Surface Mining Technology
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Lecture 40
Highwall Mining - 2

Let me welcome you to the 40th lecture of NPTEL Online Certification Course, Surface Mining Technology. This is the second lecture on Highwall Mining, we are discussing with highwall mining since last class and there will be three lecture on this. And in this lecture, we will discuss the Highwall Mining methods.

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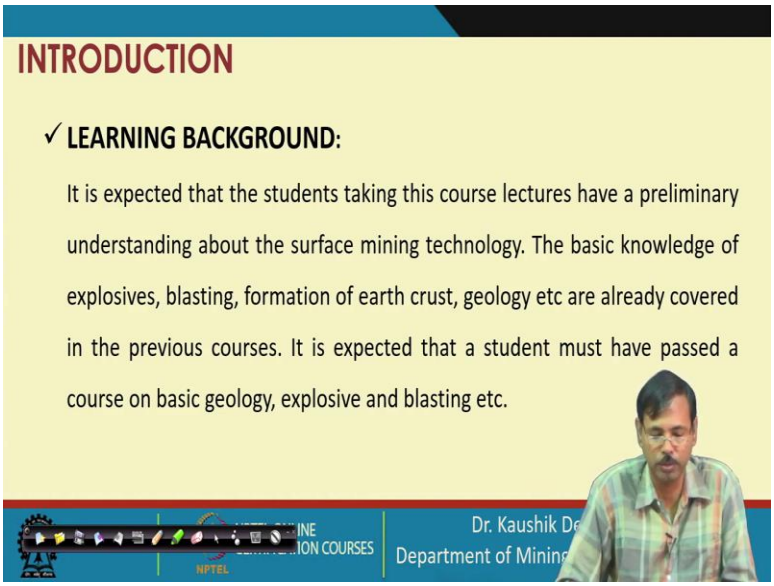


INTRODUCTION

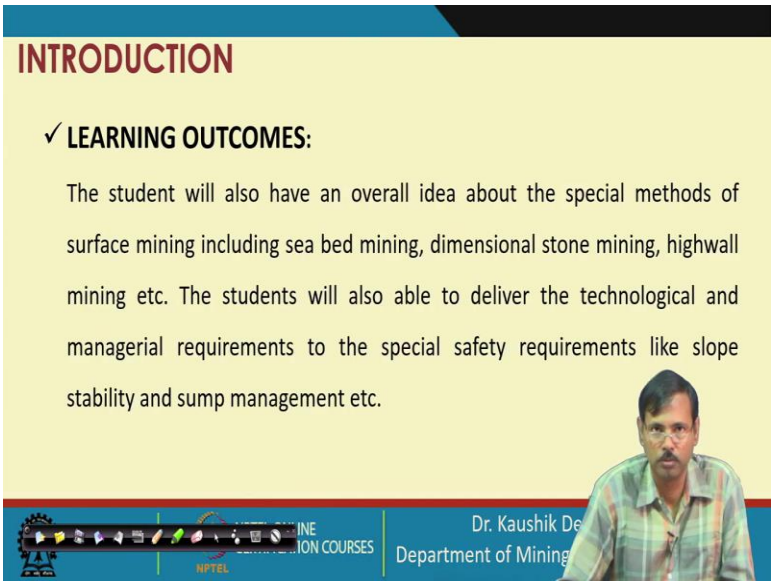
✓ **Learning Objectives of This Course:**

- To know the different unit operations associated with surface mining.
- Methods of surface mining.
- Deployment of machineries in surface mining.
- Productivity analysis of surface mining.
- Safety and environmental control of surface mining operations.
- Special methods of surface mining.

INTRODUCTION

✓ **LEARNING OUTCOMES:**

It is expected that the students taking this course lectures will be able to envisage the surface mining operation and its technological nitty-gritty. It is expected that a student will be abled to design the drilling and blasting rounds for surface blasting, will be able to choose, deploy and design the mine machineries for a set production target. The desired and environmental requirements will also be addressed.



But, before that just the way we do in every class let us have a look into the learning background required for Surface Mining Technology Course, set learning objectives for Surface Mining technology course. Expected learning outcomes of Surface Mining Technology Course.

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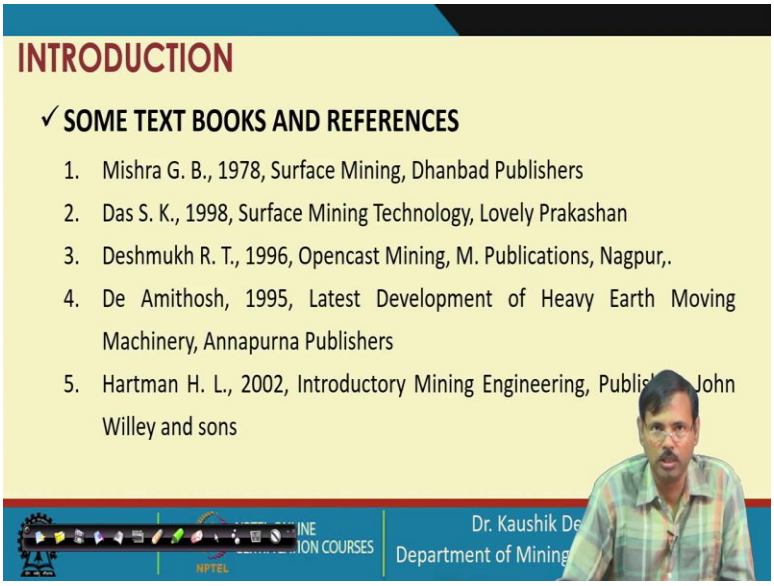

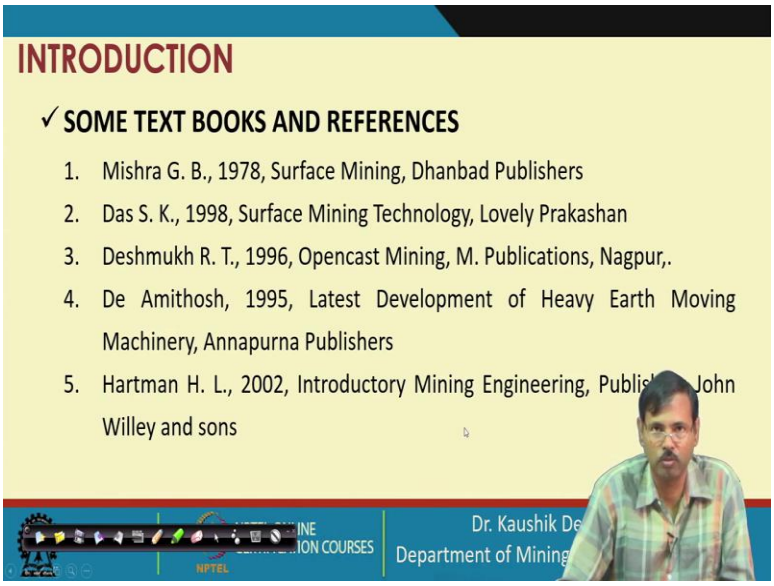

And these are some text books and references, the participants of Surface Mining Technology Course can follow.

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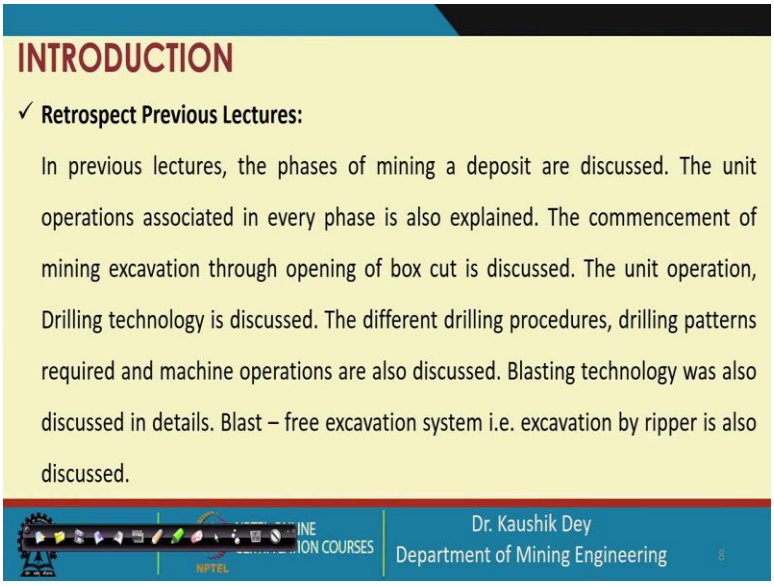

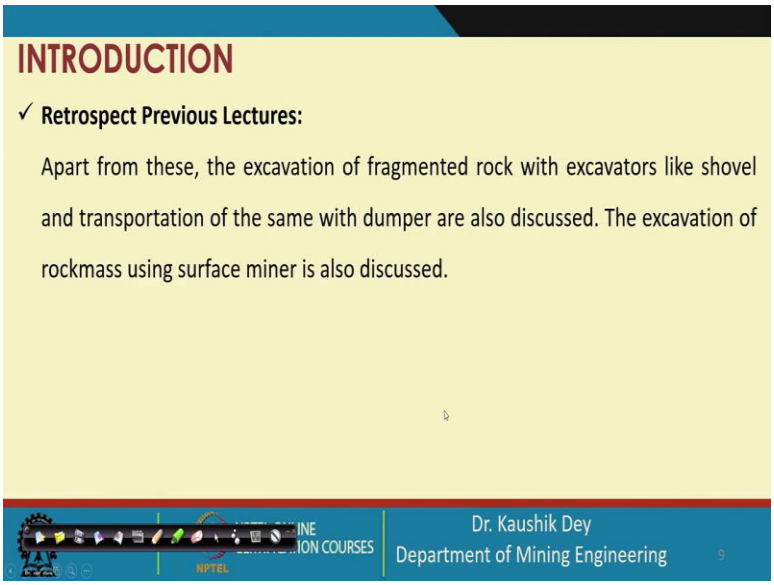

And before this lecture, we have already covered the phases of mining a deposit we have covered the commencement of surface mining using through opening the box cut. We have covered the unit operations like drilling technology, blasting technology, and we have also covered the blast free technology and like excavation by ripper. We have covered the material handling by shovel that is the fragmented mass and the transportation system possible with the surface mines along with shovel dumper combination.

We have also covered the excavation by surface miner that is the blast free technology and excavation and direct casting of the material is in the dragline. We are now continuing with the highwall mining in last class, we introduced ourselves in the highwall mining, which is a new technology. And we have already covered one lecture, we have seen, it is a basically excavation from the highwall without entering into the drive.

So, it is a construction of the drive inside the highwall without entering into the drive and the drive is self supported with the two web pillars keeping in both the side, the highwall miner self-propelled itself in the drive cut the material, it is being pushed by the pusher beam from the backside with the highwall miner which stand outside the hole or outside the excavated area of the highwall and after the completion of the desired length the highwall miner is gradually withdrawn. So, it is similar in this case.

So either we will go for the excavation using a continuous miner type cutting head or we can go for auger type of drilling. So, that we have seen in the last class that auger and continuous miner type, head and the cutter head is provided. And that can be used very easily.

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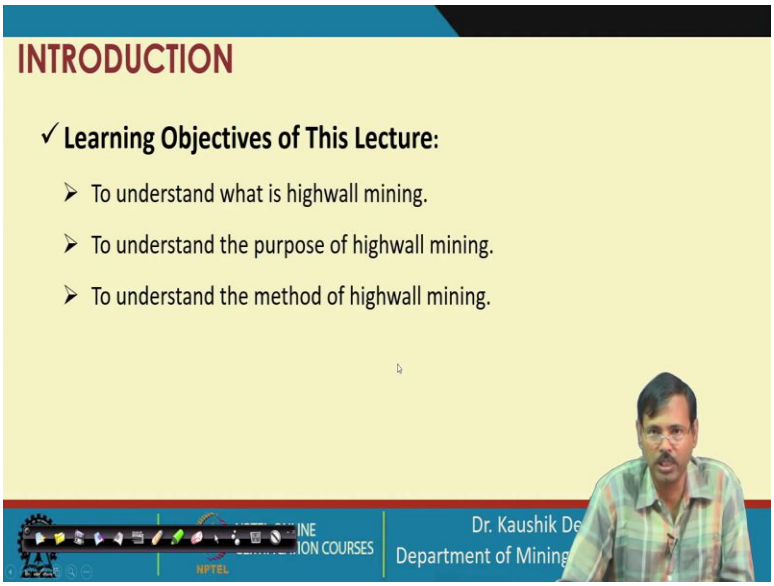

The learning objectives set for this highwall mining lectures are to understand what is highwall mining? To understand the purpose of highwall mining, and to understand the method of highwall mining. In this class, we will discuss the method of highwall mining.

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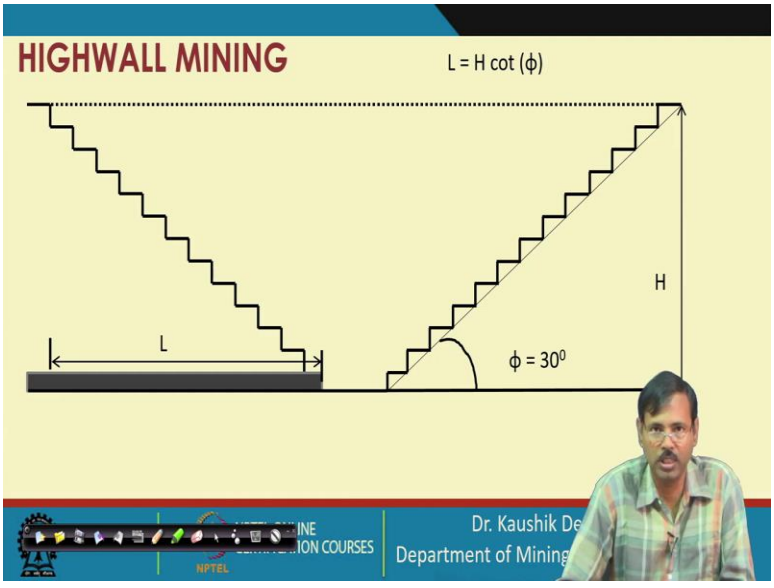

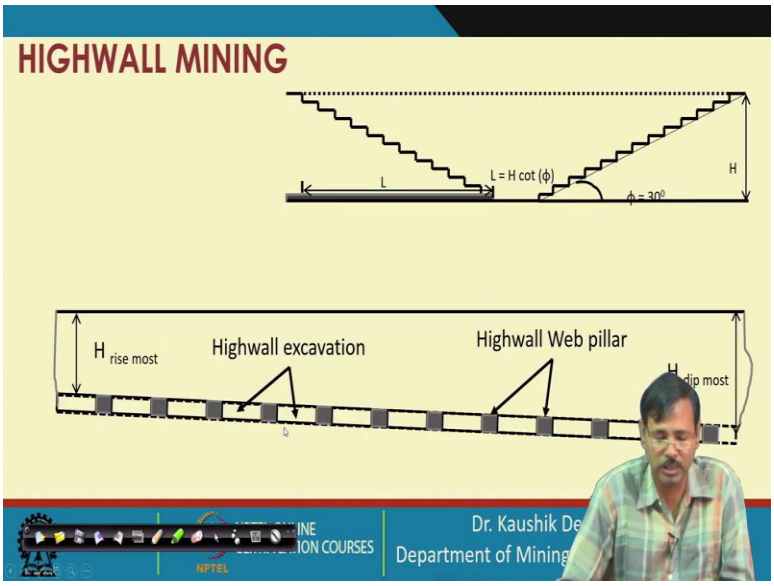

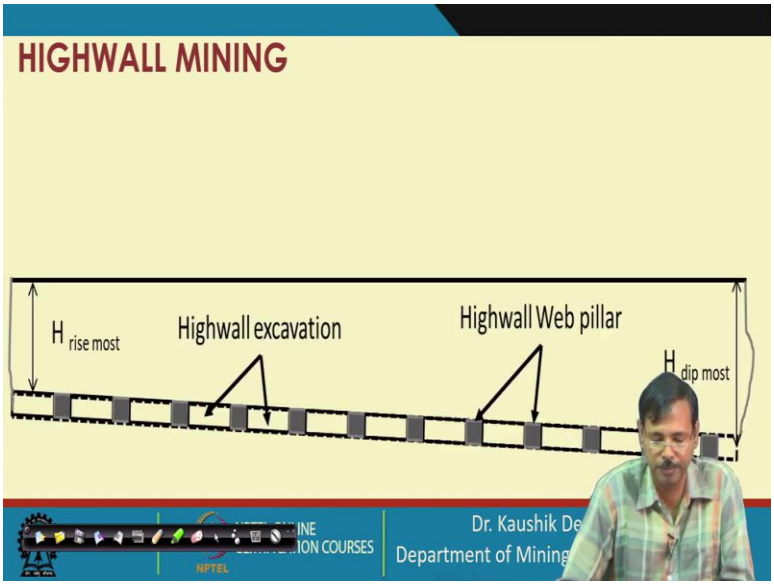

But before that, we let us understand that we are basically digging the highwall that is not in the right side not in the deep side. It is in the side of the mine on which the highwalls are kept and we are taking a part of that highwall, that coal blocked by this highwall so that there should not be any problem in the stability of the highwall and the way it is carried out so that the maximum excavation can be made out of that.

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Now, let us look into the other type of highwall, where the auger is basically used for excavation this one. So, this is the auger drill you can see the auger drill is basically cutting the highwall. So, as it is rotating it is excavating the material. And on that the material is reverse, flow in the reverse direction as the material is moving forward, and it is discharging the material onto the conveyor.

So, basically the moment the auger is opened in the time the material is discharged below the auger and the material is taken by the conveyor. So, this is the other auger head which are attached back to the first auger and by this way back to back augers are fitted so that the auger

can be pushed forward. So, this is this another auger is being placed in front of this so that it is similar to the attaching the drill rod. So, this is the first auger now rotating here.

So, this is the backside of the highwall miner. And this is the coal being dumped you can see how the auger is creating the hole. This is the auger rotating, this is the discharge, now see this first auger is moved out, the second auger is now placed behind this. So, first auger is pushed the second auger is now being placed and attached with the first auger see a crane is utilized for the seam now it is rotating.

So, one side of the auger will fit with the first auger and that is coupled there and another side of the auger will fix with the rotary head of the machine. So, now it is positioned properly and now it will be coupled. So, this will be coupled. So, you can see another video of this one.

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The second auger is now placed and fixed. Now augur has started cutting again and see now this is along the discharge of material into the chain conveyor. See how the coal is returning back along with the auger. So, conveyor is chain conveyor placed behind the auger.

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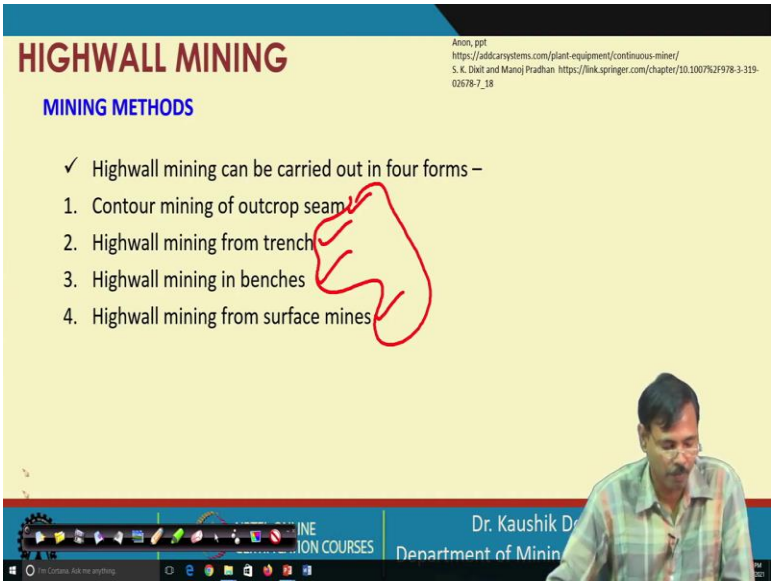

So, now let us look into the mining method of the highwall mining highwall mining can be carried out in four basic way: that is the contour mining of the outcrop seam, then highwall mining from trench, highwall mining in benches, and highwall mining from surface mine. In this first case where there is no actual surface mining is carried out but as the outcrop of the seam is available, highwall mining can be started directly from that.

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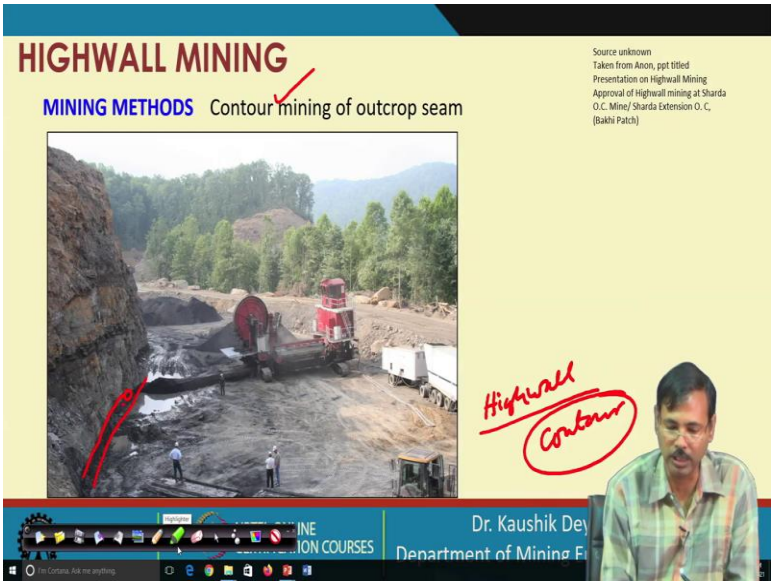

So, if you look into this here it is understood that this is the outcrop there is no actual mining carried out. So, this is a hilly terrain, this portion is the outcrop coal seam. And the material is placed at this position to dig a hole and cut the material from this place and this is the called contour mining where the outcrop seam is only allowed to excavate.

So, that is why, this is direct mining without a surface mining only the highwall mining is carried out that is the highwall mining that is also called contour mining is standing at itself alone in this case. So, this is one method where the highwall mining is carried out.

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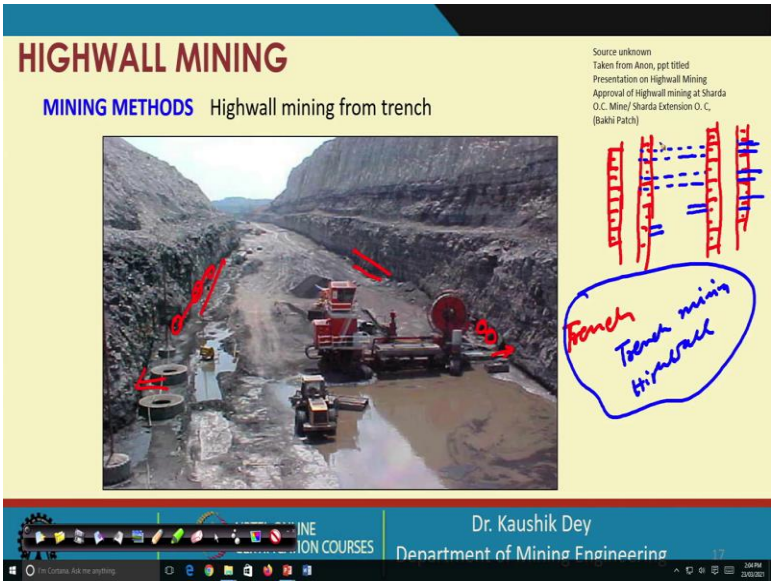

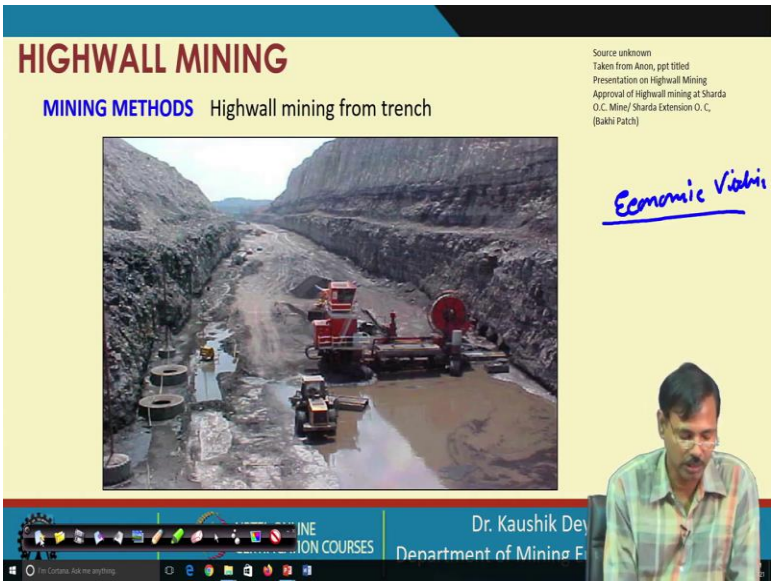

In the second method instead of carrying out it one side one trench is made. Say, both side seams are there only one trench is made in the mid of this and highwall miner is allowed to take hole in both the sides. So, this is in one direction these are the different holes created similarly these are the different holes can be created this side also. So, one trench is made and from the trench both side mining is carried out up to a significant depth a significant length without excavating this one. So, this is called a trench mining.

Where the mine is accessed through the trench and from the trench highwall mining is carried out so it is basically if you are looking into the plan view. So, these are the trench made, these are the trench made and from this highwall mining is carried out, highwall mining is carried out up to a significant depth. And similarly, another trench can be made at this position or and another trench and at this position from where the mining is carried out in this direction also.

We can have both side excavation also; that is also possible. So, this is basically a highwall mining from trench or this is also trench mining. In which highwall is used. But it is understood that the percentage of excavation is significantly less in this case but this is conserving the top features using this method.

So, this is another method of excavation within highwall miner but both the cases where the actual surface mining is not carried out, both are direct in situ excavation without any other additional excavation. So, for these two method economic viability is very important otherwise

this method of mining cannot sustain. So, this economic viability has to be tested very importantly for both cases.

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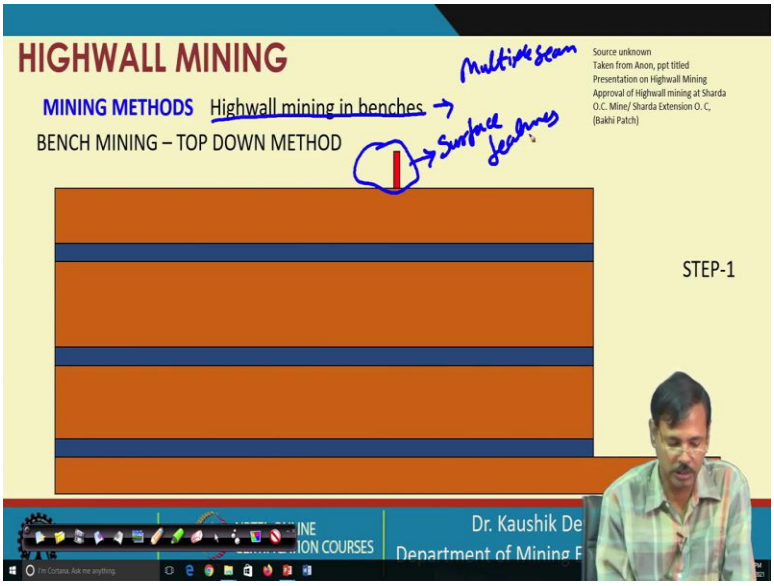

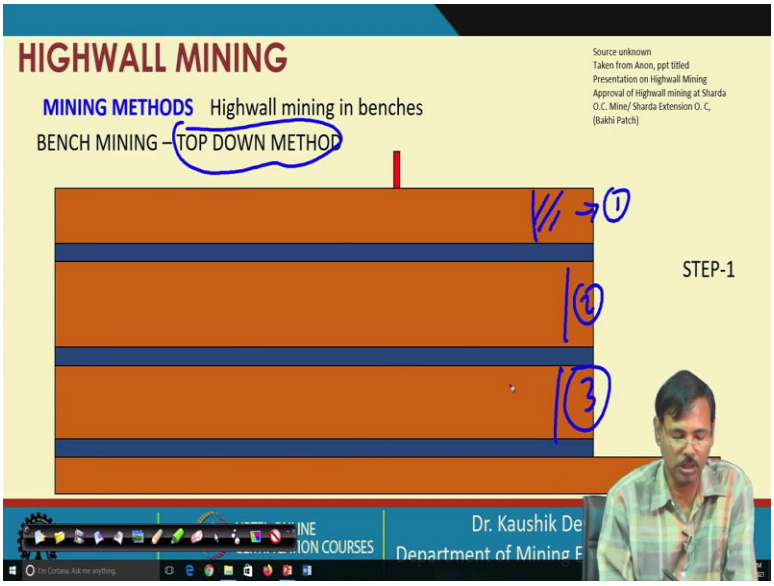

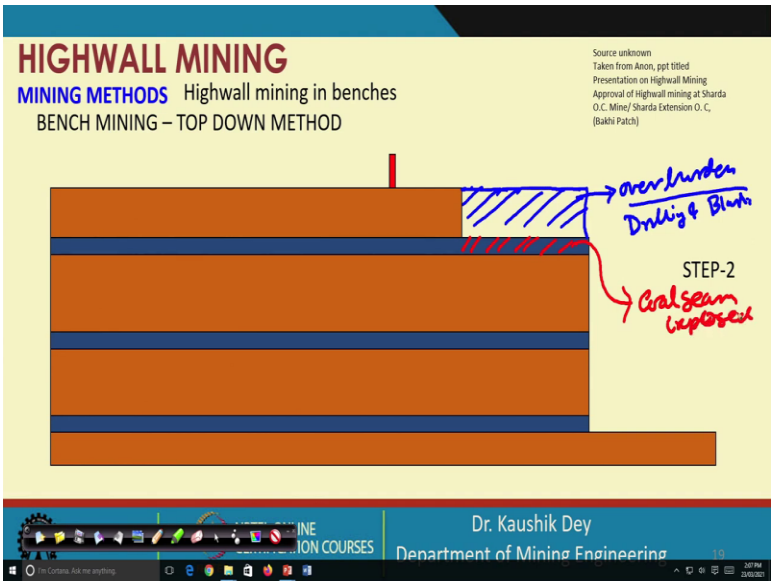

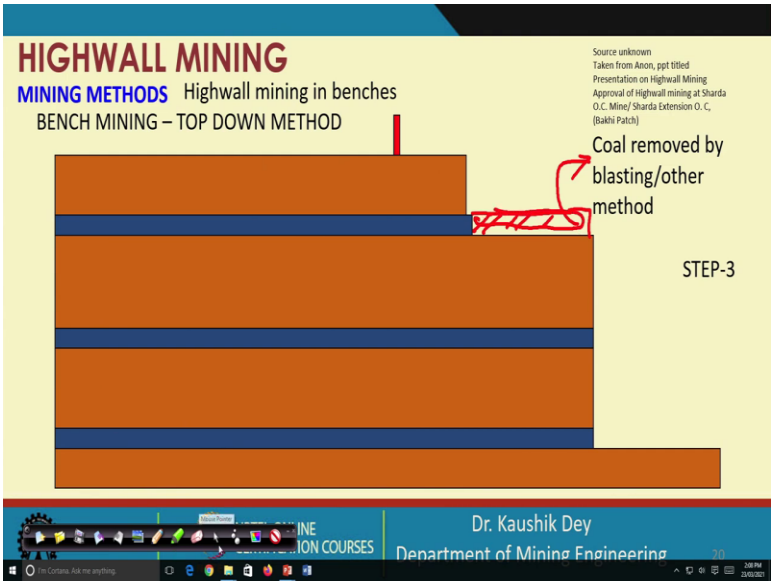

Now, this is highwall mining in benches, this method is carried out for a multiple seam and the requirement is that these are the surface features to be protected. So, the surface features has to be protected, for that mining has to be carried out and the procedure is little bit different in this case, every seam has to be excavated one by one and the method of excavation is top down method that means, this portion has to be excavated first then this one then this one.

So, this will be the process of excavation in this case. So, that is why it is called a top down method. So, now, let us look into this method one by one how the steps will be carried out. So, in step two our job we will carry out earlier it was like this. So, this portion, the overburdened rock

will take out using the drilling and blasting method. Now, after drilling and blasting this overburden rock will be taken out and dumped somewhere else.

And now, this is showing that the coal seam is now exposed. So, now this coal seam is exposed. So, this is the first job or first step is carried out here. The next step is the excavation of the exposed coal seam. So, this exposed coal seam at this place is removed by the blasting or any other method we can adopt surface miner also whatever method of excavation is possible this portion all the coals are excavated using that one.

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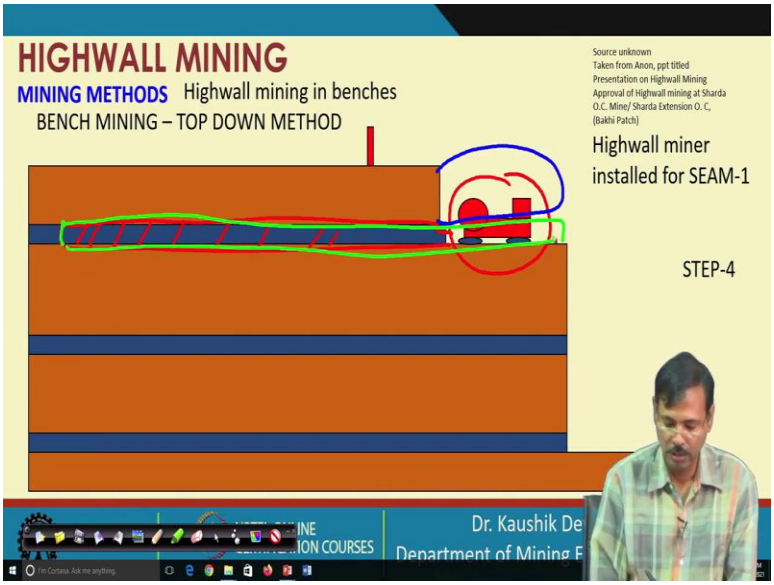

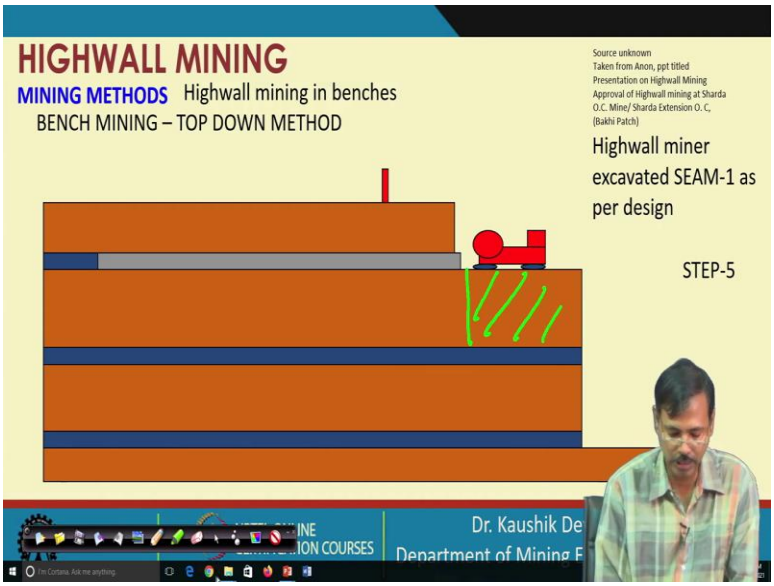

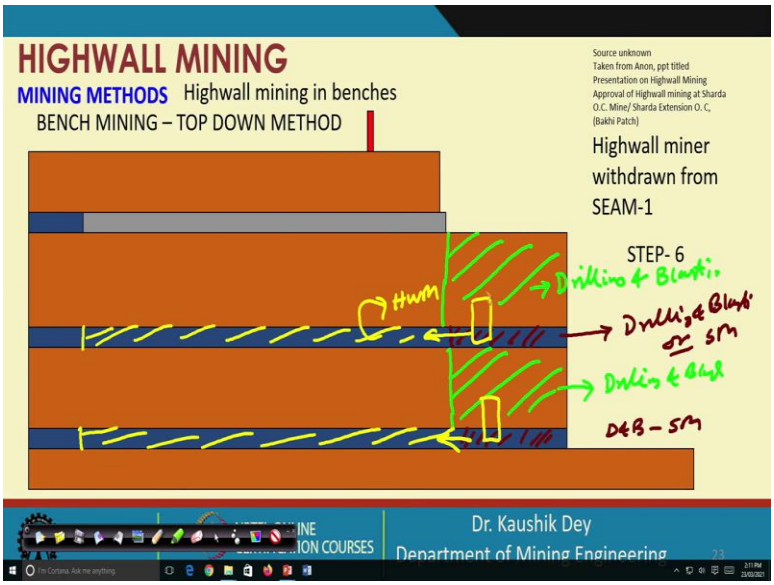

The next step is that we have to deploy highwall miner at this position. So, in the next step we will deploy the highwall miner at this position. And we have now highwall miner installed, now this highwall miner will excavate this one and the excavation up to this is carried out by the highwall miner. So, what is our achievement? Our overburden excavation is this much and coal excavation is now this much.

So, this is the achievement for the first bench. So, this is coal is excavated in the top bench. Now our next step is to take out the next one. So, we will take this much of material using drilling and blasting now in our next step. So, let us look into that. So, we will take out this one using the drilling and blasting. And in the following step we will take out this one using drilling and blasting or any other means surface miner etcetera.

And after that we will again excavate up to this using highwall miner. So, installed one highwall miner at this place. And this highwall miner will excavate this portion of rock. Now next to this again we will move to this similar option we will carry out excavation of this one overburden using drilling and blasting. Then we will excavate this one using drilling and blast or continuous surface miner.

Then again, we will deploy and install one highwall miner here and we will excavate up to this. So, the step by step means whatever is carried out at this position the similar steps will be followed for the next phases.

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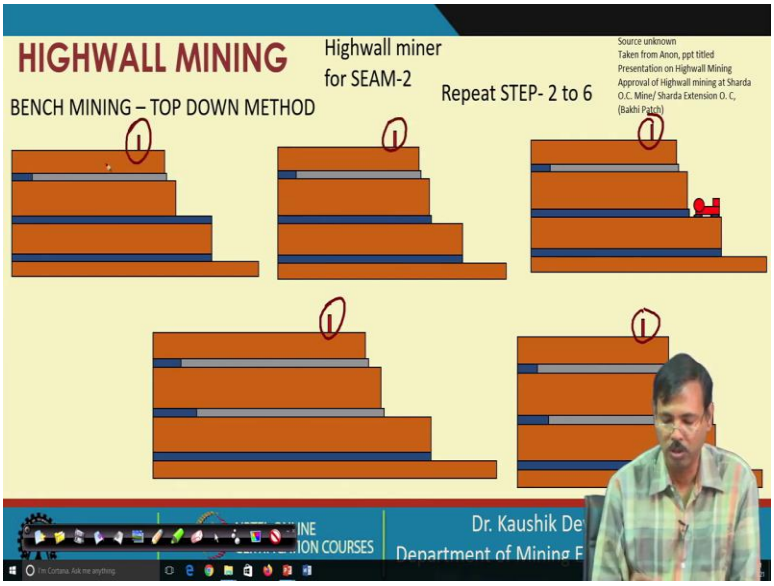

And by this way our excavation sequences maybe like this. So, this is step one. So, this is step one, this is step two, this is step three, this is step four, this is step five, this is step six, step seven, step eight, step nine. So, you can see the same way we are doing, highwall miner excavating this one. Then we are removing this overburden this coal, then again, we are installing highwall miner taking out this one.

After that we are moving it out, taking this part and then again using the highwall miner to excavate this part. So, this is the sequence made for excavation of this one and highwall miner is placed first here to excavate this one. Then here to excavate this thing and finally at this position to excavate this three and it is clear despite this three seam, that is, the multiple seams are excavated.

But this is the structure which is steady enough and there is no stability issue on this structure. So, this is the benefit of this highwall mining and that is why this is adopted wholeheartedly in this case.

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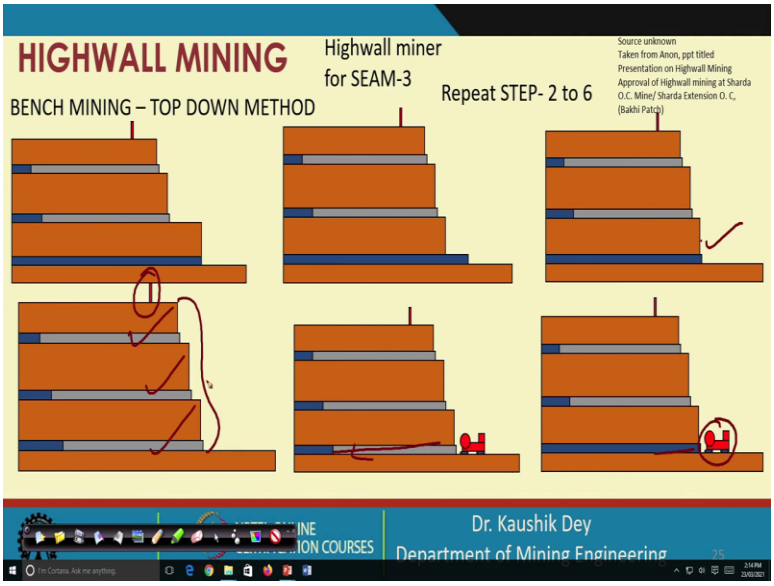

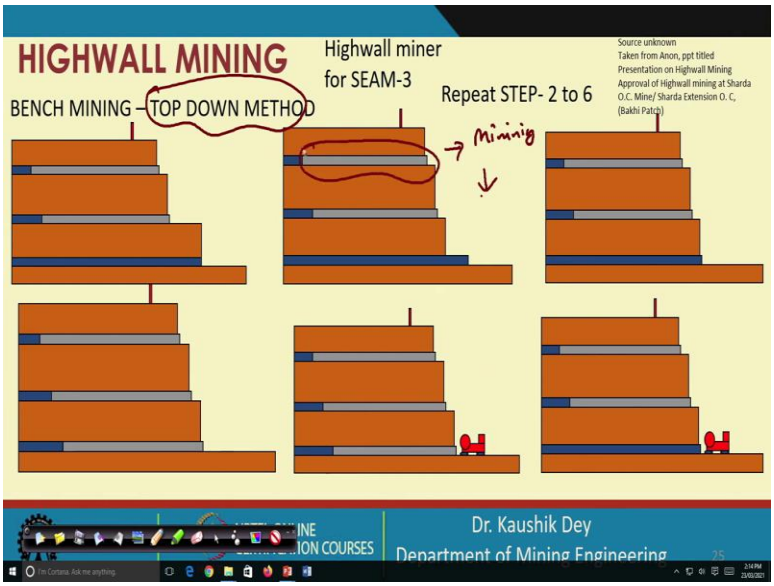

Now, the same thing is carried out for seam 3. So, after excavation of this one this portion is excavated. Then the highwall mine, coal is excavated then the highwall miner is placed at this position then the highwall miner is excavating this one then everything is withdrawn the structure is stiff. But this seam one, seam two, seam three, these all the three seams excavated using this method.

Now, this is the top down method where a little bit mining at every level is carried out. But the majority portion is excavated using the highwall miner. And that is why the stability on the structure is not basically considered.

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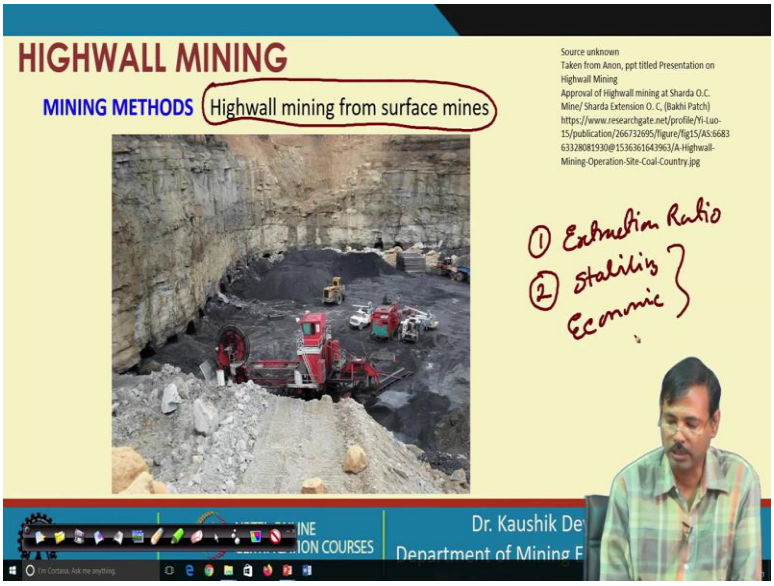

Next the last and final one which is a common method adopted in the surface mines, where the main purpose of mining is the surface mining, in general, which is carried out. However, highwall miner is basically deployed for increasing the extraction ratio or in other word you can say, take the additional coals.

So that is why the major issues related to this is the stability. And economic viability has to be considered, often this is used for keeping the increased production rate. So, highwall miners maybe sometimes adopted in this case. So, these are the different methods of highwall mining. And we will design the highwall miner in the next class. Thank you.