Surface Mining Technology
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Lecture 32
Excavation with Surface Miner - II

Let me welcome you to the 32nd lecture of Surface Mining Technology. This is the second lecture on Excavation with Surface Miner. In this lecture, we will cover operations of surface miner mainly.

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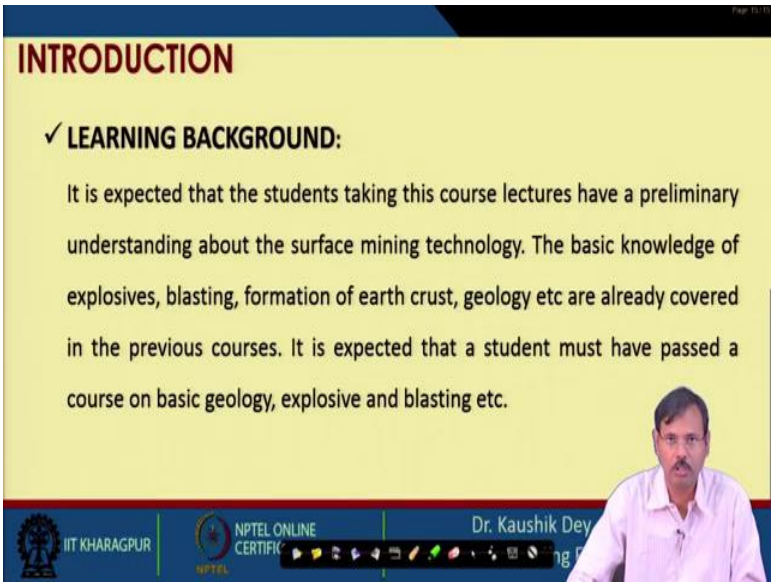

And as we do in every class let us look into once again the learning background required for surface mining technology course.

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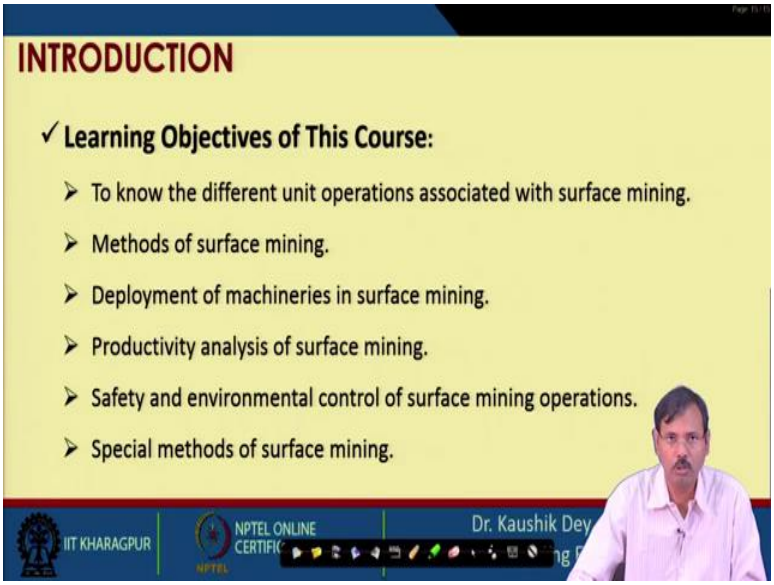

These are the learning objectives of surface mining technology course.

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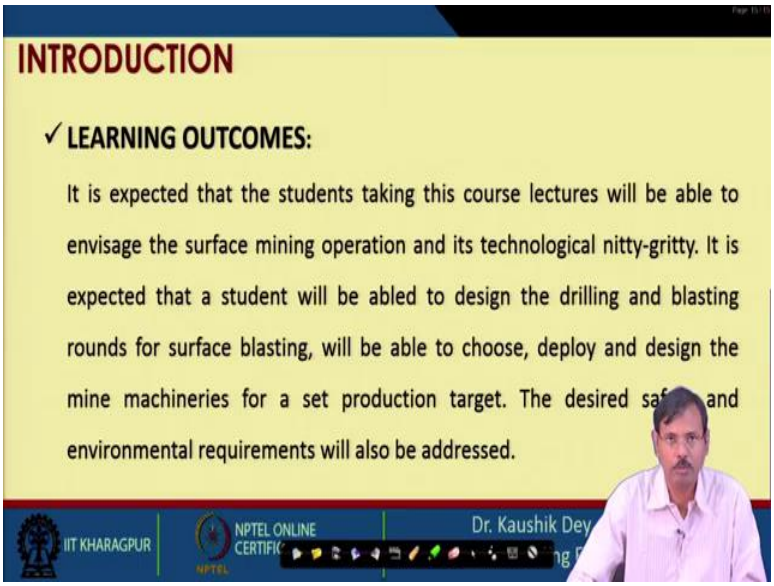

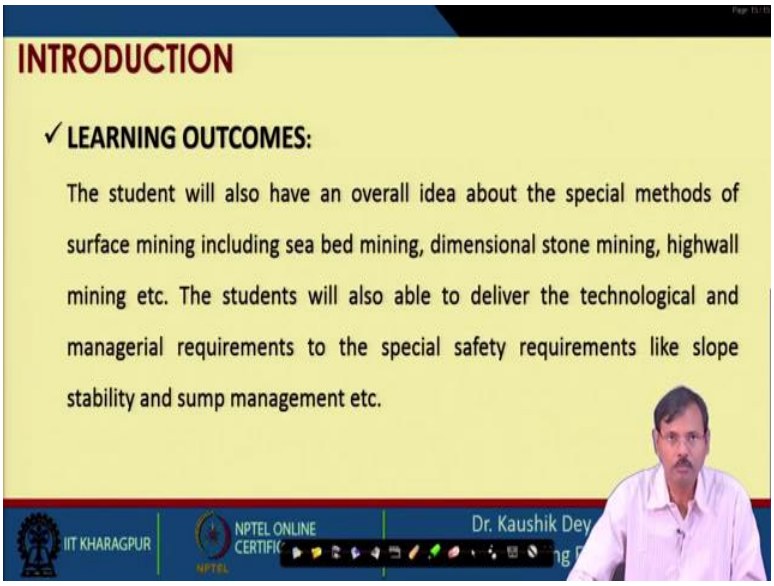

And these are the learning outcomes expect expected from the participants of surface mining technology course.

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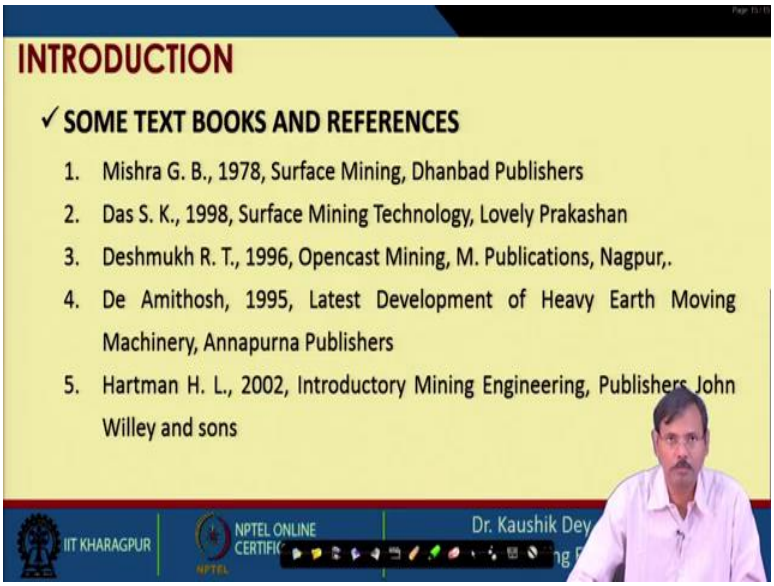

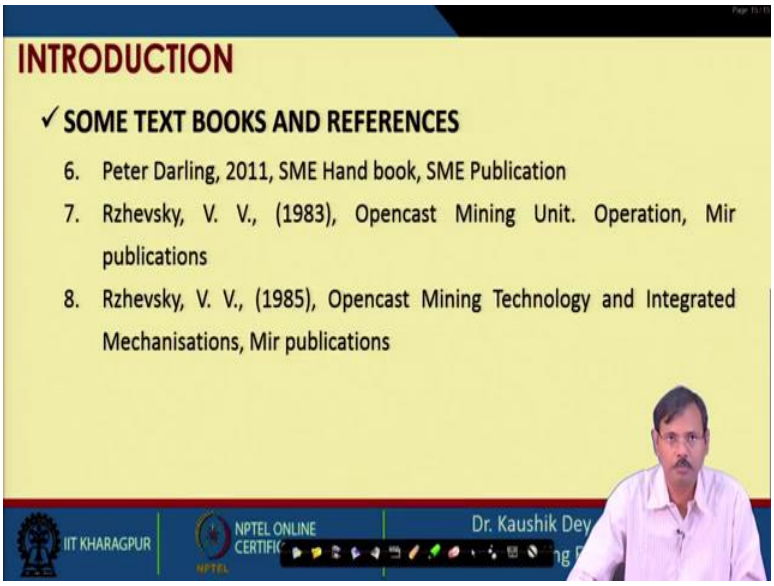

And these are some of the textbooks and references.

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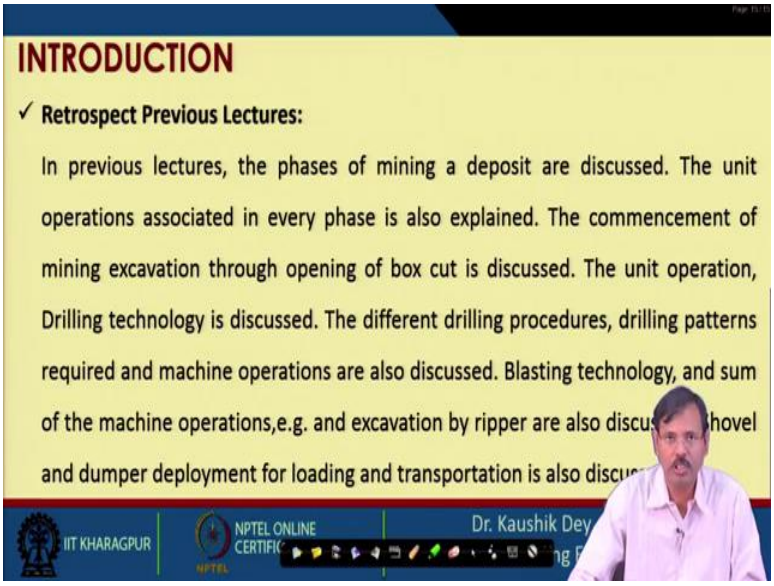

And this is the retrospect of the previous lectures. So far, we have covered the phases of mining a deposit; the different operations associated to that. We have also covered the commencement of surface mining through the opening of box cut. We have covered the unit operations like drilling technology; we have covered the details of blasting also; blasting and blast design of surface in surface bench blasting.

We have covered the excavation by blast free technology like ripper and we have covered the shovel dumper combinations which are used after the blasting for excavating the fragmented rock mass. So, up to this we have covered; we have covered the last class that was the first class on the excavation with surface miner.

So, we have seen that surface miner is basically a blast free mining technology, where this machine is utilized and this machine is essentially having a cutting drum which is mounted with the cutting peaks and this cutting peaks are basically the point attack tool., So this point attack cutting peaks are utilized through the rotation of the drum to cut the rock bed and those fragmented cut material are either left on the floor or it is taken by the machine itself through its conveyor loading system and load that. So, in a nutshell surface miner is a machine which is essentially having a cutting drum that cut the material or directly it is excavating the material from its in situ condition.

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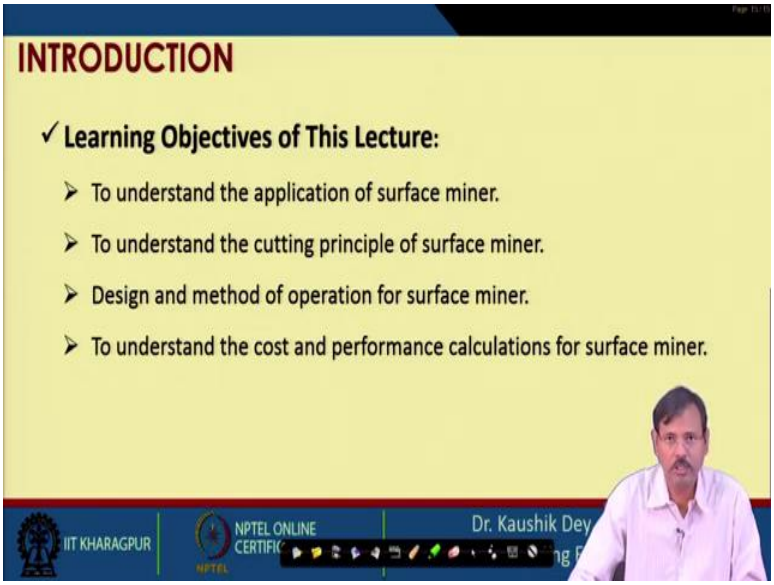

So, the there are five lectures on this excavation with surface miner. First lecture is already over. This is the second lecture and the objective of these five lectures are to understand the application of surface miner; to understand the cutting principle of surface miner design; method of operation for surface miner and to understand the cost and performance calculation for surface miner. So, in this lecture we will understand the operation of surface miner.

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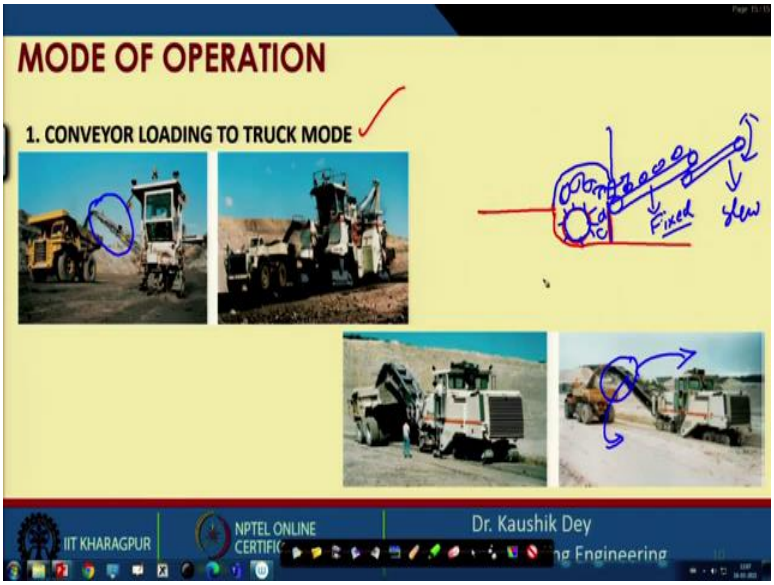

So, we have seen the surface miner can cut material as well as it can lift material from its cut bed and that can dump material. So, the first mode of operation through a surface miner is considered the conveyor loading mode, where the cut material is lifted with the system and then load onto a truck.

So, in this case, as the cutting drum is cutting the material. Behind this, a scrapper plate is provided and this is creating a crushing chamber here. As these are mounted with the peaks, so the material is cut, then the material is allowed to cross in this area and a small window is left at this position.

So, when the material is filled, then through this window the additional material is moving out and that material is dropping on this conveyor and this conveyor is assisted with another second conveyor that is called the discharge conveyor, This conveyor is slewable; for this conveyor height can be adjusted and this is a fixed conveyor and this is a slewable conveyor. So, this is the secondary or discharge convert.

So, in this figure one can see this is the material is being discharged in the side direction. Here it is in front direction so the conveyor can rotate in all the direction. Up to 180 degree, it can move and it can discharge the material. So, this is the benefit of this system and that is why it is called conveyor loading system.

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And let us look into one beautiful video, which is available in the YouTube say limestone mine which is being excavated using the surface miner and this is the truck or dumper which is allowed to take the material from the conveyor. So, it can be easily seen that the surface miner is cutting the material, this is moving in this direction. This is the front crawler; this is the rear stroller and in between that cutting drum is there and it can be seen that after cut a beautiful smooth floor is left because of the scrapper plate.

So, this is very beautiful smooth floor that is maintained by the scrapper plate and this is automatically the material being loaded and now the surface miner stopped; conveyor is also stopped; the conveyor is now slowed and the truck is allowed to move out. The second truck is now asked to come in.

Now, the second truck is being placed in front of the conveyor, so it is now reversing back, now the boom is also lifted, now as it is fixed now again surface miner is starting to take the material. So, now it is excavating and dump started dumping the material on the conveyor, so the boom is being adjusted with its height with this length and it is well controlled now, so this is the conveyor loading system.

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The second system which is possible with a surface miner is called side casting, is called side casting where the complete system remains similar but this conveyor is not dumping the material onto a truck instead it is dumping the material in the side and making a windrow there. So, what is happening in this case, the scrapper plate is remaining intact so if this is the rock bed, this is the cutting drum, this is the scrapper plate behind the drum, say in this case, we are providing the window at this position in the front direction and this is the closed circuit we are maintaining, this is the primary conveyor and this is the secondary conveyor.

So, the method remain same, the material is being cut at this position, then it is allowed to through this opening coming on to the primary conveyor, then the primary conveyor is discharging the material in this and this is discharging the material at the side at this position, so this is allowed to work here.

This type of system is very well applicable for trench construction or similar other walks road construction work, the ground maintenance work. So, in those cases this type of application is very very popular and here the conveyor system is used for dumping the material and that is why the material is placed at there.

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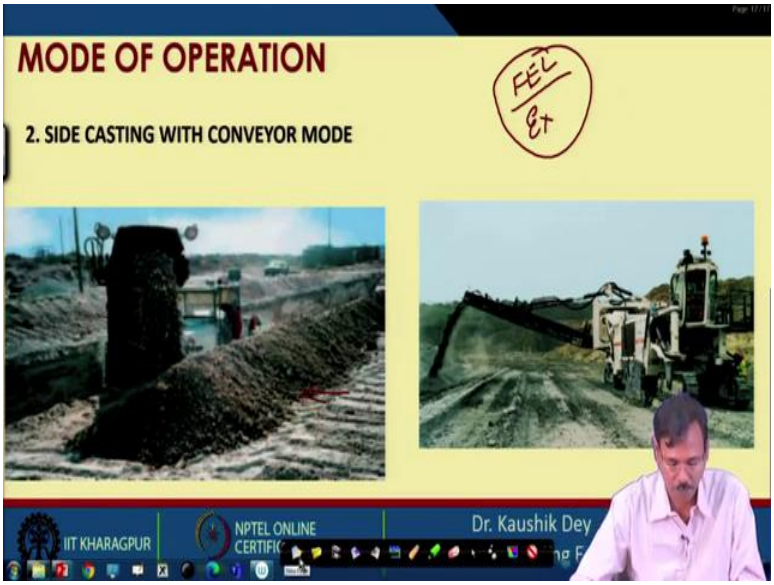

It can be later on used for again reloading again refilling of this area or it can be later on taken out using some other excavation system like front end loader or wheel loader or the excavator that can be deployed for taking out this material if it is required if otherwise refilling has to be required then it is an easy system where the dozer will be deployed to dodge this one to refill that particular area.

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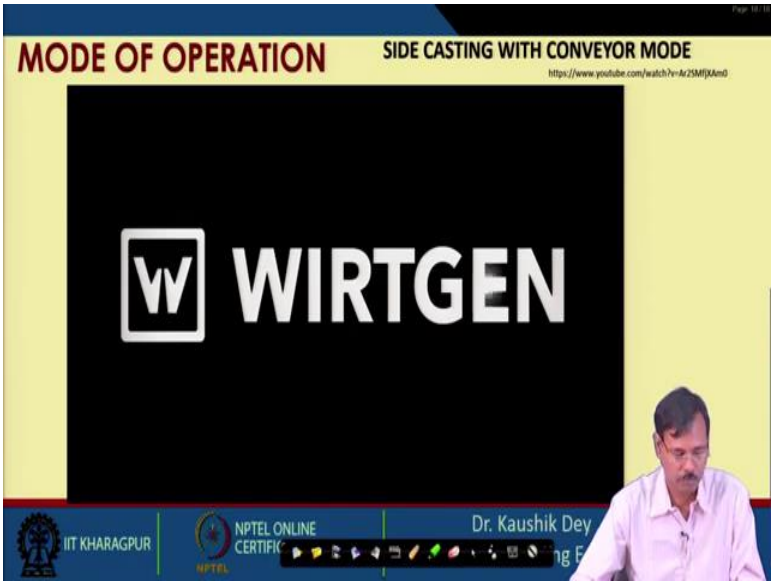

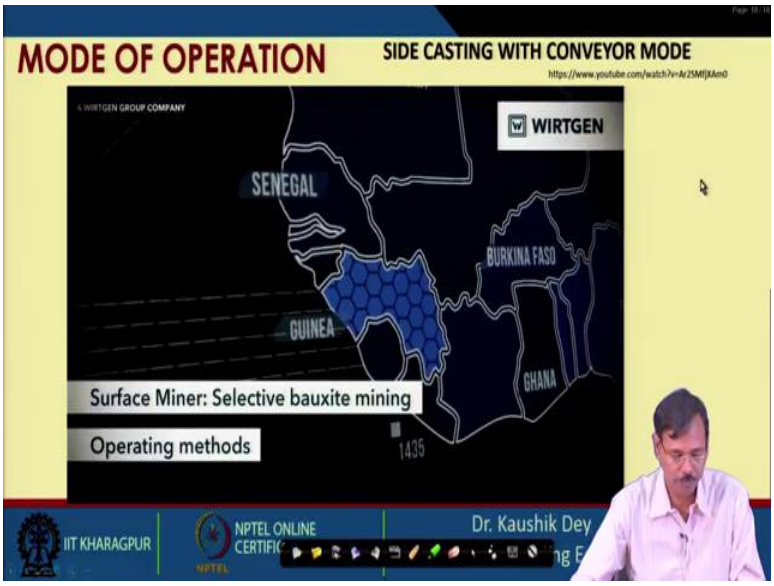
MODE OF OPERATION
SIDE CASTING WITH CONVEYOR MODE
https://www.youtube.com/watch?v=Ar25MfJXAm0
A WIRTGEN GROUP COMPANY
WIRTGEN
SENEGAL
BURKINA FASO
GUINEA
GHANA
Surface Miner: Selective bauxite mining
Operating methods
1435
IIT KHARAGPUR
NPTEL ONLINE CERTIFI
Dr. Kaushik Dey


MODE OF OPERATION
SIDE CASTING WITH CONVEYOR MODE
https://www.youtube.com/watch?v=Ar25MfJXAm0
Operating method: Sidecasting
Project Data
> Amount of bauxite per year: 9 million tons
> Direct Shipping Ore
> Compressive strength: 20-70 MPa
> Selective mining in 24/7 operation
> 100% blast free operation
IIT KHARAGPUR
NPTEL ONLINE CERTIFI
Dr. Kaushik Dey

So let us look into one particular application of this one, this is a selective bauxite mining case, this is the link of this video, this is working in Ghana and operating method is site casting and , the data production target is 9 million ton, compressive strength varying from 20 to 70 mega pascal and this is the method of operation, a 2500 surface miner is working there, so 2.5 meter is the drum width and up to 65 centimeter the thickness can cut at a time.

So, this is the cutting depth, here the material remains after cutting the material, remain in the same cutting area same cut floor. You can see there here the discharge system in the back side of the machine and it can be seen very easily that how precisely this cutting is maintained, this is the first cut area and the second cut with this closely related to that and in the same place the

material is being heaped. So, when the third cut is being taken, the material is kept piled on the on the same place and that is allowing the heap of the material so that is the benefit of the side casting.

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So, the heap is being kept higher and higher depending on the type of application and in between that, smooth road surfaces are kept for the movement of the plying machines like trucks etc.

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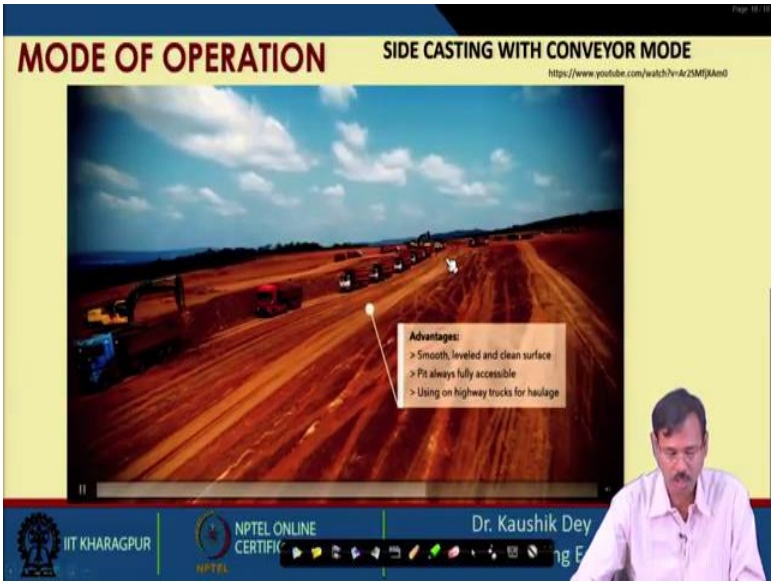

So, most of the mine material is protected from input drained stock piles, slope can be maintained very easily with the positioning the cutting drum, so 31-meter width with 13 cut is achieved here.

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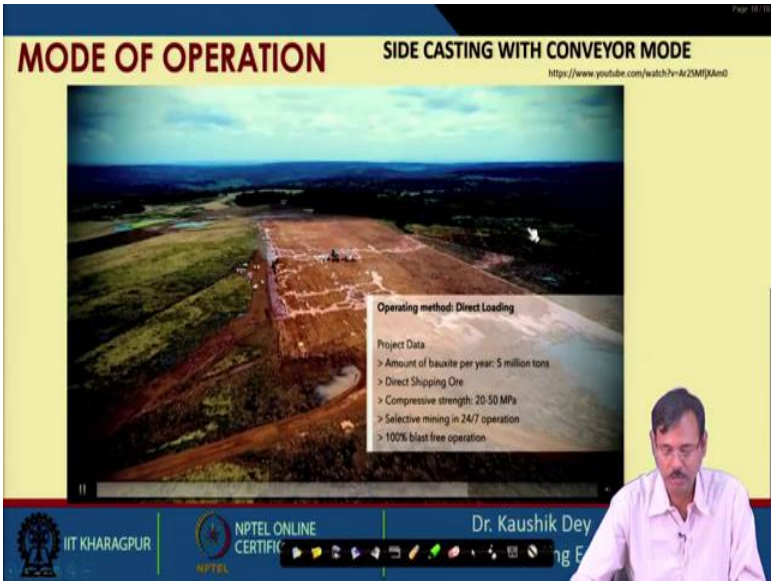

So, this is another application, where direct loading system is being adopted, which you have seen earlier also and again production target is 5-million-ton, compressive strength 20 to 50 mega pascal and here a surface miner of 22-to-2.2-meter drum width is used and here the direct loading is practiced.

So, this is the direct loading system which is used. Up to 25 centimeter cutting depth is maintained here and this is the covered conveyor used so that dust can be suppressed as more as possible, this is the transporting truck. It can be seen very easily the smooth road surface is allowing the well tire life achieving better tire life and well movement of the flying machines.

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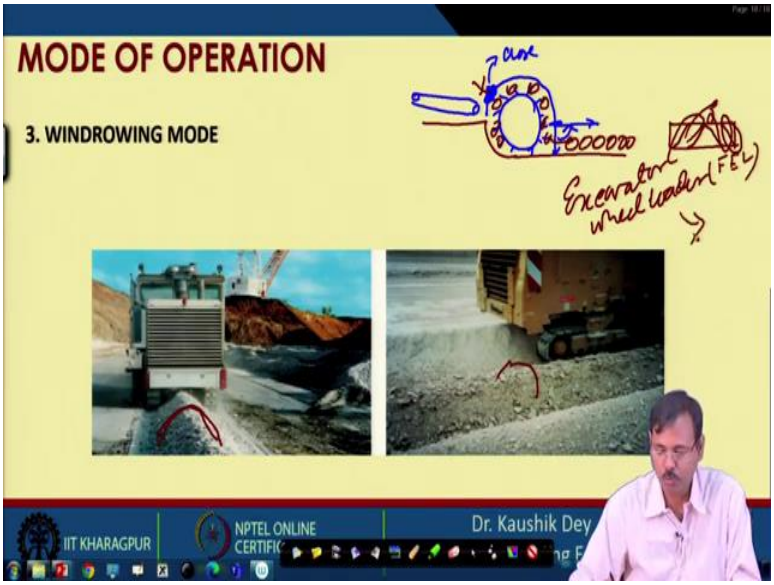

And this is the third option of operation where the conveyor is not used at all and the material is allowed to be windrowed behind the machine, so what is the modification made at this place? In this case, this front window which is kept or the rear window which is kept to take the material by the primary conveyor say primary conveyor, we are having at this position.

So, this window which is allowing the material to drop at this, this we shut, so we close this, we close this window. And here we had the scrapper plate, so this scrapper plate; we keep this scrapper plate open. So here what we are doing? Here we are allowing; we are allowing this fragmented rock mass to remain goes out and stayed in this position. So, here after the excavation we do not provide this scrapper plate, we keep the scraper plate open.

So, obviously and keep this window closed through which the material is being guided to the primary conveyor. So, the material is now rotating and stayed behind, behind the machine and you can see there is a heap made. So, this is windrow, so for achieving this in the cutting drum the peak lacing is made with an array.

So, if peak lacing is made with an array like this, so material is guided, this material is basically guided throughout the center size, this material is being guided throughout the center size. So that is why the material is guided like this and that is why this type of heap is achieved behind the operation of the machine.

So, that is why in this case we are providing the scrapper plate open and we are allowing the material to remain on the floor after the cut and that is thrown in the back side of the cutting drum through the open space provided by removing the scrapper plate. And the front window is kept close so that no spillage of the material through that window to the primary conveyor is allowed.

So, that is the benefit we are achieving and this windrowing is placed behind the machine which can be later on taken out by an excavator or by a wheel loader or which is also called front end loader or other machines can be used for taking it out. So, this is the benefit of this one and let us look into one video for this.

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So, this is in for the Kusmunda colliery of SACL, this is the link of the video where a LNT make KSM 304 is deployed, you can see now the cutting drum is being lowered to cut the material. So, now the cutting drum is lowered, the material is cut and there is no conveyor you can see, the material is allowed to windrow behind the machine. So, here the machine is allowed to turn, so machine is turning.

So, that is why it is not cutting anymore, so now you can see this turning is made by the differential motion of the crawler. So, no differential gear is provided just like trucks. So, you can see the windrow which is left behind the machine. Now, machine is being set at its original

position from which it will start to initiate the cut. So, machine is being positioned to its original position now.

So, it is just adjacent to the first cut where the cutting is complete in the previous round. Now the machine has started to cut the new face you see, this is the lowering of the cutting drum; this is lowered; now it is cutting the material. Now, it is cutting the material and leaving the material windrowed behind these two crawlers. And now see the loader has started gathering the material for dumping. So, the essential part is that whenever the windrowing is carried out, it is it is mandatory to deploy a loader.

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See this is the wheel loader, which is taking the material and see the wheel loader is dumping the material to a Volvo dumper, this is the link of this video. So, this is dumping the material onto the, and the surface miner is now working in this direction, in this place. So, this shows that a surface miner is a very highly productive machine and for this particular case it can be seen that two-wheel loaders are deployed to match the surface miner.

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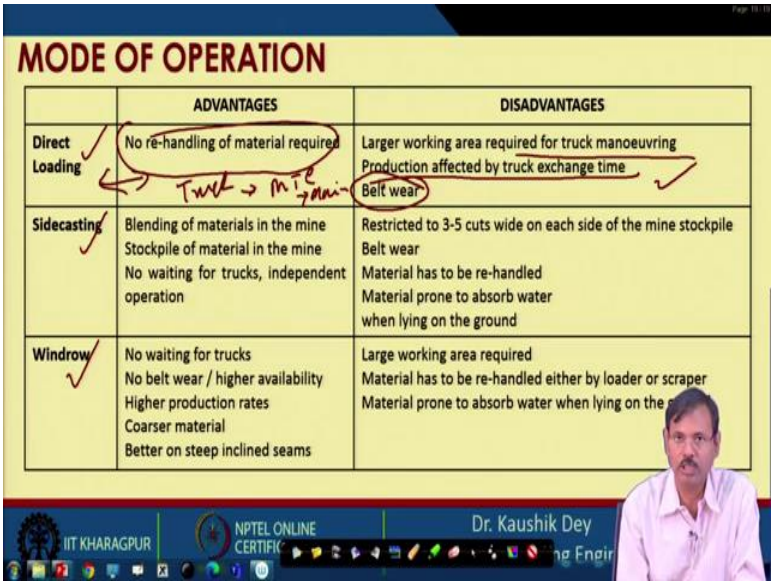

So, now in a nutshell if you see that we have seen direct loading method, site casting method and windrowing method. In direct loading, there is no re-handling required. We have seen the direct loading onto truck; similarly, the direct loading can be possible with mobile transport conveyor and main conveyor system or shiftable conveyor system also.

So, there will be throughout conveyor system possible with surface miner and disadvantage is that larger working area required for truck maneuvering, production is also affected by truck exchange time, we look into this matter at a later stage. And there are often the belt wears are also disturbing this one, because the conveyor, two conveyors are provided means two additional components are there. So, whatever the disadvantages of those components breakdowns etcetera that has to be incorporated the problems or the downtime for the machine also.

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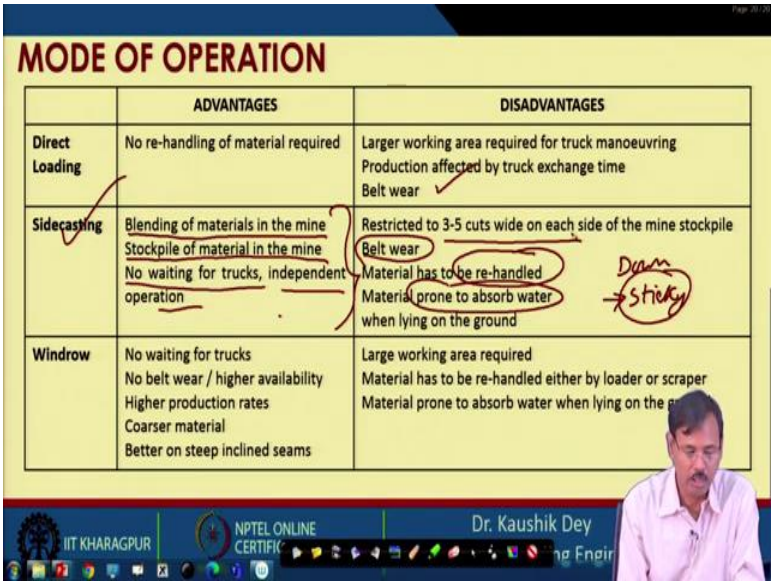

If we can see the side casting of this one, here the blending of material is possible that is the advantage, stock piling of material can be done, there is no waiting time for the truck independent operations are there, and this is also allowing the operations of the machine and dumping of the material at different levels. So, if the machine is operating in a trench that can dump the material onto the surface that means at elevation which can be later used for refilling the area or may be removed later on.

And in this case, the problem is restricted to few cuts of the machine for a particular stockpile, belt wear which is the disadvantage of this one; is not avoided here; material needs to be re-handled; material is prone to absorb water because it is remaining at that place for a long time and this is the problem with this. In this, where the belts are used, there are belt down time often occurs because of the belt wear and not only for this if the material stickiness is increased, for the stick material, sticky material this the downtime with the belts remain increased and that may create the problem. So, these are the main drawbacks with the conveyor system.

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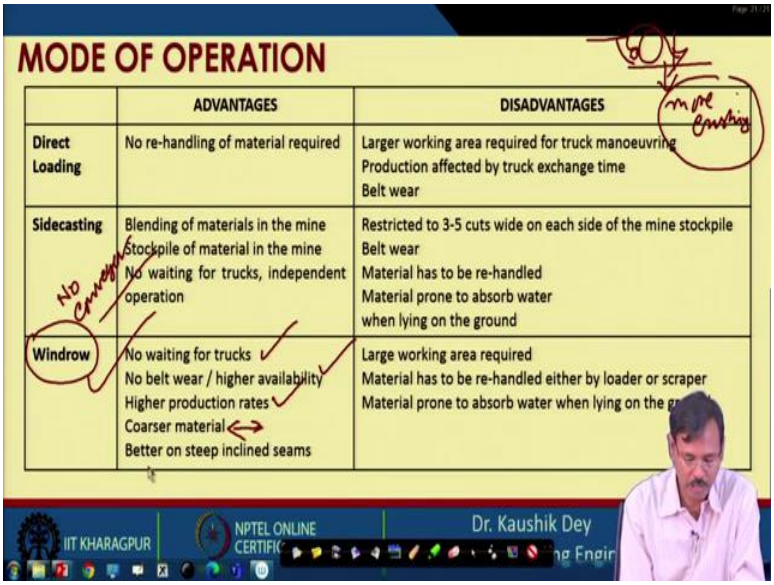

But these drawbacks can be little bit ignored in our windrowing system where there is no conveyor. So, here there is no conveyor. So, as there is no conveyor in this case, there is no waiting time for truck; no belt wear so the availability is more; production rates are high. And one factor is very-very important: that is the coarser material. What is happening in this case where we are placing the scrapper plate behind we are allowing the more crushing, more crushing of material because the chamber is closed but as the scrapper plate is removed from that the encasing of the material is not significant in that, so the material is cut and then left behind.

So, the crushing is not that much significant, so as crushing is not significant then we do not have very fine material. So, the moment we need to have a little bit larger size in those cases we should adopt for the windrowing method because that is giving us a little bit larger size. So, often this may be a requirement, where we want a larger size material, in those cases we should opt for a wind drawing technique not for the conveyor loading technique. And this is also better for a steeply inclined deposit, so in this case this is having a better advantage because the engine power is more guided towards the cutting as the conveyor part is no more under operations.

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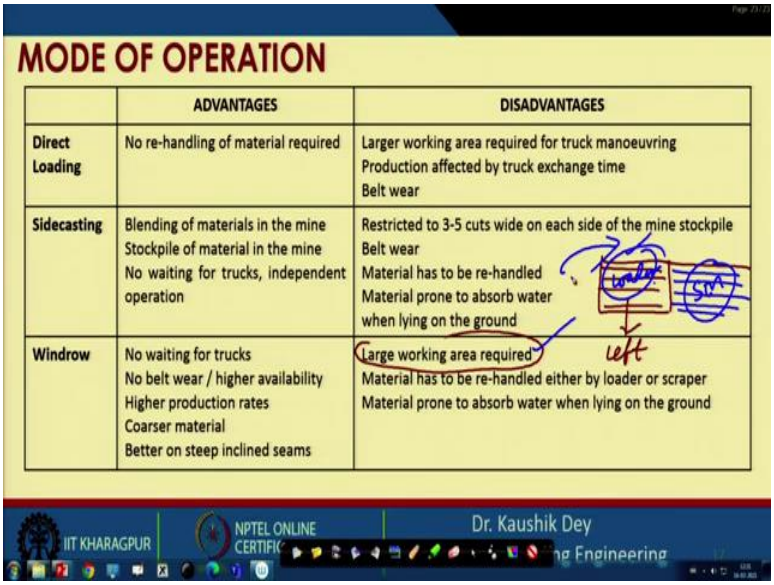

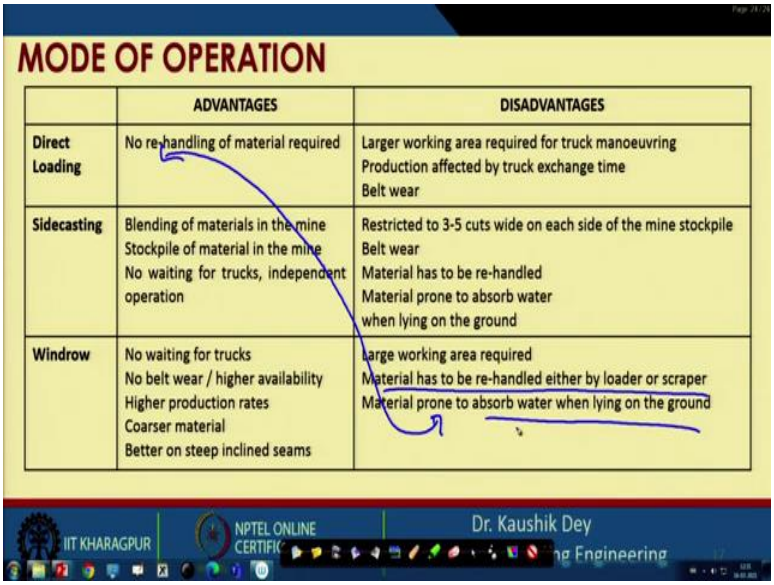

But there are some disadvantages; we need large working area because suppose if our pit is like this so we allow our machine to cut at this place. So, this portion is cut and then the windrowed material is left at this position. Then we guided our machine to cut in this area and by this time we can allow our loader to work at this place when the surface miner is working at this position so that means we need a large working area for the smooth operation of loader and smooth operation of the surface miner and because loader when the loader is working in that place huge population of dumpers and trucks are also required to match the production target of the both machine.

And the additional re-handling cost of the material is also there which is not at this position, so here it is disadvantage here it is advantage. And as the material is lying in the bench floor it may absorb the ground water, it may it may absorb the rain water also so that is the disadvantages in this particular windrowing mode of operation.

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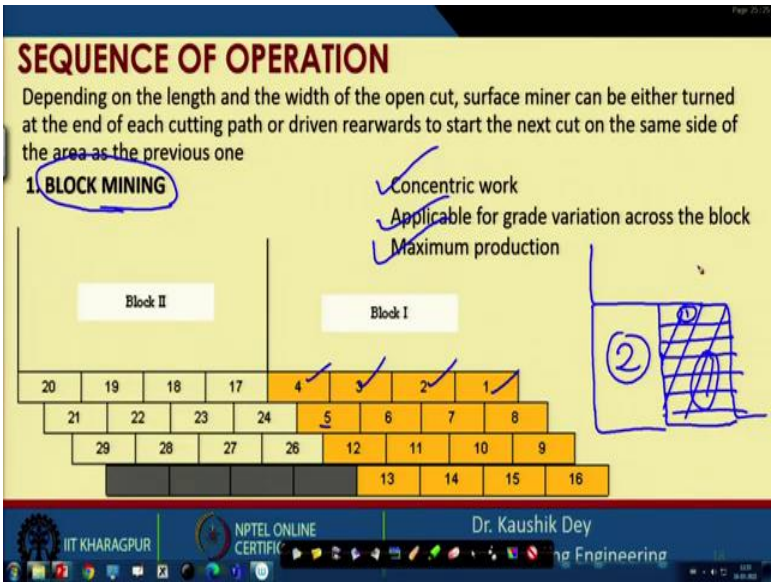

And these are the sequence of operation which can be utilized. First one is the block mining mode; in block mining mode we take the first block at this position, then we take the second block so that means if we are considering our bench is like this so we take the first block this is the block 1; then we take the block 2.

So, this is the way we move out so here the benefit is that concentric work applicable for grade variation across the block and this can maximize the production, this is one benefit because this is concentric work you can see this actually basically it is taken out this is slice 1, slice 2, slice 3, slice 4. So basically, the first slice is carried out; taken out, then we are taking 5th, 6th, 7th so slice and slice wise we are basically taking out in this case. So, this is the most common application, this is allowing the maintenance of the gradient above the slope, so this is very good for maintaining the drainage system in this case.

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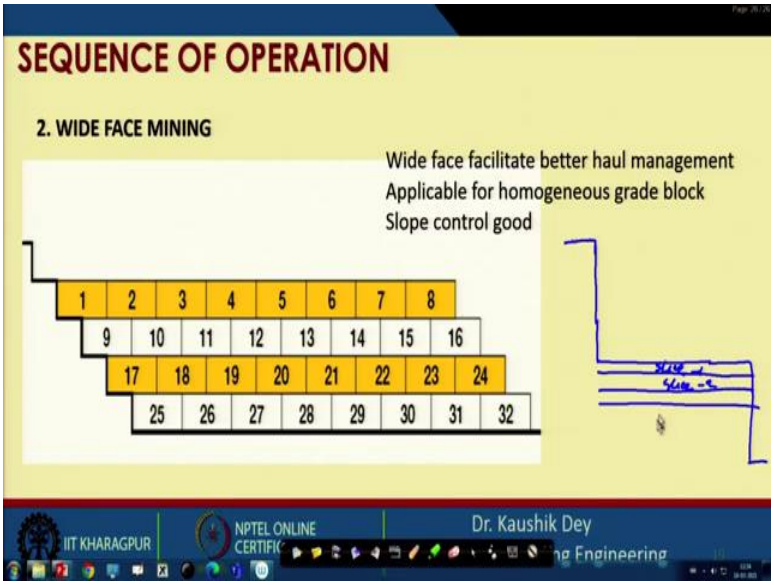

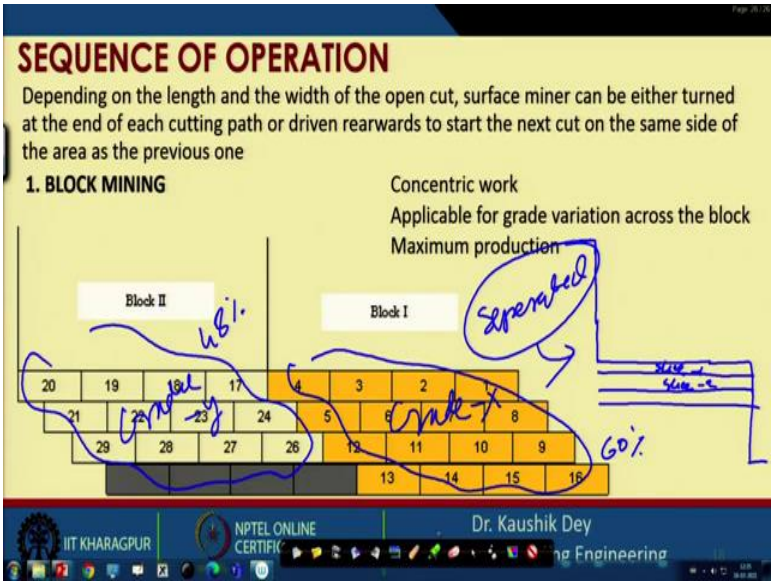

This White Face method; white face method is applicable where the material is more or less homogeneous, in that case the white face method is applicable. So, this complete slice is taken together in this case. So, this slice 1, slice 2 is taken this is carried out because we do not need any blending work in this case.

Earlier we had a grade variation at this position, at this position we had this grade 1, this is grade 2. So, these two materials need to be blended and that is why we are taking out differently or need to be sold not the blended, it is need to be separated. The better word is need to be separated and that can be handled differently. Say if it is a 60 percent Fe and this is a 48 percent Fe; so

prices are different; so we are taking it out we are taking it out and separately and we are selling them separately.

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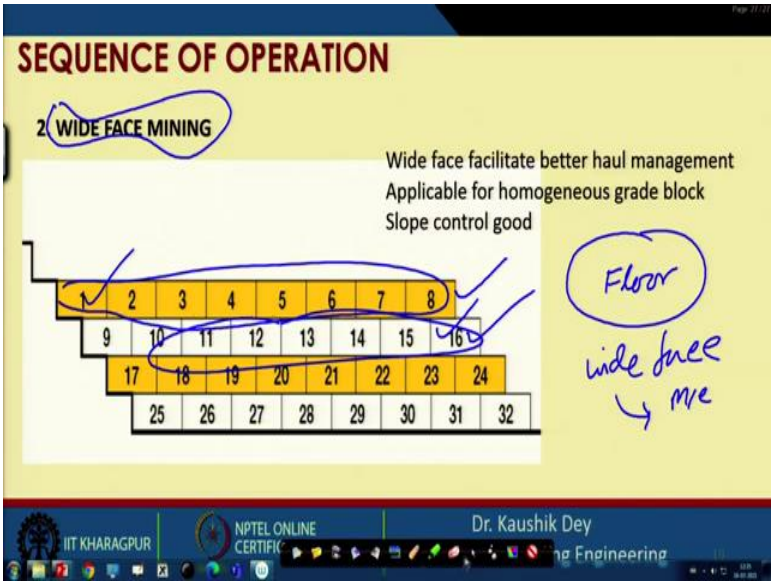

But in this case the material is homogeneous so whether we are taking this one or this one; is no matter, so we are gradually taking this so that we can maintain a better floor, better floor wide face which will allow the better movement of the machines. So, there is no problem with the grade, there is no question of blending whether we are taking this one or this one no problem.

So, that is why we are trying to maintain the wide face so that the machines application can be better, more safety can be achieved and the performance of the machines can be improved. So, that is the objective of this one and that is why it is called wide face method.

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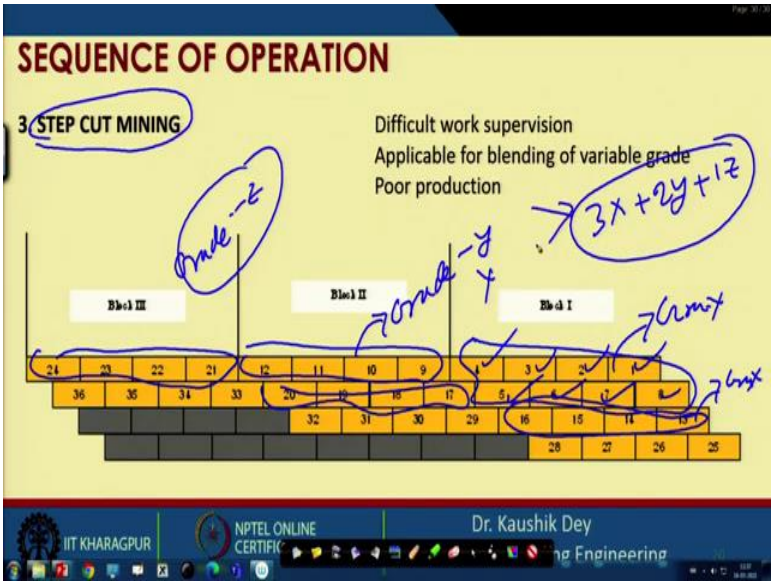

And this is called step-cut method. In step cut method see 1, 2, 3, 4 is taken, then we are taking 5, 6, 7, 8 so this is the grade x we have taken. So, this is grade x we have taken, then we are taking this one. So, this is grade y and then we are again taking this once again grade x then we are taking this one, so this is grade y again and this is then grade z. In a nutshell we are basically taking 3x+2y+1z, so the blending occurred like this way to we are getting a proper product.

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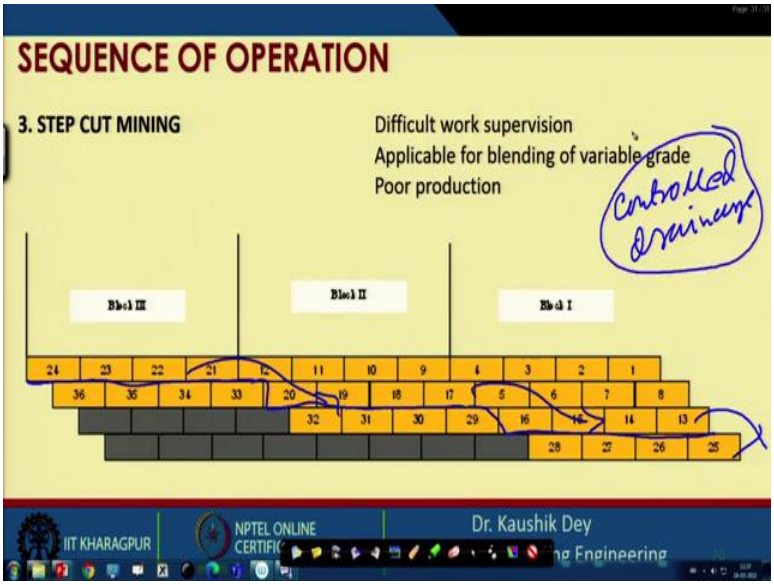

And not only that this is also allowed in other way at a particular point you can see our face position is like this. So, this is allowing the better drainage of the water and the operation can be

kept a little bit with controlled moisture system. So, the better control drainage is achieved using this step cut method.

So, that is the advantages of this one, but there are n number of disadvantages with this also, this is difficult supervision blending with variable grade in the application but often its controlling is very difficult so expert supervisory staffs are required in this case. So, these are the more or less operations required, these are the more or less operations available with the surface miner. Thank you.