Surface Mining Technology
Professor. Kaushik Dey
Department of Mining Engineering
Indian Institute of Technology, Kharagpur
Lecture No. 09
Opening Through Box Cut- 1

Let me welcome you to the ninth lecture of Surface Mining Technology. Before this, we have covered the introductory part. And from here, this lecture topic is opening through box cut. This is the first lecture on the box cut. There will be another lecture on this. So, the commencement of surface mining is carried out with the opening through box cut. So, basically, we are also commencing our main Surface Mining Technology class from this lecture on 1. So, the title of this lecture is Opening Through Box Cut - 1.

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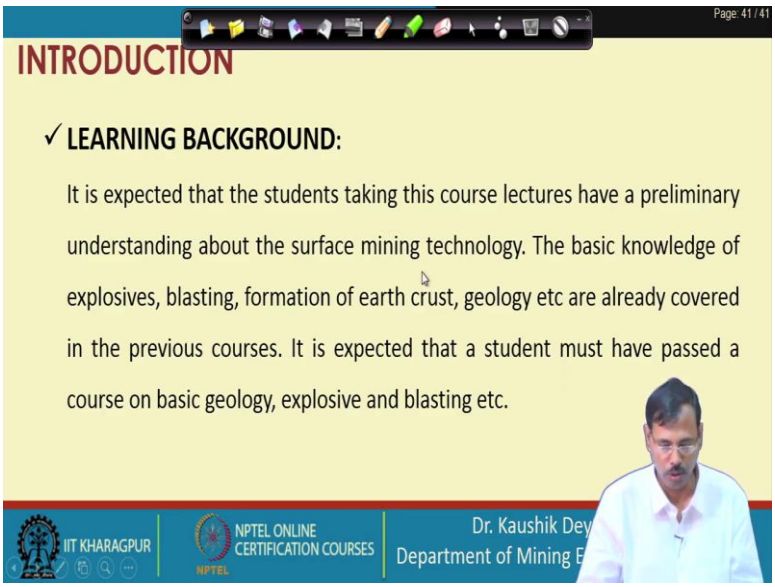

As per requirement, let us show the learning background of the Surface Mining Technology course.

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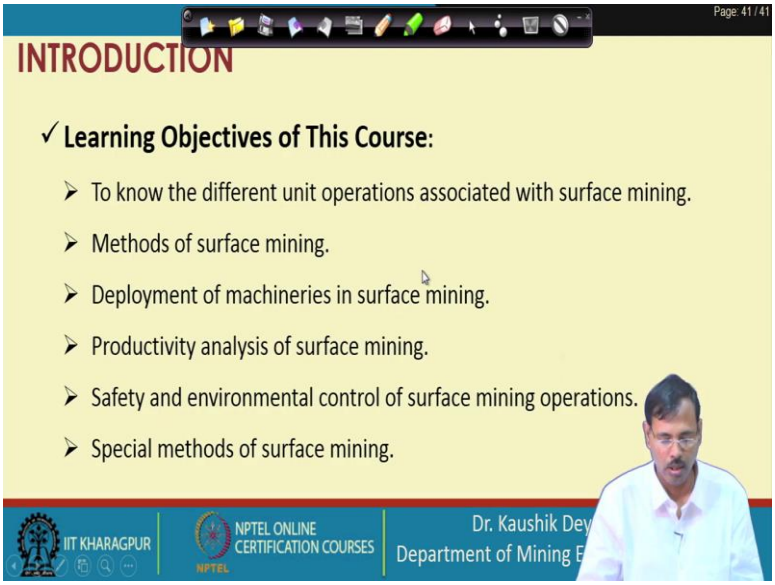

Learning objective of the Surface Mining Technology Course.

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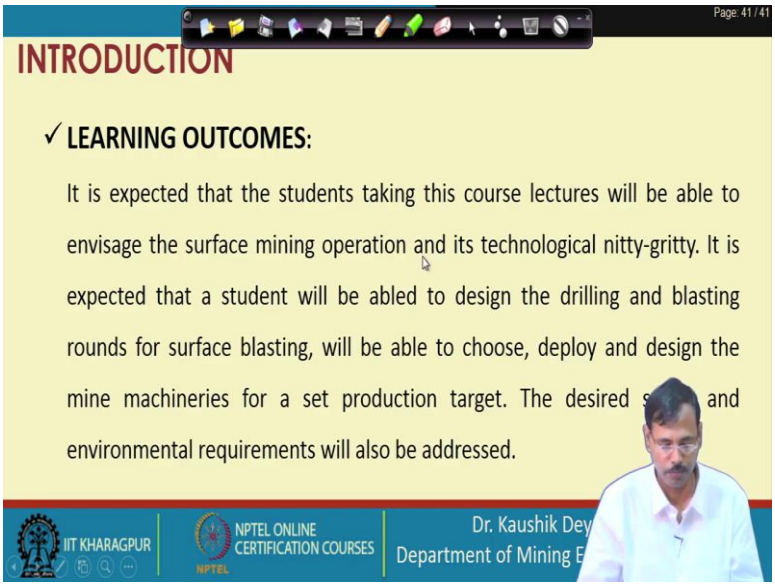

And what is our expectation from our Surface Mining Technology course participants?

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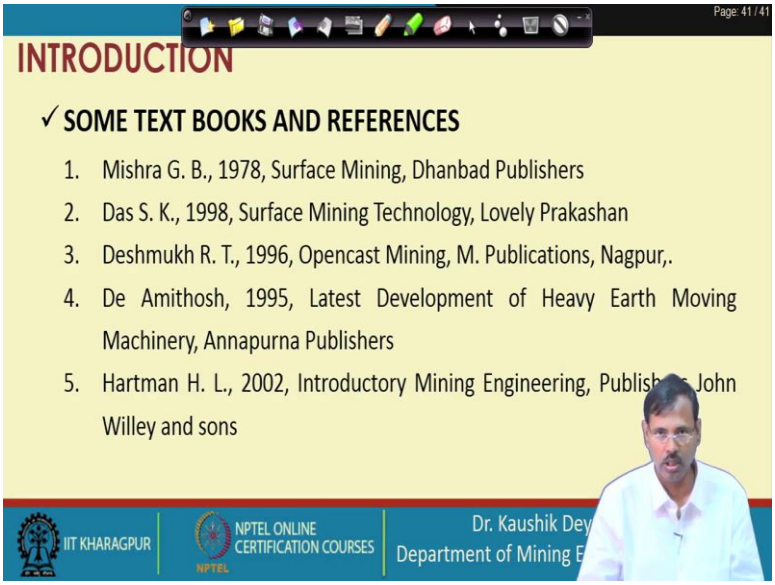

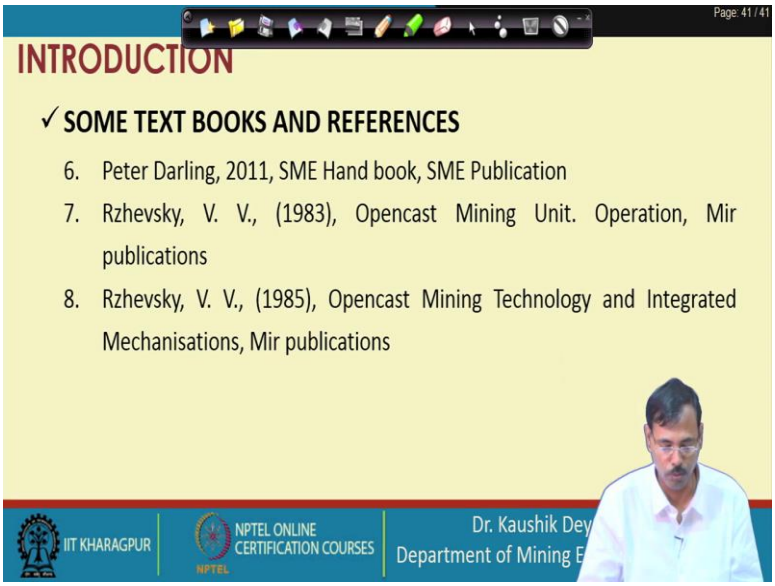

And these are the textbooks and reference books we advise the participants should go through.

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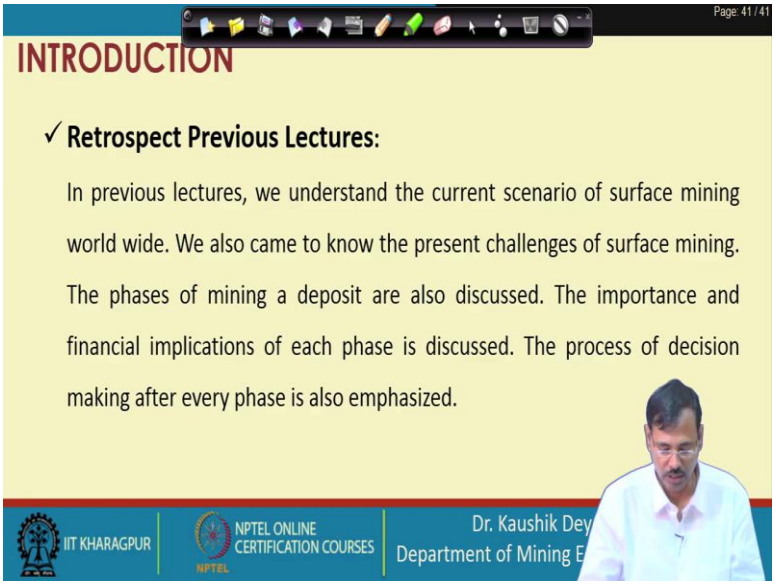

And this is the retrospect of the previous lecture. In the last lecture, we discussed the current status of surface mining, discussed the phases of surface mining, discussed the rocks and minerals, and saw the process of decision-making in every phase. The previous lecture also gives an overall idea about the different surface mining mercenaries.

So, we now know what an excavator is, shovel, drilling machine, and dragline the glimpse of that is already shown in the introductory classes.

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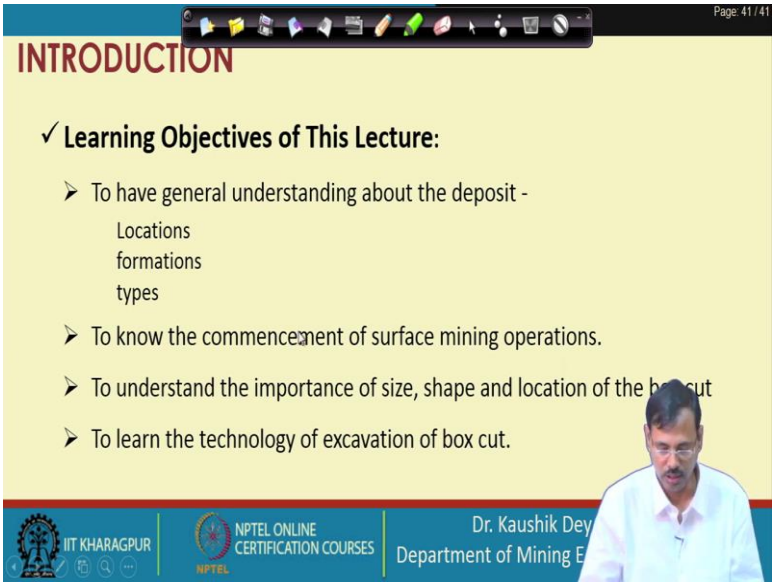

So, the learning objective of this lecture is to have a general understanding of the deposit location formation types. And to know the commencement of surface mining operations to

understand the importance of site safety and location of the box cut and the technology for excavation of the box cut. This is the learning objective of this particular lecture.

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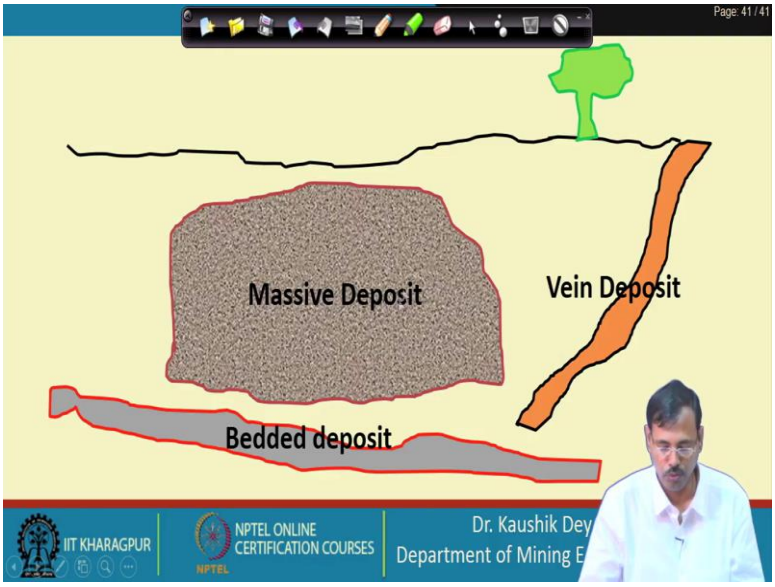

We have discussed, but from now onward, our mining has to be carried out, and that is why we should have a little bit of knowledge about this deposit. We can have a massive deposit, vein deposit, and bedded deposit, so we can also have columnar deposits. So, this is a little bit of idea about the types of deposits you always keep in your mind while you are following the Surface Mining lectures.

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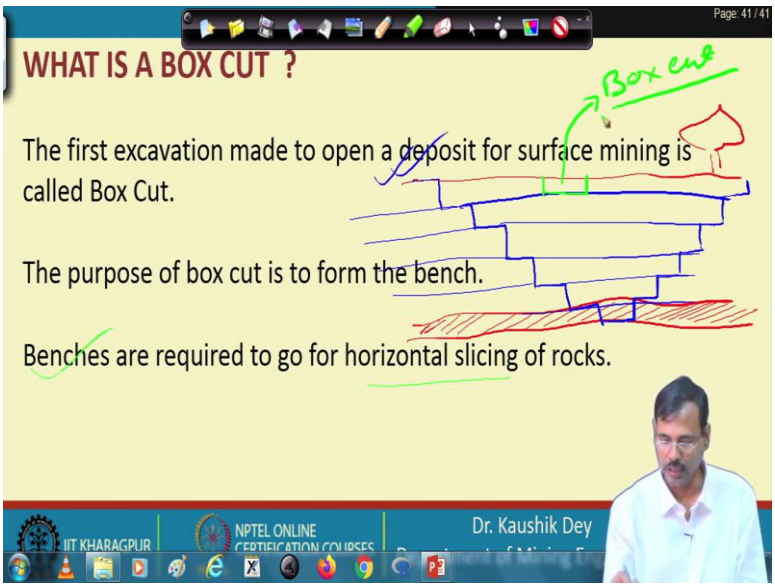

So, what is a box cut? Box cut is basically the first excavation made to the deposit for carrying out the mining to it is not actually to the deposit. It is the first distributed excavation

made to exploit a deposit by surface mining. It is called a box cut. Now what is in another way you can tell the box cut is basically the starting point for the formation of benches. That means whenever we are carrying out surface mining. We from the bench to exploit the deposit.

So, box cut is the first point to form a bench, or it is the starting point of the formation of a bench. Benches are essentially required for the horizontal slicing of the box. So, what is Surface Mining? Let us understand in a little bit way like this? Suppose this is our surface, and our ore body is lying in this position. So, this is the ore body, and we have to excavate this for that what we carry out we go for forming the bench like this.

And by forming benches, we exploit this one. This part we have discussed in our layout where we have shown how the benches are made. So, benches, you know this benches is a rock cell. So, we have carried out. And you can say surface mining is nothing but the horizontal slicing of the deposits. So, you can consider these are the slices. So, these slices are taken out gradually, one by one, for excavating.

So, the first slice taken at this position lets us use a different colour. This is the first slice which is taken out at this position is called box cut. So, benches are required to go for the horizontal slicing and the first opening made is called a box cut. I think this part is more or less clear to you now.

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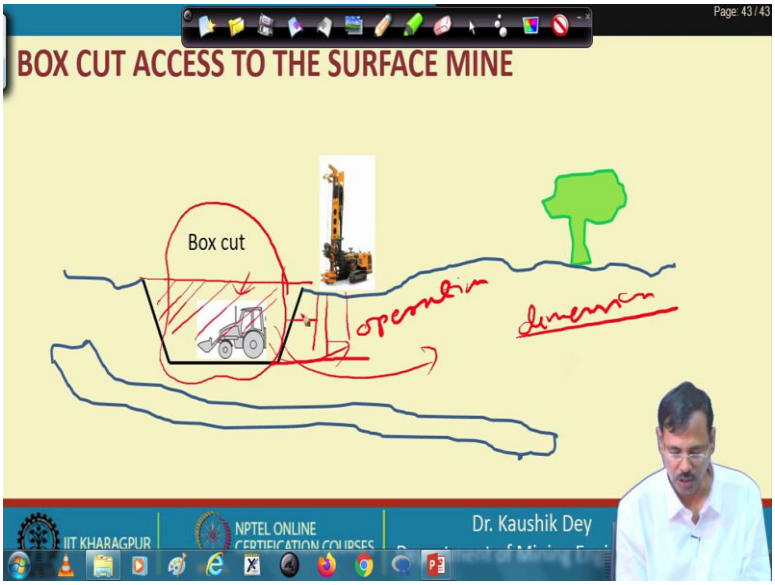

So, you can see this is the first initial cut made this angle is showing. So that it can remain stable, it will not fall down at this position. So, this is the first excavation made in the in-situ,

which is creating the box cut. In another words, you can say box cut is also the opening made to go for lowering the machine into the lower band. So, this excavation is made to lower this machine at this position.

That means this gives us the idea that we have to create an opening in this place. In such a way so that the excavation should have sufficient dimension. That should have sufficient dimension so that these machines can be placed and have sufficient space for the operation. So, that means a box cut has to be made that is excavation of this much of volume, and this volume should be sufficient.

So, that machines can be lowered there, and they can be used without any hindrance at this position. And what is the next? Next, we basically extend this one. That is why our drill machines are placed at this position. So that we can excavate this one further.

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This is a photograph of the box cut. You can see the excavation is already made. This is the boxes already made at this place. You can see this portion. We are making it ready for the blasting here; the excavator is working here, the dumper is moving this is the dozers. So, all these machines are working here. So, sufficient space is created at this position. But simultaneously, as the machines are lowered, machines are working here.

So, there should be some access so that the machine can move, and this is the access. This is the access made here, and this is the ramp. So, that means a box cut not only has an opening it should have access for entering into that lower level and that access is called a ramp. So, this is the essential requirement essential part of the box cut. And this has to be remembered

that a box cut is not only the ramp. A box cut is not only the opening. It is an opening along with a ramp. So, that must be remembered.

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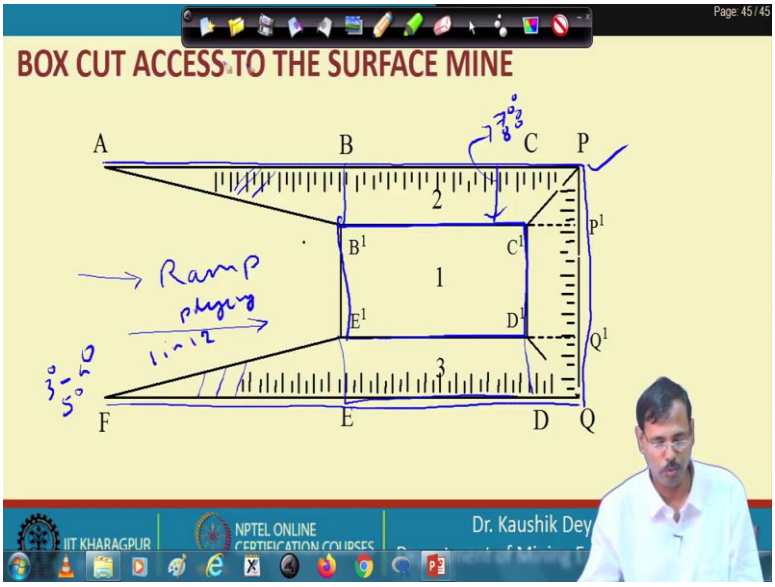

So, in the plan view, is that this is basically a box cut. This is the box cut. This is the opening made in the lower level, this is in the upper level, and this is the ramp. This part is the slanted one. This is the slanted part, and this is also the slanted part. This is the angle provided for the stability of the benches. So, this is having the inclination which is required for the plying of the machines.

So, you can say it can be it may be in 1 in 12 or such so that means it is said 3 degree fourth degree angle is in general provided or maybe 5-degree angle is provided here. These are the slope of the benches. So, you can consider this may be of 70 degrees, or 80-degree angle are provided in this poiser. So, this is the plan view of a box cut.

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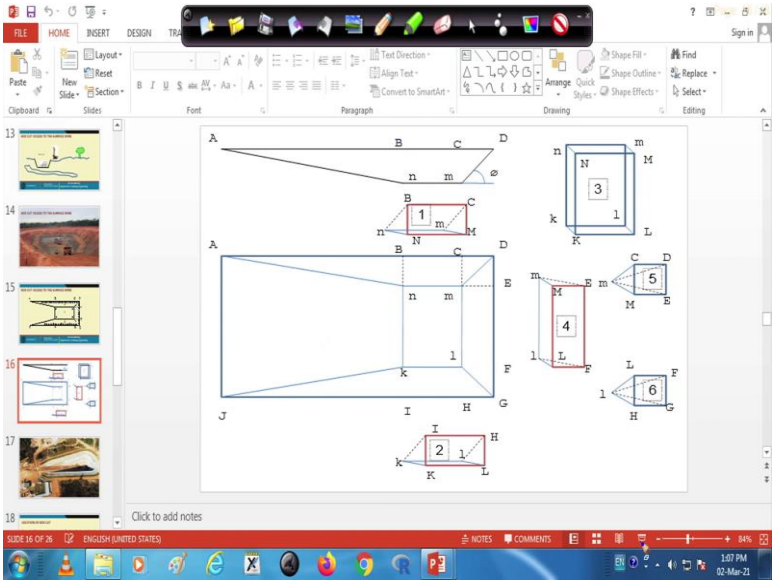

If you look into the sectional view, let me come out of this. So, you can see the sectional view here. So, this is the sectional view, and this is the plan view. So, this is the plan view. This is the sectional view. We can see this is the bench. This is basically bench, and this is basically ramp. So, our machine can ply on this, and this is the bench. So that we can carry out drilling and carry out blasting here.

So, we have given a little bit more angle for the better photographs in this. Now this portion will discuss later on. This is the different segment you can see the nomenclature the surface points are named the capital one and bottom points are named the smaller ones. So, the m is at this position smaller m is at this position is the capital M. So, capital M is excavated. That is why you cannot see the capital M here.

Instead of that capital M is directly on the top of this position. But so you can see, the capital M is somewhere in this position. But as it is in the same line, you cannot see it that is the way it is showing in this way. So, this is the nomenclature shown in this. We will go into the details of this one at a later stage.

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So, this slant part is shown in this figure you can see this part is a little bit slanted one. That is why it is the sectional view is given like this way.

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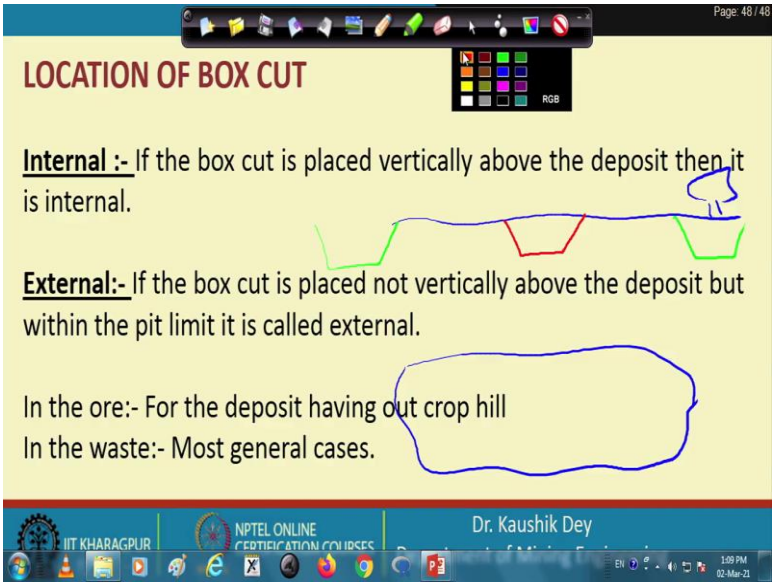

So, we have to say a huge deposit. This is the surface and says we are having a deposit like this. Now we have to decide where we should place our box cut. Whether we will place our box cut here or place our box cut here or we will place our box cut here. So, what will be the position of the box cut? That decision has to be made.

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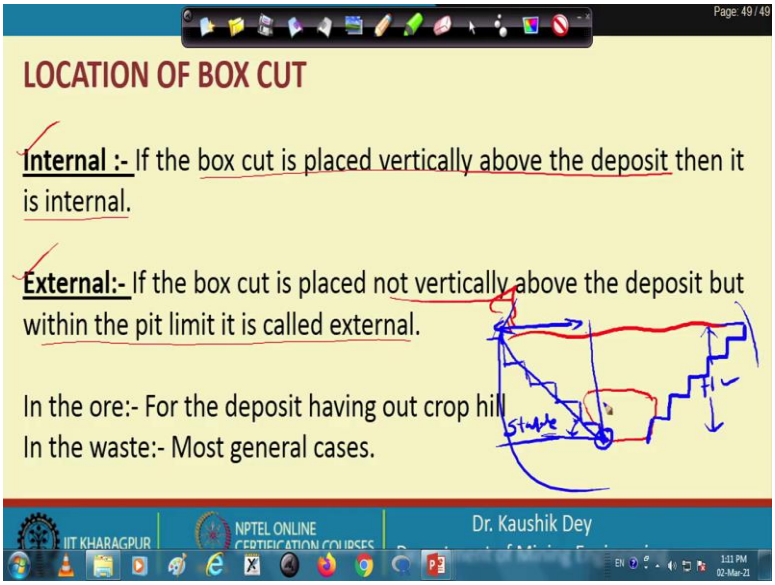

And in this case, we can either provide an internal box cut or an external box cut. What is an internal box cut? If the box cut is placed vertically above the deposit, then it is called internal. If the box cut is placed not vertically above the deposit but within the pit limit, it is an external box cut.

What is the meaning of pit limit? Suppose we have this surface and say we are having a deposit like this. So, the lowest point we will excavate is this one and this one. Now to excavate at this position, we have to carry out our benching say this is the benching. So, this benching is required so that our machine can ply on the benches. And this portion of rock will remain stable.

So, this is the actual angle slope angle that slope angle has to be provided to remain stable. So, this is called pit slope angle. So, this pit slope angle has to provide it so that the rock will not fall down here. So, this excavates this point we have to excavate at a surface. This is the H depth. So, to excavate this point at H depth, we have to excavate this much of distance beyond the directly vertical point of the deposit.

So, this is the vertical point of the deposit but we have to go for additional excavation up to this. So, this point is called pit limit. So, this is the final pit layout when we are excavating. So, when we are excavating this is the pit limit you can consider this is the pit limit that we are carrying it what we are excavating for extracting the complete ore.

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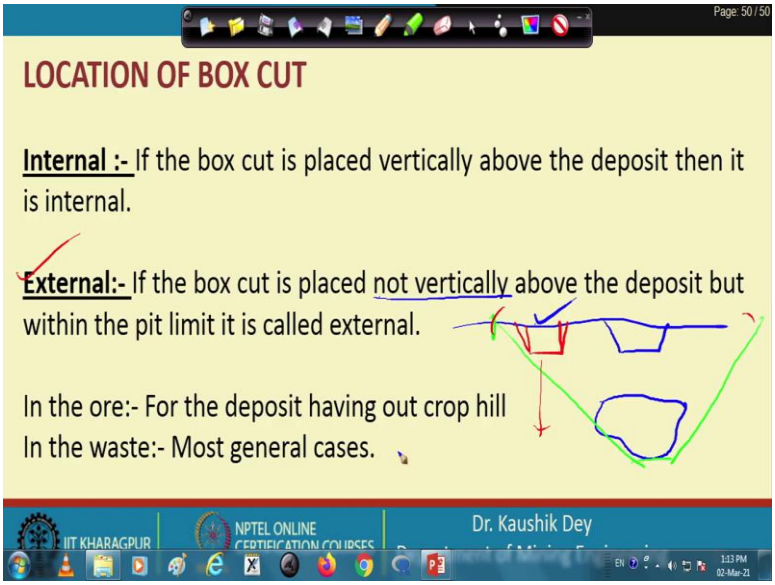

So, we are basically placing our box cut not vertically above the deposit in the external box cut. That means if this is the deposit and this is the surface, let us draw the pit limit in a different colour. If this is the pit limit, then we are placing our box cut at this position, which is not vertically above this position.

So, this is where it is not vertically above the deposit, but within the pit limit, then it is called external box cut. So, now you have understood that internal box cut if the internal box cut is in blue. So, this is the internal box cut, and this is the external box cut, and there are the basic requirements. But some we have some different idea also available.

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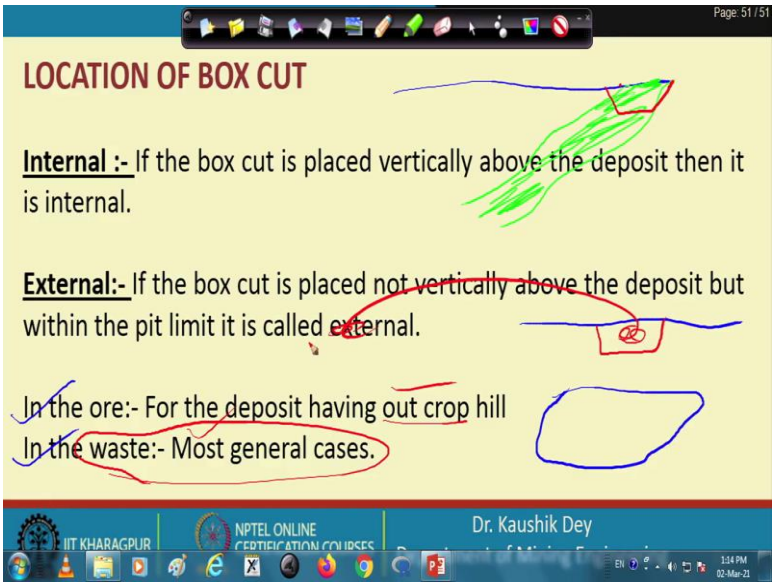

We can have our box cut in the ore itself or have our box cut in the waste itself. So, obviously, it is understood if our deposit is like this. We cannot have a box cut in the ore because the box cut is the first excavation. So, we cannot reach here because it is at a depth. So, in the ore box, cut is possible only when our deposit is exposed to the surface itself. In that case, we can go for placing our box cut in the deposit itself.

So, this is a rare case we can have the option if the deposit has the outcrop. Otherwise, in general, we have our box cut in the waste truck only. And that is why whenever you are excavating this one, you should prepare to dump this one somewhere in this material somewhere outside the area.

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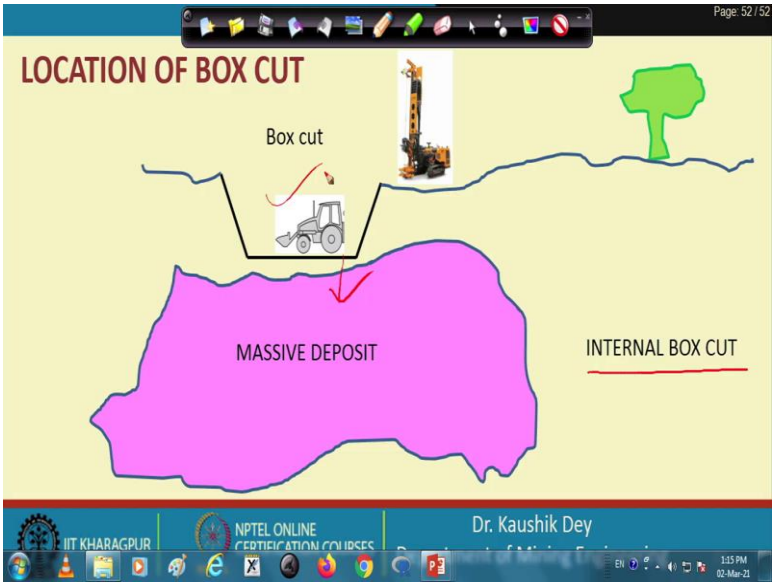

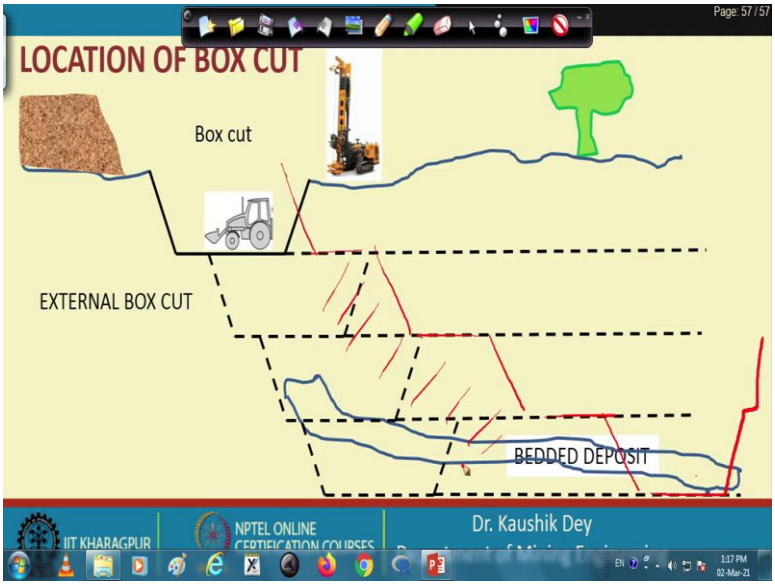

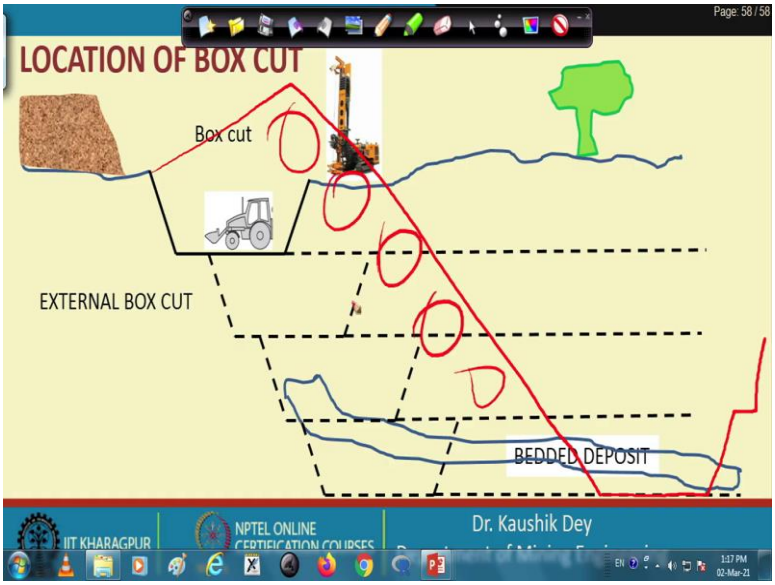

So, we can look into the different options, say for the massive deposit. We have to go for the internal box cut because if we provide an internal box cut, we will reach the deposit very shortly. And that is the moment we are reaching the deposit, which means we have to excavate the mineral, and we can sell that and get the return money. So, that is very important and for that to early reach to the deposit.

We are placing the box cut above the deposit vertically so that is why we go for the internal box cut same thing we can see for the bank deposit also. But in case of bedded deposit, we may go for the external box cut. If our bedded deposit is like this, what we would like to do. Say deposition of this all this overburden material transport and deposit it so some outside area required huge land acquisition.

So, to overcome this, we try to carry out mining from one side and after the execution. Say this part is taken out. If we have taken out this one, then we may utilize this area; after taking it out, we can utilize it for dumping the overburden rock. Say suppose our if our pit is at this position. Say if our pit is at this position in that case, up to this up to this is already excavated.

So, this part can be utilized. This area can be utilized as the dumping of the overburdened rock overburden dump. So, let me actually draw this one heap. If this is the position of the pit we are excavating this material at this position. This part can be utilized as the dumping of the overburden material at this position, or we can directly dump it like this also.

And in that case, this is our pit. So, this is the overburden dump truck that will allow us to go for backfilling of the area. And we need not have so much land acquisition in this case. So, that is the benefit of this backfilling, and to exercise this backfilling, we have to go for an

external box cut. So, that external box cut is possible if we have a better deposit. And we are opting for the backfilling technique.

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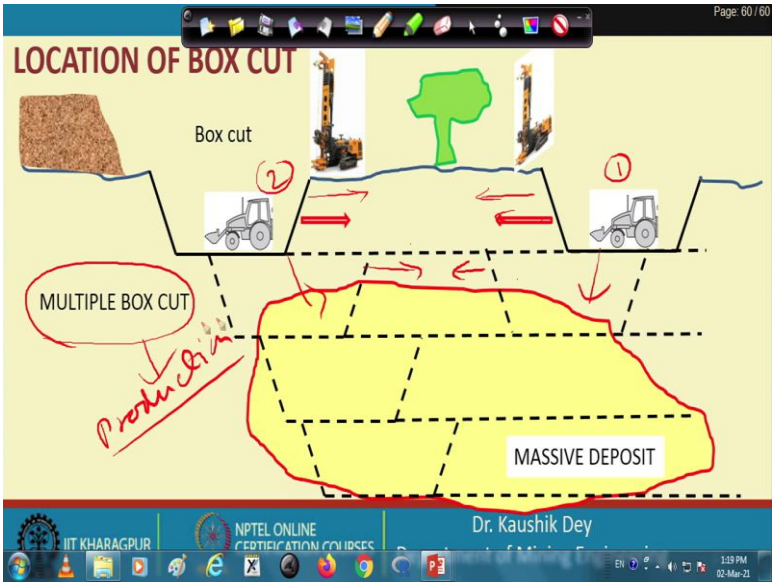

We can have multiple box cut also. We can have multiple box cut also set one box cut at this position. Another box cut at this position and will allow our movement of the benches in this direction. And gradually in this direction also that will also move towards this direction. So, gradually we can have this type of system in case of multiple box cut that increases the if we are having multiple box cut it increase the production rate.

So, will our dev development will be faster and that is the importance of the multiple box cut. So, we can often go for the multiple box cut also using more machines.

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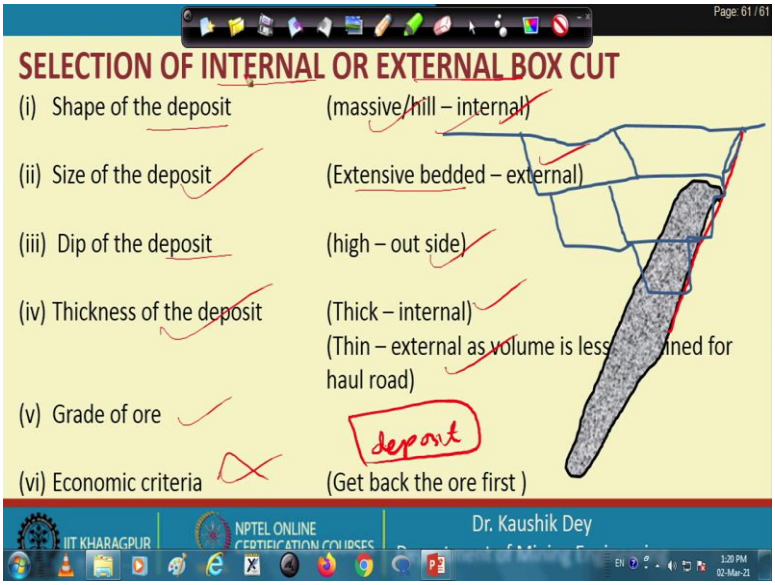

So, in general, we say we can go for the internal box cut in this vein type of deposit. And the choice of whether we will go for the internal box cut or external box cut depends on the shape of the deposit say massive hill et cetera we go for the internal box cut size of the deposit for the extensive bedded deposit. We can go for the external box cut also deep of the deposit, then we can go for if it is high, we can go for the outside. If it is outcrops, we can go for in the ore itself.

The thickness of the deposit for thick it is internal. We may go for the external grade of ore then economic criteria for thin. So, all these things our economic criteria are that we should get the stuck the excavation that is the reach reaching the deposit should be as early as possible. And that is why in most cases we go for the internal box cut because that allows us to reach the deposit at the earliest. So, that is the benefit of the internal box cut.

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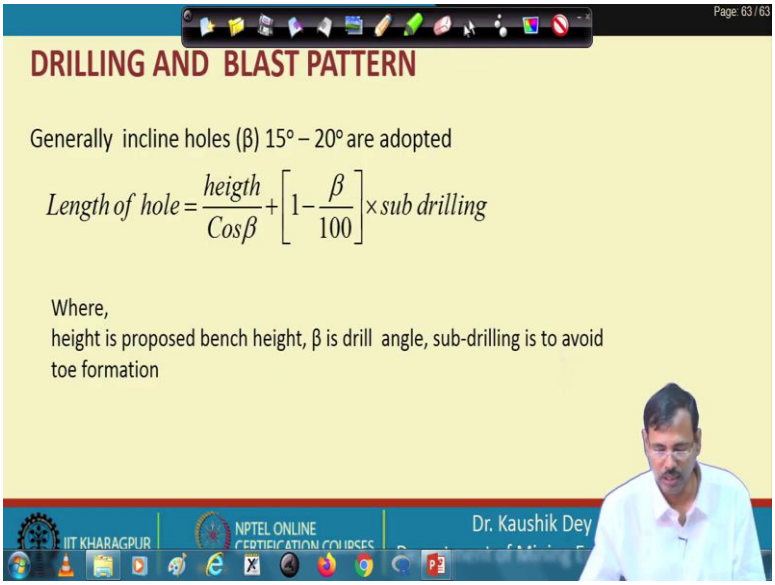

The way of excavation of the box cut is also important. Generally, if the material is soft, an excavator can dig it out easily. We will come to that part at a later stage. First let us discuss if the material is very hard in that case. The excavation technique can be adopted is the drilling and blasting technique. So, in drilling and blasting, generally, we can have vertical holes; we can adapt the inclined hole also.

And this is the length of the hole decided using this criterion where height is the proposed bench height, beta is the drill angle, sub drilling is to be avoided for sub drilling is carried out to avoid the toe formation. So, this is the general concept of determination of the length of hole for drilling and blasting carried out in a box cut.

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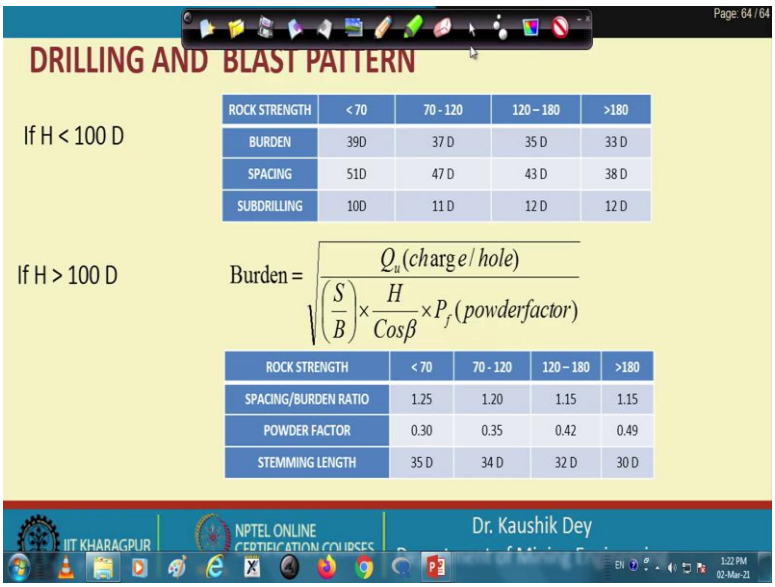

And this is the selection of the burden, spacing, sub drilling for the depending on the strength of the rock. This criteria is the Lehenga Force Christian criteria for the drill diameter and bench height relationship it is given for both the cases based on this. So, this is Lehenga Force Christian criteria what will be your burden, spacing, and sub drilling if your bench height is less than 100 D if your bench height is more than 100 D this is the relationship and this is the rock strength.

And otherwise, you can adopt the burden value, burden value for this case you can adopt the equation this model for calculation of the burden for this case. So, this is the Lehenga Force Christian guideline for carrying the blasting.

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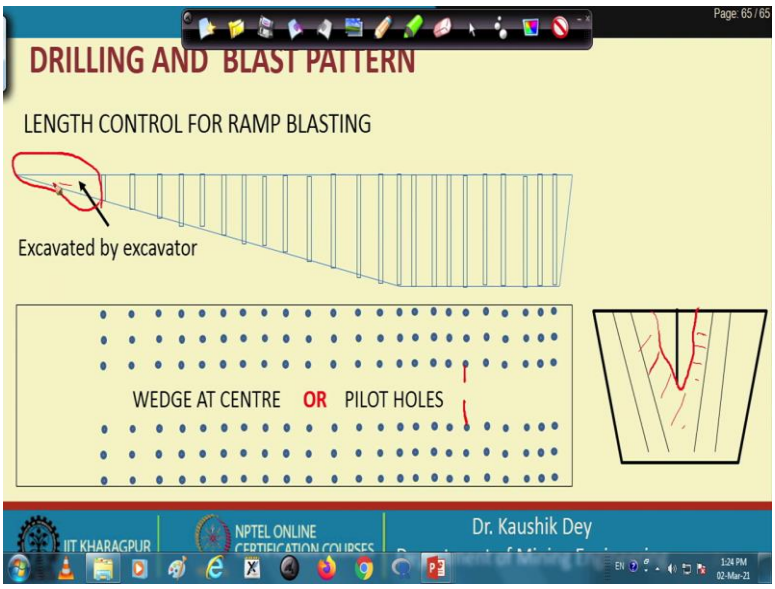

And this is the pattern, in general followed in a box cut. So, this is for the ramp part up to this is for the ramp part. And here, the drilling length depends on the ramp height you have to maintain. So, this is the drilling length as there is no free phase. In general, we can go for a wedge cut drilling system. And if it is a hard rock is available very hard rock case we can provide a pilot hole of short length so that an initial excavation is created.

So, an initial excavation is created at this place that will act as the free face for the rest of the wage part. And this is the system we can follow wedge cut blasting system you can see these holes are inclined to us, this direction these holes are inclined towards this direction. This is the general blasting pattern carried out for the wedge cut excavation. This part, as the height is not significant.

It is not various significant for carrying out drilling and blasting systems here. The excavators are strong enough to dig this one once the blasting is carried out at this position. So, an excavator can dig this pot of rock with his bucket a strength bucket teeth. So, this is the common general drilling and blasting pattern for the wedge cut that is in general practice for a strong rock. But you remember that in most of the cases, your box cut is the first initial card.

So, box cut is in general placed on the top surface. So, as it is in the top surface is more or less a soft formation. So, drilling and blasting system may be required for a little bit depth. If a soft surface is available, the excavator can be used to excavate that one. So, that is a very commonly used method we will come to that we will see the video of that in the next lecture. So, let us stop this lecture at this point. Thank you