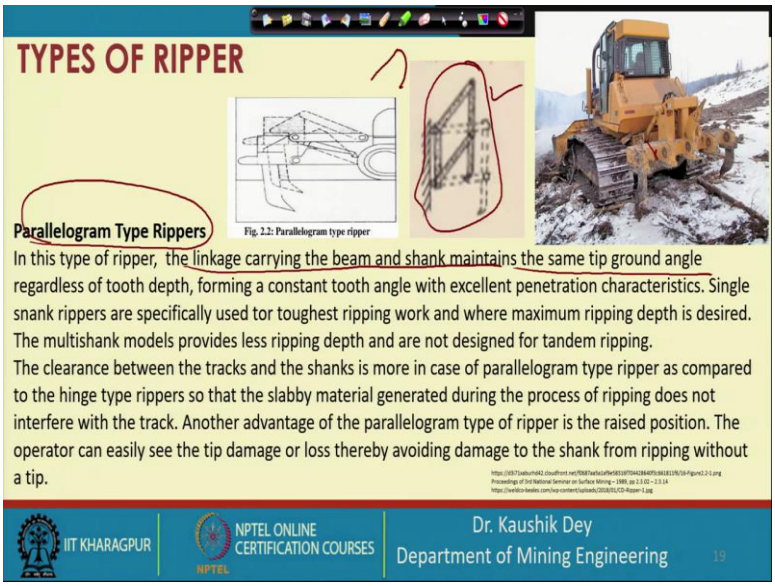

This is a parallelogram-type ripper. This is the parallelogram type ripper, where we maintain this angle as well as there is no change in the angle in hinge type ripper the angle is changed, here the angle is not changed, because it is parallelogram type. And these are the different

examples of the parallelogram type ripper, where this is also controlled, and there is another cylinder which controls this ripper from this pole position.

So that is why it is called a parallelogram type ripper. The linkage carrying that beam and shank maintains the same tip angle in the ground, which is advantageous. So that is why this is another type of considered the another type of ripper.

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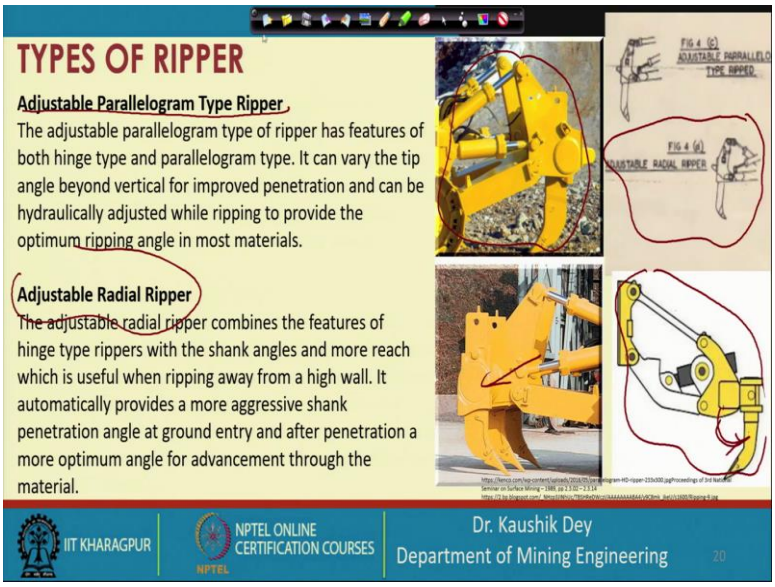

This is called an adjustable parallelogram type ripper, where you can control you can see where you can control the angle of the ripper blade in the ground. This is also called adjustable radial type here. So this is an adjustable radial type ripper, this is the adjustable radial type ripper, where the angles are, this angle and this angle having some inclination you can provide at this position where you are basically changing the angle of the whole system from these cylinders or the adjustable parallelogram type ripper I think it is now understood how the different types of rippers are evolved.

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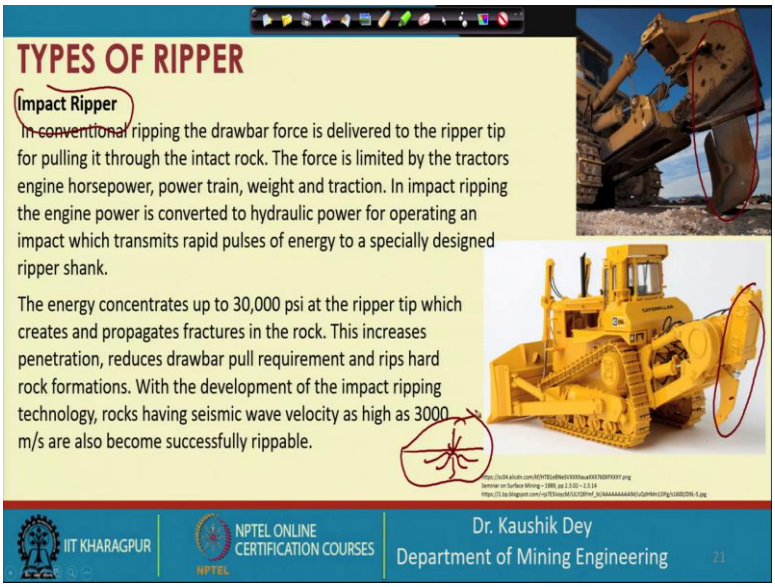

And this is the recent development, impact type ripper where the hammering action is provided at this position, and hammering action is provided at this position. So it is ripping penetrating, and hammering accent is provided on to these. So that the initial part where the tip is basically penetrating that part the hammering action is given to generating the initial cracks that will help the penetration of the ripper tip.

So this is heavy-duty, and very, very advanced technology is used here. And this increases the applicability of the ripper furthermore to the application domain in the rock excavation area. So, this is more or less about the different types of rippers. We will continue with the ripping in the next class also. Thank you.