Surface Mining Technology
Professor. Kaushik Dey
Department of Mining Engineering
Indian Institute of Technology, Kharagpur
Lecture No. 03
Stripping Ratios and Pit Layouts - I

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Let me welcome you to the third lecture of Surface Mining Technology. In this lecture, we will concentrate on the stripping ratios and pit layouts. There are three lectures corresponding to this stripping ratios and pit layouts. So, this is the first lecture in this, and this is also a part of the introduction to Surface Mining.

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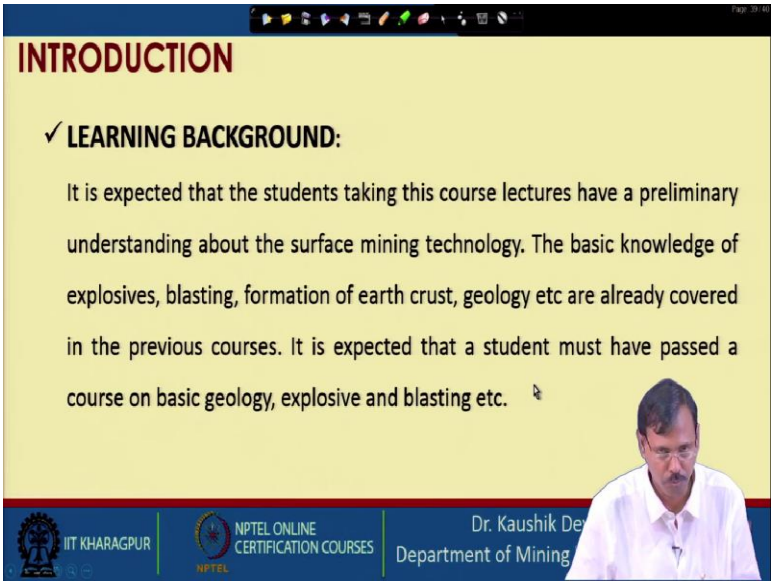

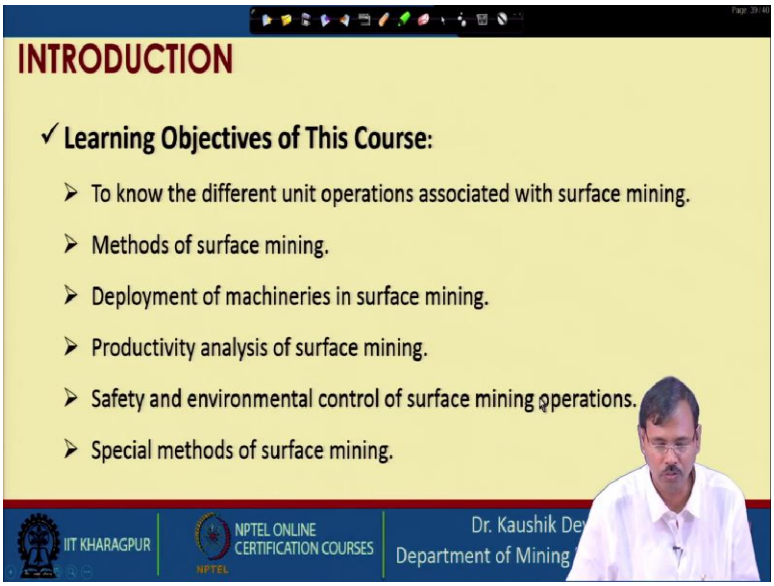

INTRODUCTION

✓ **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 [illegible] and environmental requirements will also be addressed.

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INTRODUCTION

✓ **LEARNING OUTCOMES:**

The student will also have an overall idea about the special methods of surface mining including sea bed mining, dimensional stone mining, highwall mining etc. The students will also able to deliver the technological and managerial requirements to the special safety requirements like slope stability and sump management etc.

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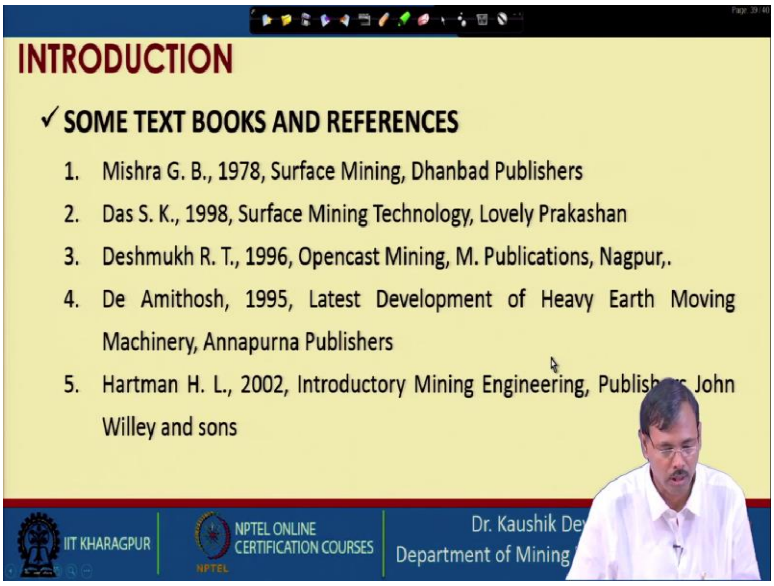

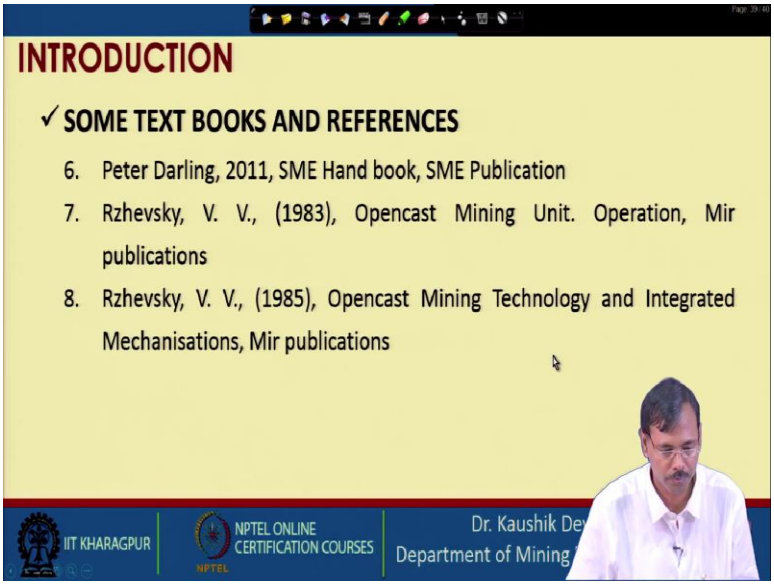

This part is already discussed with you, but every lecture should contain this, the learning background of the Surface Mining Technology. The objective of learning the Surface Mining Technology course and the outcome of the Surface Mining course, after learning this, what will be the outcomes. These are the textbooks, reference books.

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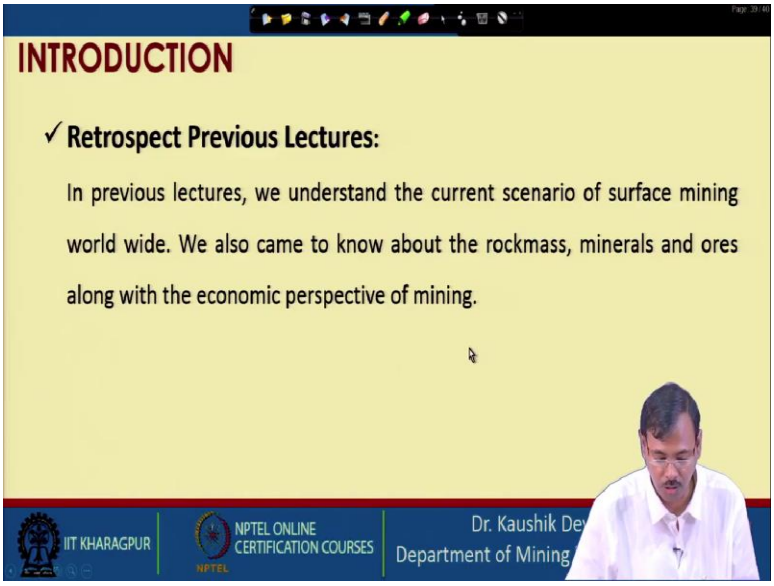

Let us retrospect what we have learned so far in lecture number one and lecture number two. In the previous lectures, you understand the current scenario of Surface Mining worldwide. We also came to know about the rock mass, minerals, ores, along with the economic perspective of the mining. We understood that mining is a very important activity. This is the basic industry; without this, civilization cannot sustain itself. And its, economics importance is very, very high for the growth and development of a country.

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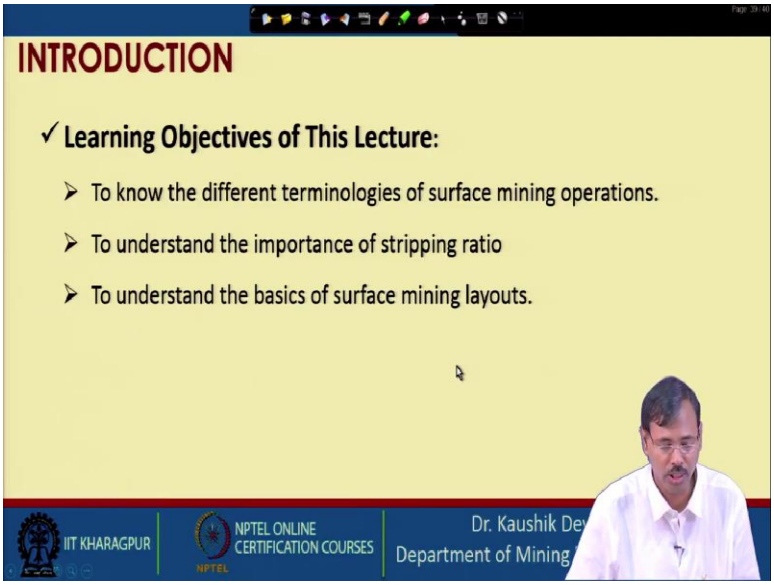

Now, learning objective of this lecture: this is not only for this lecture; all these three lectures of stripping ratios: To know the different terminologies of Surface Mining operations; to understand the importance of stripping ratio, and understand the basics of Surface Mining layouts. The layout means the plants and figures that we will understand this gradually.

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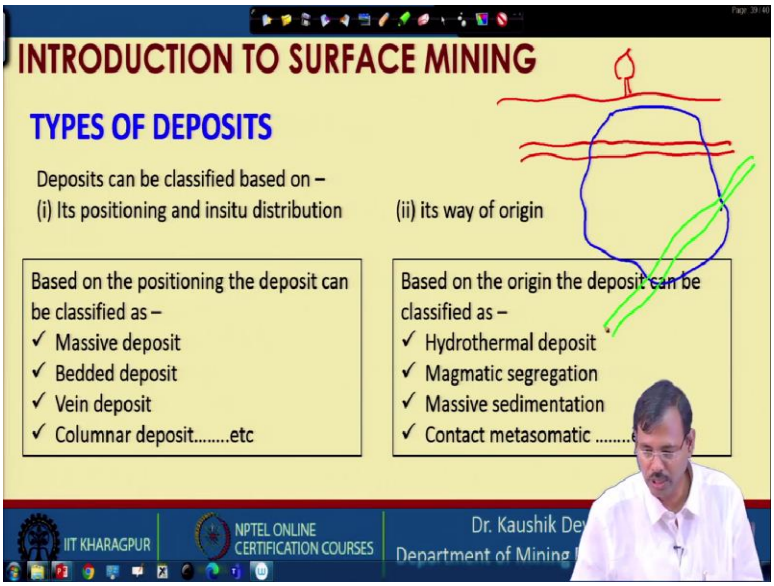

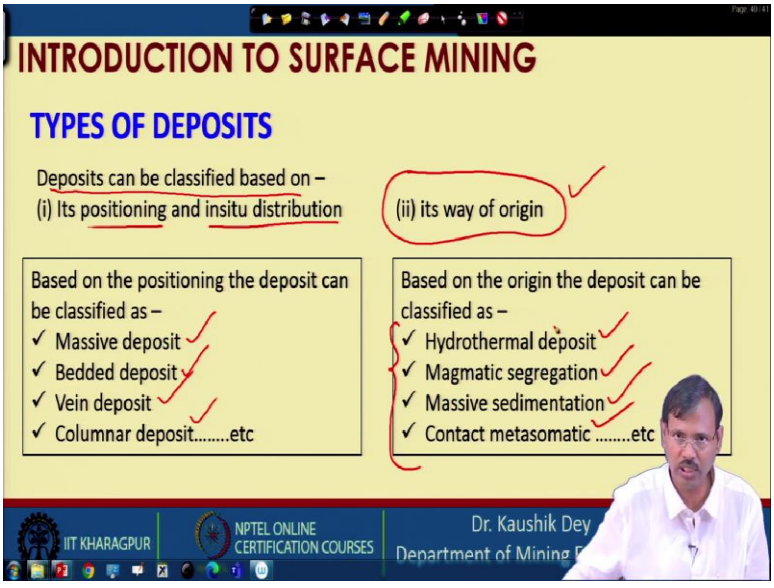

So, before starting the stripping ratio, let us try to have some idea about the deposit because in last class we have already described about the mineral reserve and resources. So, mineral reserve and resource, we understand. Now, let us try to understand what is called a deposit.

Deposit means basically the way the minerals are occurring in the Earth's crust. So, that means, the way the mineral is lying, the way, suppose this is the Earth's crust and below which a mineral may lie like this, a mineral may lie like this or a mineral may lie like this. So, the way a mineral is lying inside the Earth's crust is basically considered as the deposit.

So, the deposit can be classified based on its positioning and in-situ distribution or it may be classified by its way of origin. So this, there is no particular formula or rule the how the deposit will be lying inside the Earth's crust. But depending on that, there may be different types of deposits. But some of the common deposits can be named: Massive deposit, Bedded deposit, Vein deposit, columnar deposits, etcetera.

On the basis of its origin, the deposit can be classified as Hydrothermal deposit, Magmatic deposits, Massive sedimentation deposit, contact metasomatic deposit. So, these are the different ways of formations, and because of these formations, deposits have some different characteristics. And based on this, the deposit can be classified like this. So, we will see in the next few slide the way the Massive, Bedded, Vein deposits are basically showing.

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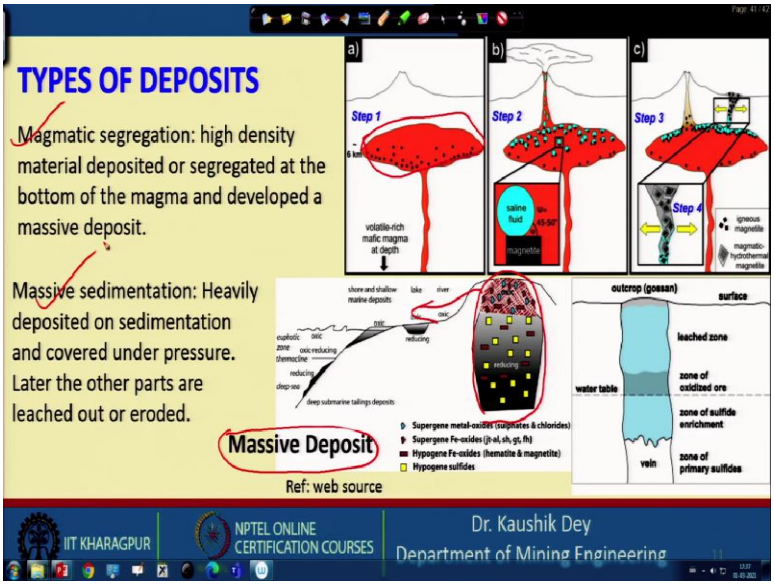

This is basically the Massive deposits. You can see how this massive deposits are formed, these massive deposits may be when the magmas are basically spreading like this, and this portion is remaining, and this is generating a Massive deposit. Or sometimes a deposit was like this and

finally, this portion is eroded, and this was, as it is a strong one is standing like this. This is also called Massive deposit.

So, there are different ways a deposit has occurred in a massive formation, and that deposit is called a massive deposit. Thus these are the different origins, the magmatic segregations, massive sedimentation, in these cases, this type of massive deposits may occur.

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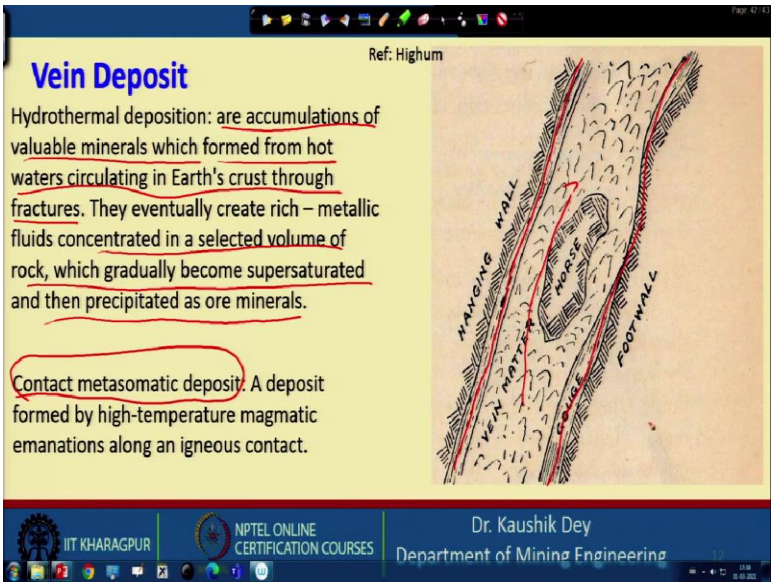

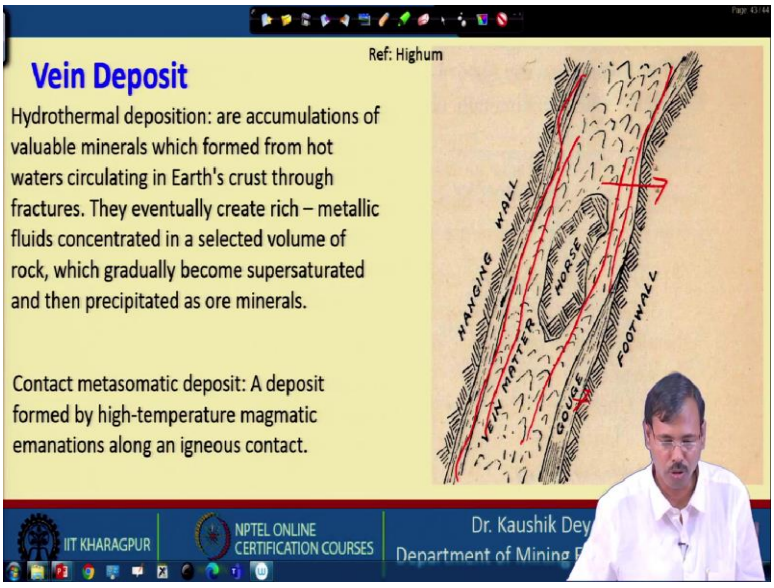

This is called a Vein deposit. Mostly you will find out the hydrothermal deposits are formed like this, where the joints are filled with the materials, and this is hydrothermal deposits are an accumulation of the valuable minerals which formed from the hot waters circulating in Earth's

crust through fractures. And there, you will find out most metal sulfide deposits are occurring like this and gradually supersaturated and then precipitated as the ore minerals.

Often you can find out the metasomatic contact deposits are also occurring in the vein form, where the magnetic segregate, magnetic when the lava's or magmas are flowing towards the cracks, that is changing the others surrounding rocks and also depositing in that cracks and called creating the veins like this. So, that is often called dikes also. So, in that cases, the deposits also occur often in a similar ore.

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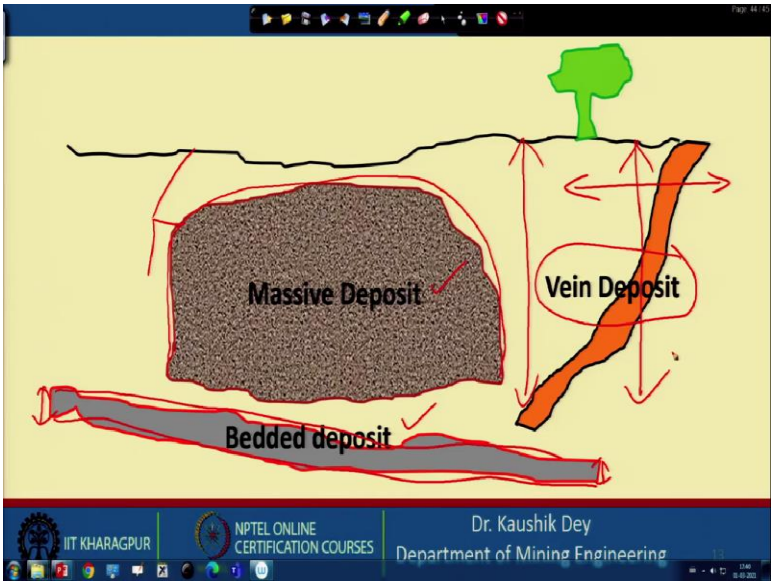

Now, in a nutshell, you can see a Bedded deposit can be termed like this, which is more or less systematically spread over an area. A massive deposit is a huge dimension in thickness in spreading. That deposit is called a massive deposit. Bedded deposit the thickness is thin, but it is spread over an area that is called Bedded deposits. And Vein deposit is not highly inclined deposits occurring in a Vein. So, that is why the width range is not that much significant, but vertically it is spreading over a significant distance.

There is the basic characteristics, and massive deposit is having all three dimensions are very, very large. Here, the vertical dimension is not significant, but the spreading over a significantly larger area. Here vertical dispersion is much, much more, but the horizontal dispersion is not that much significant. So, these is the basic characteristics of the three deposits that is a massive deposit, bedded deposit and vein deposit.

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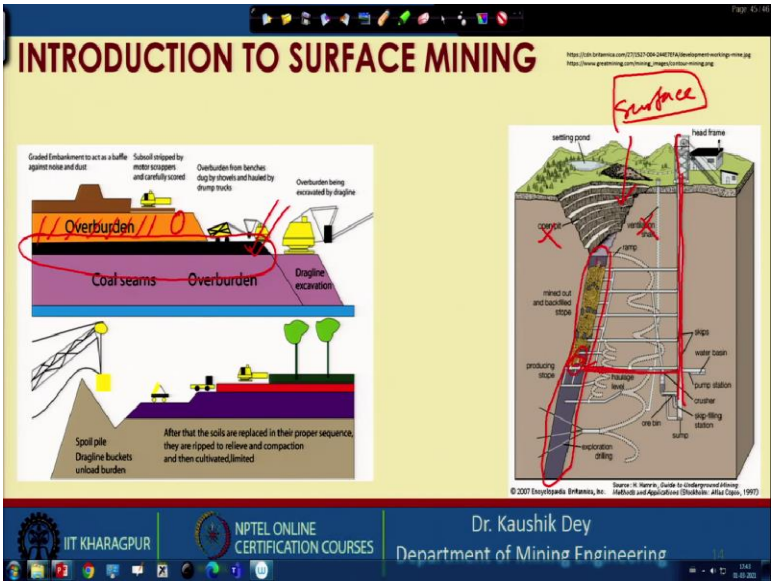

Now, let us have some idea about the Surface Mining. If the mineral deposits are occurring in the Earth's crust, so this is a Vein deposit showing here and this is a bedded deposit showing here. So if this is the case then how we are carrying out mining?

So, when we are carrying out mining just under the sky, then it is called Surface Mining. So, surface mining means just the above sky is there. So, that is subjected to rain, subjected to temperature change, subjected to change in the daylight and all these things are basically impacting on the surface mining operation.

Whereas, in underground mines, we create an opening, vertical or horizontal or maybe spiral opening. From there we enter into the underground and carry out mining there is called Underground Mining. So, underground mining does not affect what is going on in the surface; whether the changes, temperature changes, raining, these atmospheric changes do not impact the underground mining. But these are impacting on Surface Mining.

Underground mining obviously, it does not have the illuminations like surface mining daytime the illumination is good, the operation can be carried out, widespread disabilities there. In underground mines, it is dark only artificial light, lighting system has to be provided then only the machines and manpower can operate there. This is the basic difference between Surface Mining and Underground Mining.

In surface mining, you have to carry out below the sky. So, in that case, all the available waste rocks or are lying above the main desired ore or mineral whatever we are going for mining that has to be removed first. So, you have to remove first the waste rock, overburden rocks which are situating above the ore body that has to be removed first. And then the, and then the main mineral has to be removed.

But in the case of underground mines, you can say you can without excavating the waste rock, you can directly enter into the ore body person and you can excavate the ore body only. So, that is the benefit of underground mining.

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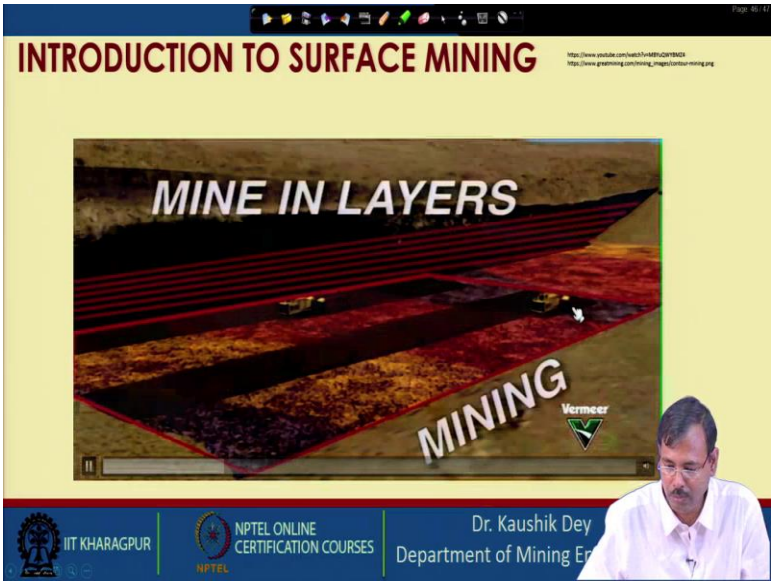

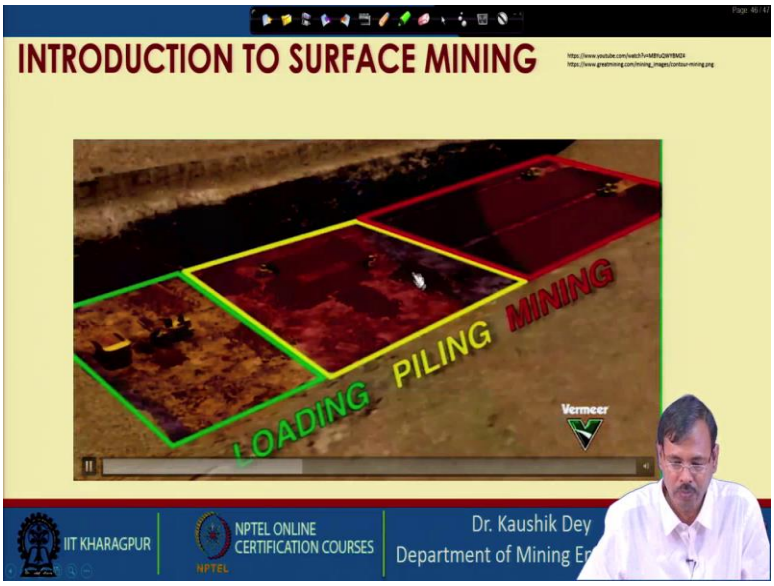

So let us have some look into surface mining and underground mining. This is a small video, an animated video. You can see this is the excavation is carried out in a surface mine. This is animated, and this is not the real one. So, this excavation is carried out. You can see the floor is being basically cut by this machine, and this machine is cutting the material. After cutting the material, the excavator is coming, and the excavator is gathering the material. Then after that, it is loading the material onto a truck.

So you can see every operation is going on just below the sky. And you can see the quality of the ore, position of the ore, position of the other machines, so the visibility is also good while working space is very large, the operations can be made very easily in the surface mines. That is

why as there is no dimensional restriction, you can go for deploying huge dimension machines, big and big machines can be deployed in the surface mines to achieve high production and productivity. So, this is for the surface mine.

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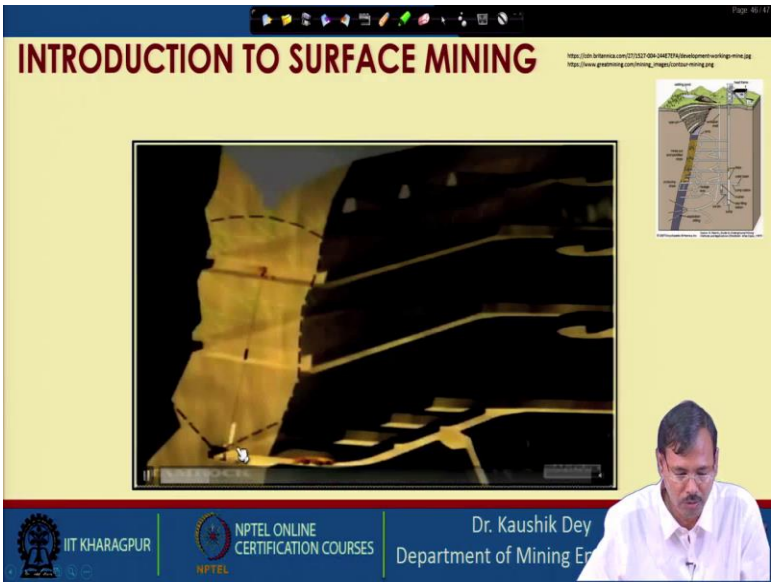

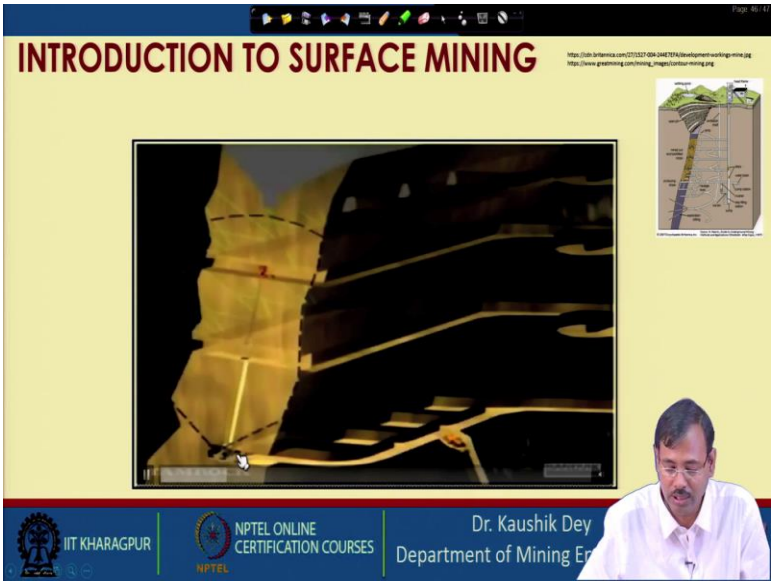

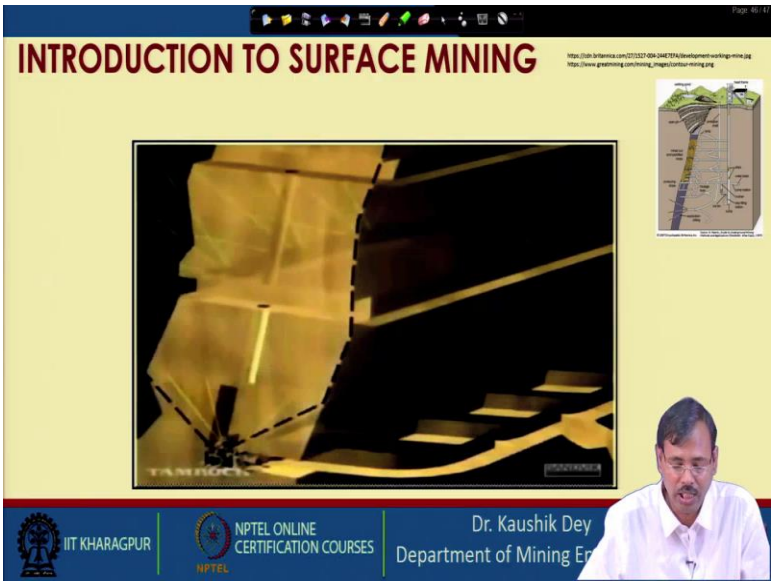
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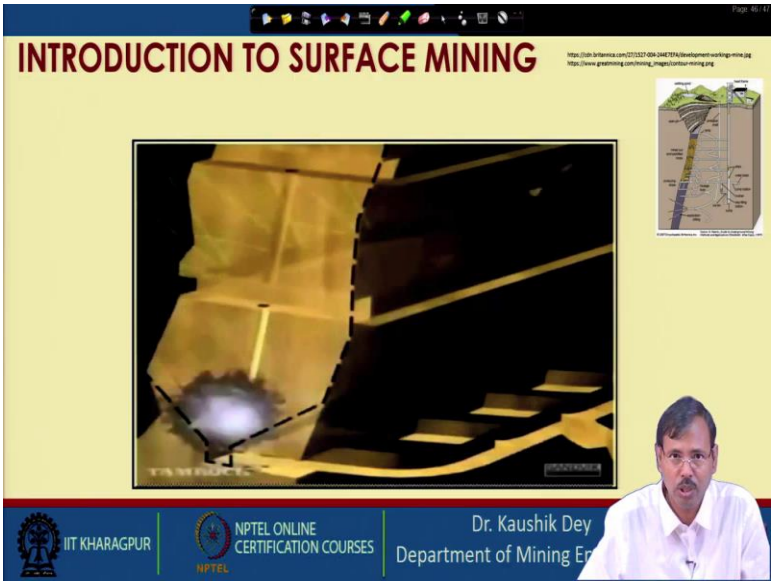
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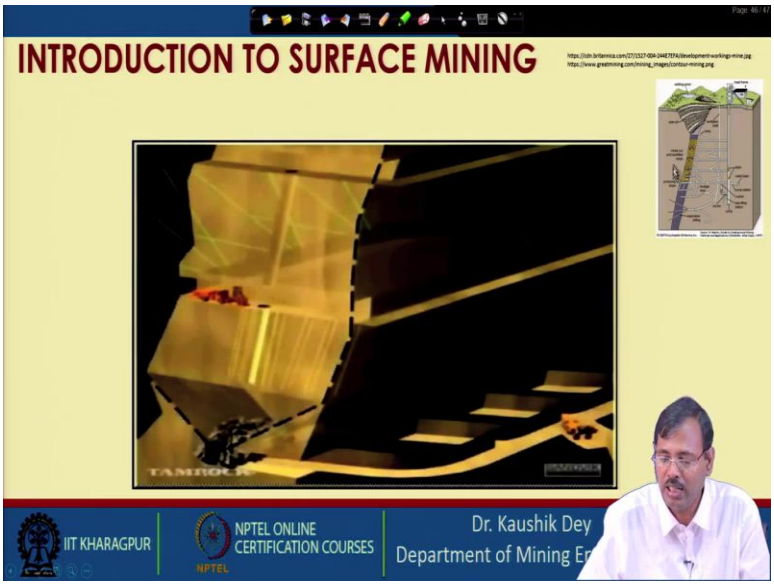

Let us see some operation of the underground mine also. See, in the underground mines, the similar way we have coming out from the surface than from surface to the ore body, we are creating the excess. This is the excess is made. Our small size machines are deployed in this case, say you are carrying out blasting at this position.

See these your machines; the small machine is coming because your dimension is restricted in the underground, you cannot have a very large dimension opening because the supporting cost is required. You cannot have; without supporting the roof, you cannot create an opening. So, that is why your supporting requirement is there, that is why dimension is limited and that is not allowing the deployment of the large machines. Small machines are deployed, and you can see the small machines are taking the material after the blasting.

Now further problem is that whatever material is you are taking it out that has to be taken out, that has to be taken out from the shaft, from this shaft which is made. So, the total production target of the underground mines is restricted with the capacity of the shaft, which means in one day how much material can be taken out from this shaft is basically capping the production target of the mine. So, that is why these is the limitations of the underground mines.

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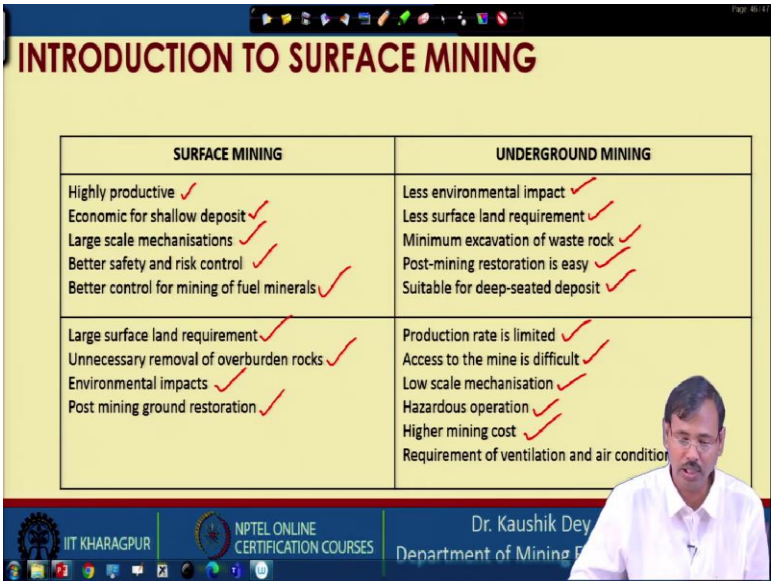

Now, in a nutshell, let us look into the features of the surface and underground mines. Surface mines are highly productive. The economic, the surface mines are economical also for the shallow deposit. The large scale mechanization is possible. There is no restriction on the dimension. And because of the better visibility better communication, the safety and risk control is better.

And this is very, very good for the mining of the fuel minerals because if it also burns whatever the gases are generated, that is not creating a polluting environment because it is dispersed into the atmosphere. But if it is happening to the underground, it creates a carbon dioxide, and carbon monoxide filled atmosphere environment.

In underground mining, the environmental benefits are that environmental impact is less, which means in a surface mine if you are generating some dust, that dust is going to the atmosphere. But here, the dust, etcetera, are limited to the underground environment only, it is not coming out and polluting the surface environment.

The land requirement is not significant. Only you need a small space to construct the shaft. In surface mine, you have square kilometres and a leasehold area is required because your dimension of the mining is very large. Minimum excavation of the waste rock, you need not to spend money on the excavation of the waste rock, so the shaft etc., are constructed in the waste rock.

Post mining restaurant is also easy because you are not degrading the land of the surface. And this is very, very suitable for the deep-seated deposit because the overburden excavation or the waste rock excavation is not significant. In surface mining, you have to take out all the above rock cap before taking out the original mineral or ore body. So that is why if it is deep-seated, that means the rock cap is very high. In that case, the excavation requirement is very high in the surface mines.

So, the drawbacks of surface mining are the large surface land requirement and especially a highly populated country or where the forest land, etcetera, are there. Land acquisition is a big problem and that is the greatest challenge nowadays in surface mining. It is unnecessary to remove the waste rock cap which is lying above the main mineral. It has environmental impacts: the groundwater is being disturbed, your environment is being disturbed by the generation of the dust, generation of the sound, these are basically annoying local populations.

Then post-mining ground restoration is another problem because this large area that is being mined has to be restored for future use. Drawbacks of the underground mines are the production rate is limited; access to the mine is difficult, low scale mechanization; hazardous operation; safety is very, very difficult; illumination is less, mining cost is much, much higher; and it requires ventilation and air conditioning for the better work environment.

So, basically, you understand for a shallow deposit, for a shallow deposit, surface mining is no doubt very, very profitable, very, very economical and popularly, people are asking for that. But we have a little bit of doubt that it is not a deep-seated deposit, whether we should go for surface mining or underground mining? But the problem is, I believe that this discussion should be based on mathematical calculation economic analysis.

It is, it should not be carried out based on some remote idea that in a deep mine, Surface Mining cannot be carried out, in shallow mines only it can be carried out, because we are having the example that Bingham Copper Mines is working at 1.2-kilometre depth. Other few mines are also working in 800-meter depths, 600-meter depth, so surface mines have been found have occurred, are operating at very, very deep condition also with significant profit.

In Germany, the Lignite mine is operating at a 500-meter depth also. So, that is why this is very important, and this must be taken care of while someone is deciding on whether you should go

for surface mining or you should go for the underground mining operation. So, we will come to more discussions related to this. We will find out how this judicial decision can be taken on this surface mining and underground mining just between surface mining and underground mining in our next class. Thank you.