Surface Mining Technology
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Lecture 18
Technology for Surface Blasting – IV

Let me welcome you to the 18th lecture of Surface Mining Technology. We are continuing with Technology for Surface Blasting. This is the fourth lecture in the technology for surface blasting series. Before that, we have covered the different essential influencing parameters for surface blasting and how we have seen how we can design a surface blast for a particular bench blasting to achieve the desired target production.

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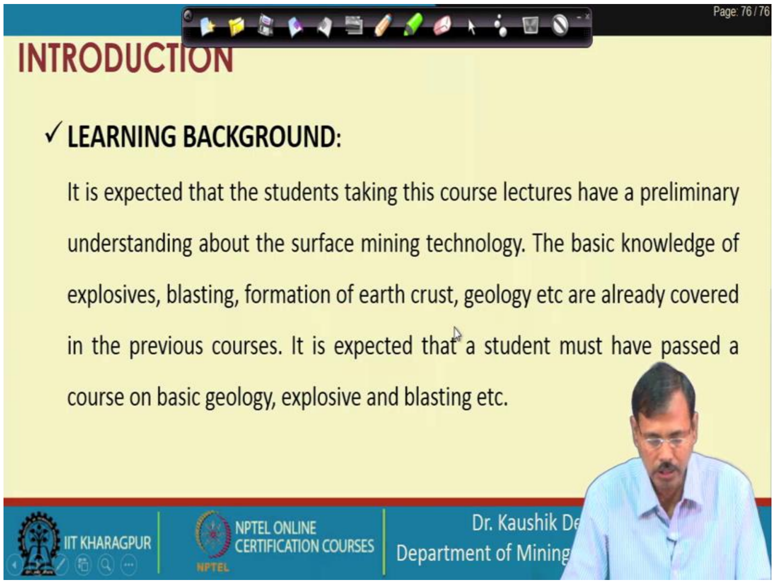

So, as we see, let us see the learning background for the surface mining technology course.

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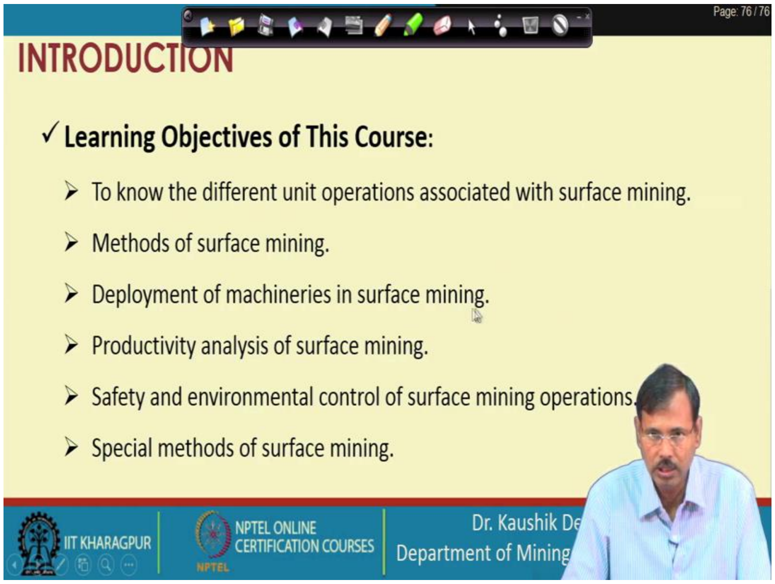

This is the learning objective of the surface mining technology course.

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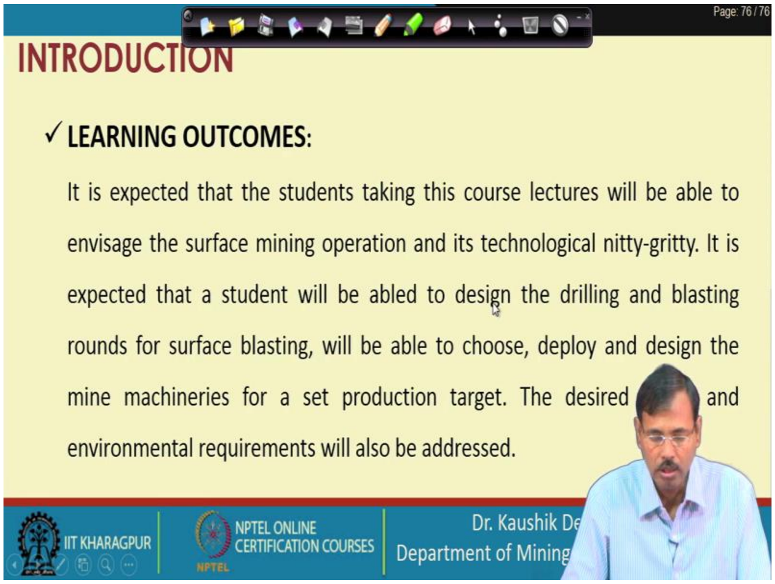

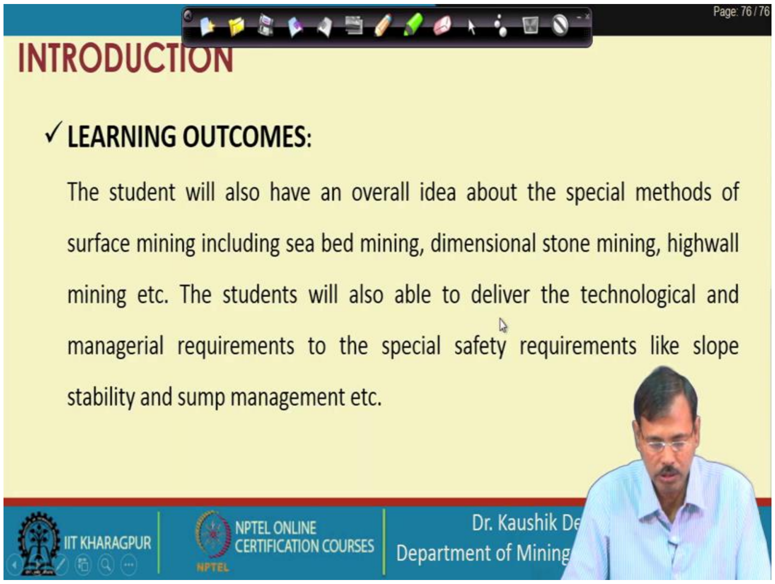

This is the learning outcomes expected from the participants.

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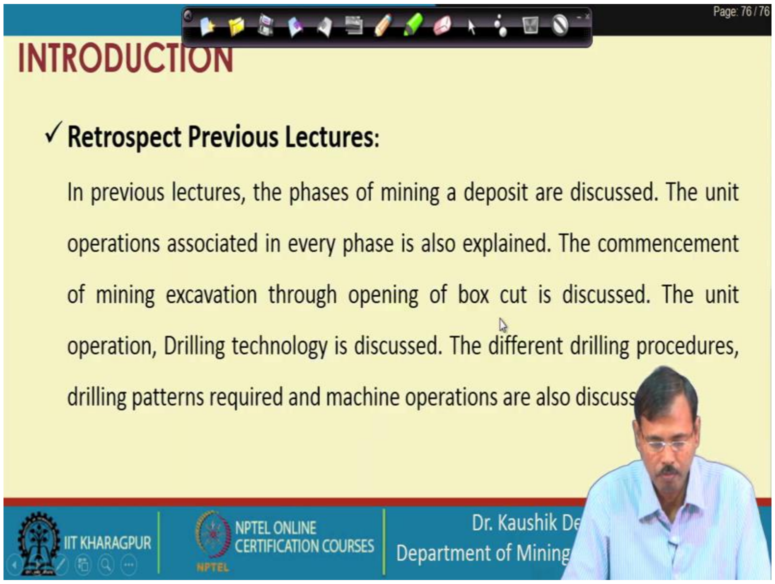

And this is the retrospect of the previous lectures. Before this starting the lectures pertaining to surface blasting, we have covered the phases of surface mining, we have covered the introductory part of the surface mining, the status of surface mining worldwide, we have seen the stripping ratios, we have covered the opening of surface mine using box cut, and we have also covered the drilling technology pertaining to surface blasting. So, that part is covered.

We are continuing with the surface blasting technology, and we have already carried out three lectures on that. This is the fourth lecture of surface blasting technology. We have covered the influencing parameters, and we have seen how to design a blast with different available economic and technical parameters, particularly for a mine.

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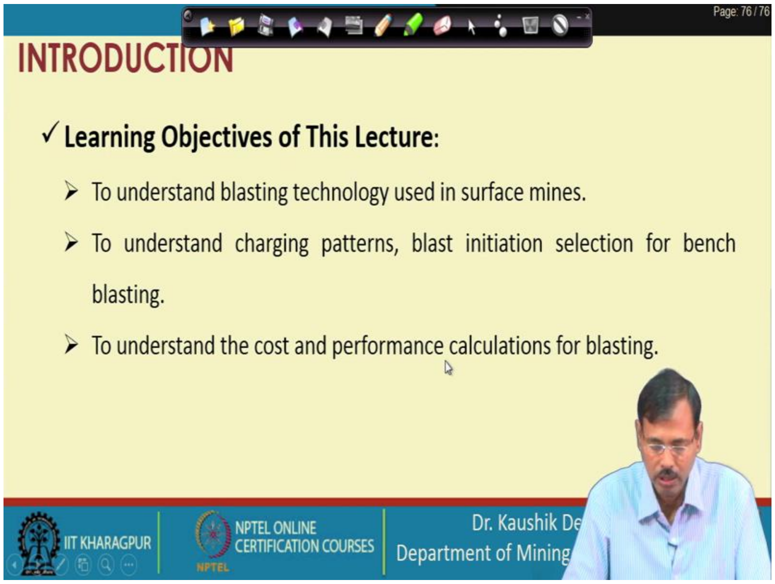

The learning objective of this lecture series of surface blasting technology is to understand the blasting technology used for surface mines, particularly the bench blasting technology, charging patterns, blast initiation selections for bench blasting, and the cost and performance calculations for the blasting. In this particular lecture, we will actually, emphasize the calculation of the cost for a particular blasting.

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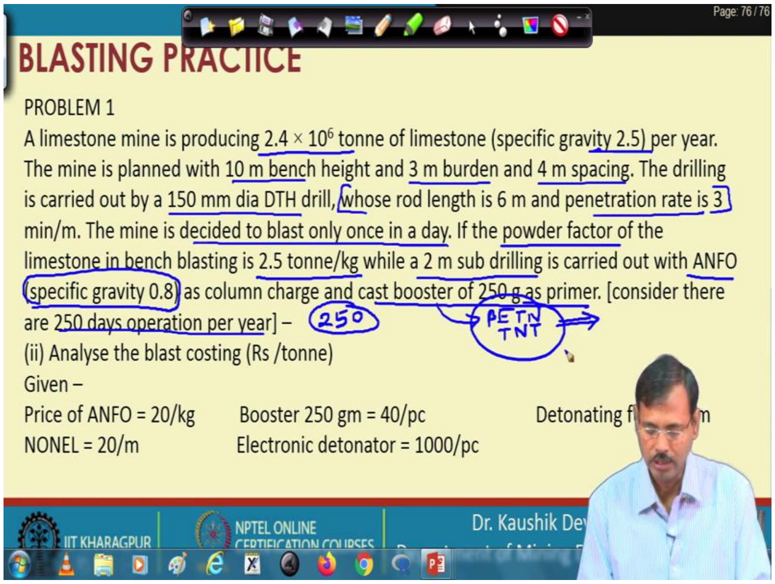

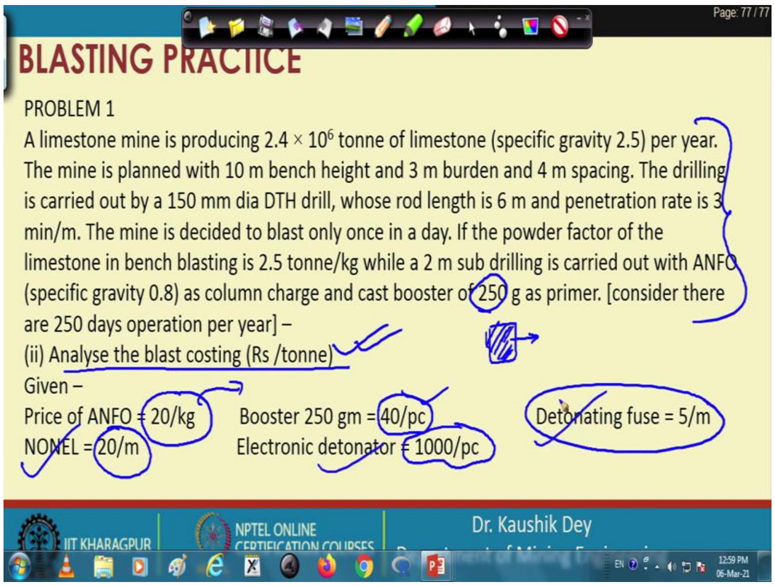

So, we have already seen the design of this blast. So, for this blast, we have already carried out the design. In the next slide, we will go to that. But first, let us read this problem. So, our target is to produce this much limestone, specific gravity is given, and bench height, burden, and spacing is given. The drill diameter is given so that we can calculate the linear charge concentration.

This part is required for the drilling cost calculations, which we have already covered. This is already covered in our drilling lecture. Mines we have discussed decided to blast once a day, and there are 250 operating days in a year. In consideration of that, obviously, there will be 250 blast rounds we are expecting in the mine.

Powder factor is found suitable for the, in considerations with the fragmentation, etc. is found 2.5 tonnes per kg, and during the blasting, we have seen that 2-meter sub-drilling is required. So, that there will not be any toe formation and the bench face will past blast bench floor will be accepted.

We are using an ammonium nitrate fuel-oil mixture. So, the ANFO of specific gravity is 0.8. We use that as the main charge for blasting and initiation of ANFO; you know ANFO is a non-cap-sensitive explosive. So, there must be a cap-sensitive explosive to be used to initiate the ANFO.

We are using a cast booster as the primer charge. Cast booster is a mixture of PETN and pentolite. So, in other words, you can say it is a mixture of PETN and TNT. So, that is used as the primer charge. So, the Nonel and detonating fuse, etc., can easily initiate this cast booster.

So these are the design; these are given to achieve the design parameters, but we have to calculate the cost in rupees per tonne so, that the management is always interested in the cost per. So, what will be the blasting cost considered in rupees per tonne and the prices are given.

Ammonium nitrate fuel oil ANFO price is given as 20 rupees per kg, Nonel price is given 20 rupees per meter, booster price is given 250-gram booster is used which price is given 40 rupees per piece that mean that 250 grams piece, the cast booster piece which is coming as a container so that cast booster price is found 250 rupees, electronic detonator price is given 1000 rupees per piece and detonating fuse price is given 5 rupees per meter.

So, this is the price list available with the manufacturer. We are not using Nonel detonating, electronic detonator detonating fuse all simultaneously. So, we are not using all the values, but this is the price list available with the explosive manufacturer. We are just showing that one. What is our job? Our job is to find out the blast cost for this.

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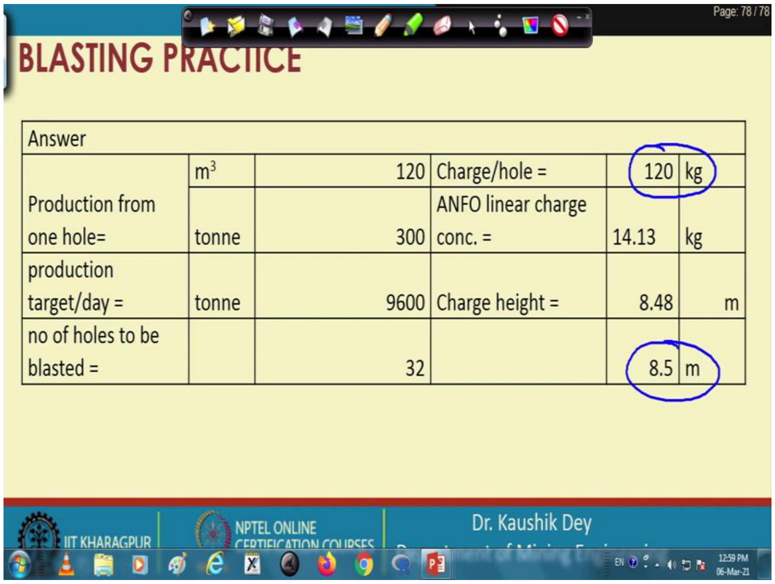

So, this part we have already covered in the previous class. We have found our charge requirement is 120 kg and charge height is 8.5 meters.

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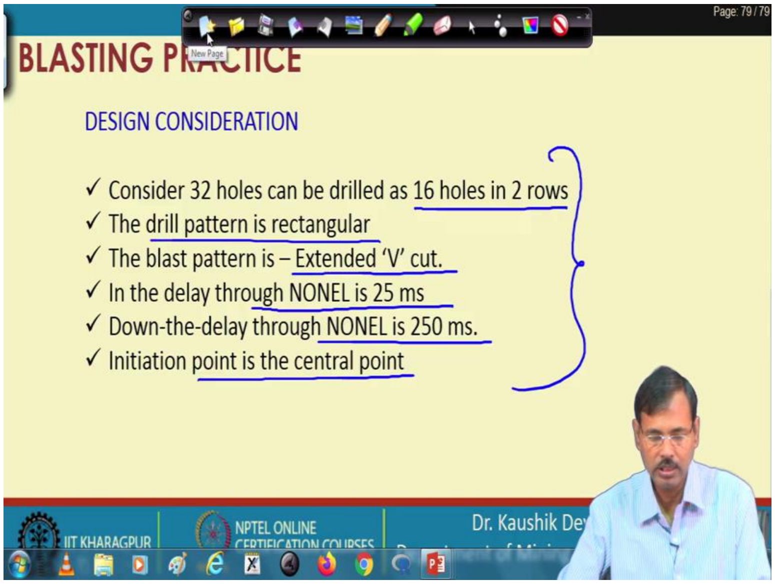

In the last class also, we have considered these considerations are made. There will be 16 holes in two rows .the The drilling pattern is rectangular, extended v-cut is considered the initiation pattern, surface delay of Nonel 25 ms is used, down the hole Nonel of 250 ms is used, and it is centrally initiation is started. So, these considerations have already been made and we have to calculate based on these considerations.

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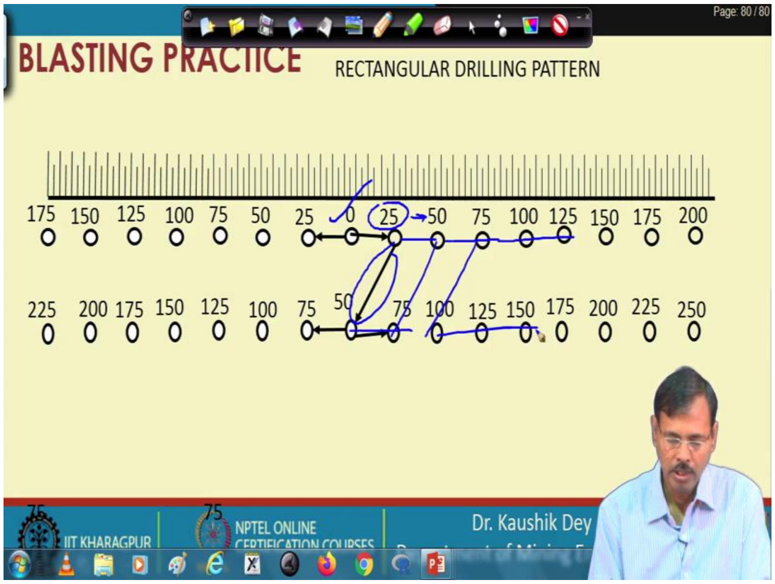

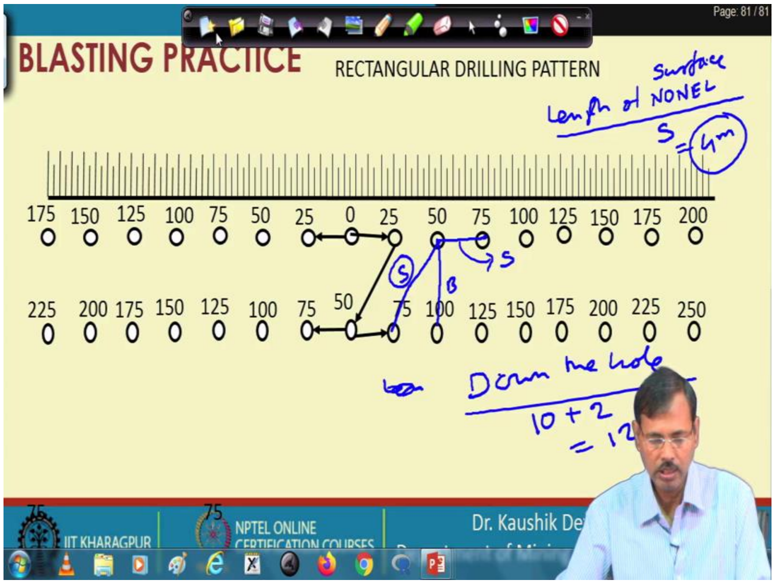

So, this is the pattern we have made. This is centrally positioned. Then we are using 25 ms Nonel surface connections, and another 25 ms surface connections are placed like this, and by this way, we are 25, 50, so this is, these are the 25 ms connectors, and these are also 25 ms connections, or you can use this also. So, you can see this is basically the use of Nonel, and this use of Nonel is very important; this use of Nonel is very important for our finding out the length of the Nonel.

So, if you see, observing this one, if you are connecting Nonel from this to this, this is you can consider a spacing distance. If you are connecting from this to this, this is a burden distance, but you are connecting this to this, so you are just considering this is also a spacing distance.

So, the length of surface Nonel, length of surface Nonel let us assume it is equal to the spacing that is 4 meters. So, this is the length of surface Nonel and if you are considering the down the hole Nonel, if you are considering the bench height is 10 meters, sub-drilling is 2 meters. So, it is the 12-meter height you are considering; the length of Nonel is 12 meters. So, this is the consideration. Actually, for practical purposes, generally, 1 meter cushioning is kept for both cases for the proper time suitably. But for this calculation purpose, we are omitting that one.

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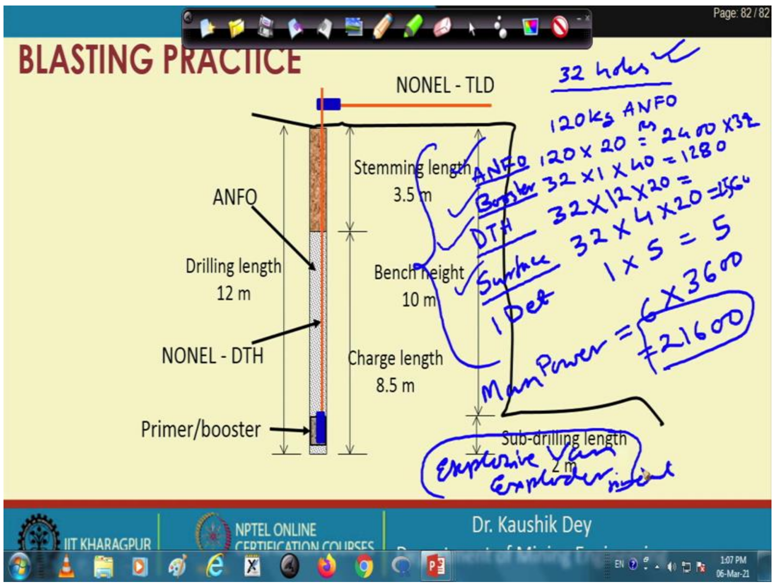

So, you can see this is the surface Nonel we are having 12-meter surface Nonel, and we are having 4-meter surface Nonel, and we have 12 meter down the hole Nonel is placed for this conditions. So, these are the conditions we have to consider while carrying out the casting.

So, let us start calculating at this point. Say for we, are having 32 holes. The solution is given on the next page, but let us do it manually at this position. In 32 holes each hole, we are providing 120 kg ANFO. So, the one hole price of ANFO is 120 into the rate of ANFO. So, this is the price of ANFO, and if you have 32, you will multiply it by 32, you will get the total rupees. ANFO, this much ANFO cost is required for blasting one round of 32 holes.

You also need 32 boosters. Their price is 40 rupees. So, this is the booster price. So, this is ANFO; this is a booster. So, the ANFO booster is over. Now, let us consider down the hole, Nonel. If you consider down the hole Nonel, there are 32 down the hole Nonel. Each Nonel is 12 meters, and each meter's price is 20 rupees. So, this is down the hole, Nonel. Whatever it is, I am not calculating it, and if you are observing the surface Nonel, then it is 32 holes, consider 32 surface Nonel are required, 32 into there are 4 meters and each is of 20 rupees. So, this is surface Nonel.

So, ANFO is over, a booster is over, down the hole Nonel is over, surface Nonel is over. We need one detonator, an electric detonator, and one detonator for initiation. So, let us consider it to be a lump sum of 5 rupees, so 5 rupees here. So, this is the explosive cost we have to incur for 32 holes, and let us consider the manpower cost, say assume we need to have six-person as a blasting crew and the EMS is 3600 as we have considered in case of drilling.

So, this is manpower cost for one blast round, because in one day this one shift, this man powers are blasting only one phase. So, for 32 holes, their manpower cost is this one, you may have a cost related to an explosive van, you may have a cost related to an exploder. All these costs of siren all these may be required. But for this particular calculation part, let us ignore these things and only utilize up to this. Then let us look at what will be the result.

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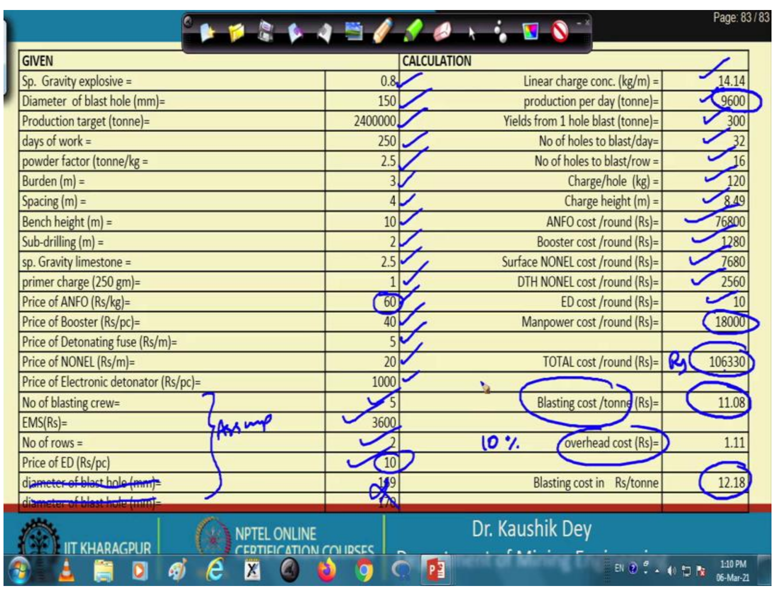

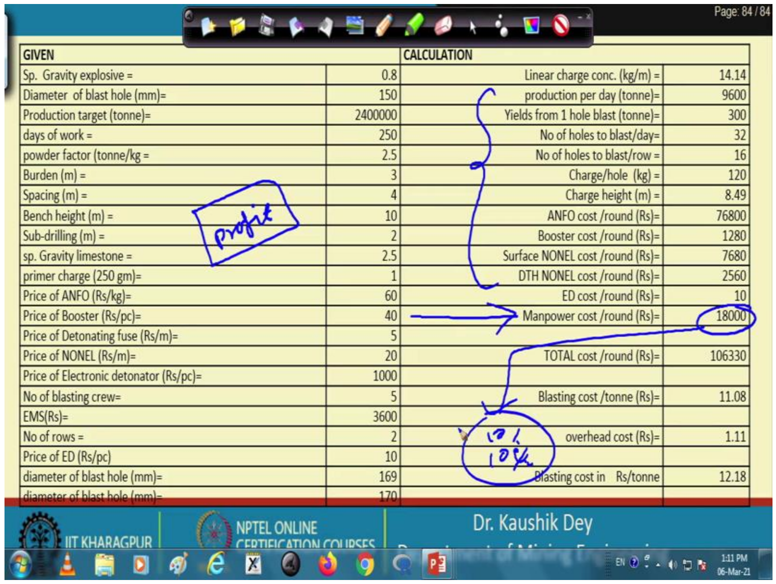

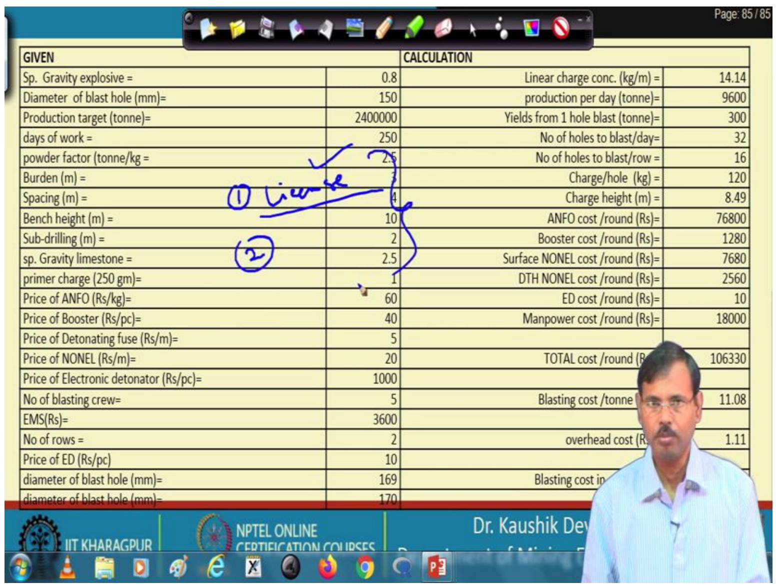

So, you can see in consideration all this. This is the specific gravity. This is diameter, production target, and days of work are given. Order factor, burden, spacing, bench height, sub-drilling, specific gravity of limestone, primer charge, ANFO, booster, detonating fuse, Nonel, and electronic detonator are assumed. I have taken five here; this is EMS, this is a number of rows, this is the price of ED, there I have considered 5 rupees, here I have taken it as 10 rupees. This is a blast hole. This is something I think there. Some problems are there.

So, this is the linear charge concentration. This is production per day per tonne. This is the yield from one hole. This is the number of holes to be blasted per day, number of rows, then charge per hole, charge height is obtained, ANFO cost, ANFO cost is obtained 76,000 rupees that is the

32 into 120 into the price of ANFO that is 20 rupees, 60 rupees which are considered. So, considering that it is there. Then booster cost, surface Nonel cost, we have considered spacing here, then down the hole Nonel cost, then ED cost is added, and manpower cost five-person of 3,600 rupees of earning per man shift that is considered here.

And then, by this way, we have come out with that the total cost for one round of blast is 106,330 rupees. So, this is the total cost of one round of blasting and if we are dividing it in tonnes, then the yield from one 32 hole blast, 32 hole blast yield is your 96. This is the yield for one round blast. So, the moment you are dividing this 106,000 with the 96,000, 9600 , you are getting blasting cost per ton. Overheads cost you have assumed 10 percent of this one. So, the blasting cost in rupees per ton is 12 rupees.

Say, if you are outsourcing this one, you also need to add a profit margin to this job, and in that case, you can go to find out the total cost. In general, most of the mines opt for procuring the explosive by themselves and often they go for outsourcing the manpower part. So, this is the amount they added to that overhead cost of 10 percent, and profit of 10 percent is added and awarded to the contractor.

So, this is the reason that mining organizations go for procuring the exclusive by themselves; there are two requirements. One is that generally obtaining a license is easier for a mining authority than in consideration with a contractual authority, so that is one second is that the security etc. is also an important part that can be taken care of by the mining authority. So, that is the benefit of this one. So, this one cost calculation provided here for a particular design which we have already discussed in the last class also, in this class also we have retrospect that one.

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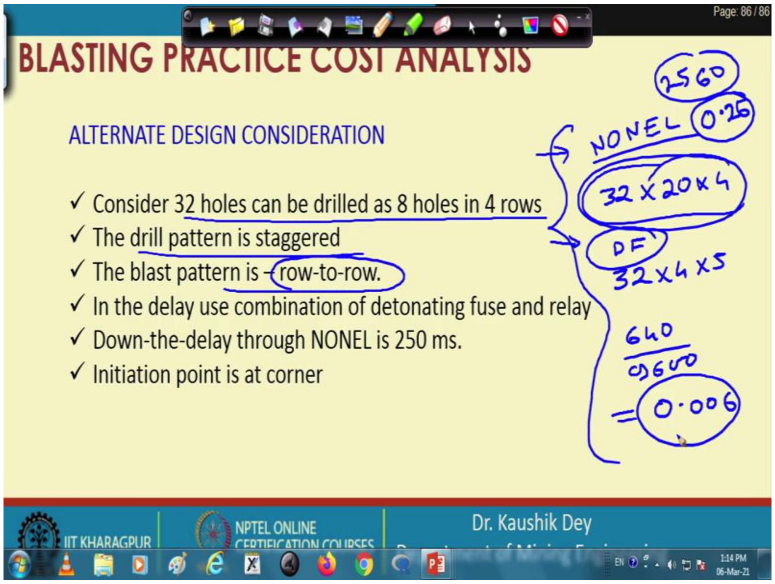

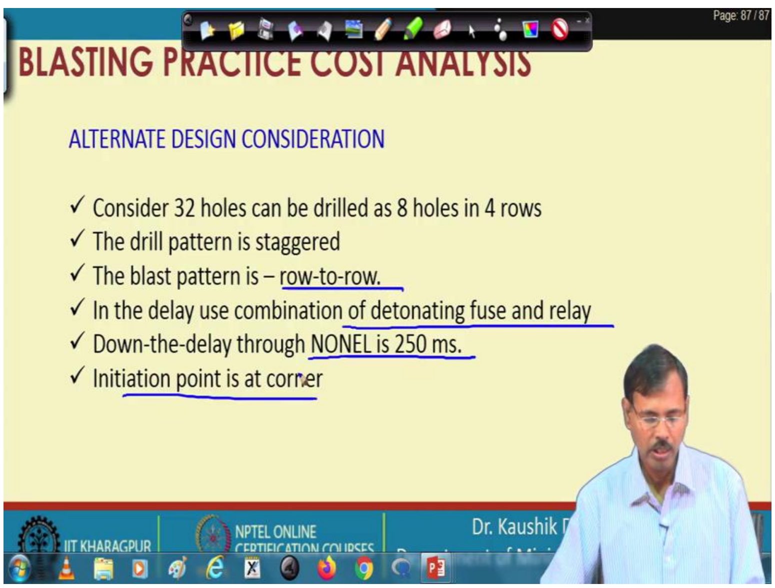

But there are maybe some alternate way of getting out that design and pertaining to the each design you can have the cost calculation. So, the cost will be a little bit different that 32 holes, 8 holes in 4 rows is possible, drilling pattern may be staggered. You can opt for row to row blasting using detonating fuse say instead of using Nonel there are 32 Nonels are used which are say 32 into 20 into 4 this is the surface Nonel price.

If you are using detonating fuse, then the price will be 32 into 4 into 5. So, you can see this much will be the difference if you are using Nonel and detonating fuse as the surface connections, if you are using detonating fuse as the surface connection and if you are using Nonel as the surface connection. So, detonating fuse it is 640 only and in this case, this is this much.

However, if you are considering it is spot on then it may not be, this is 0.006 and in this case it is 0.25, 26 maybe. So, this is cost is, maybe there is a difference of 0.20 paisa cost between the, these two. Similarly, if you are changing the different cost calculations, there are differences will be there, but whether it is significant or not significant one has to decide on this. So, this is the alternate design criteria. Row to row blasting is possible. Then surface connection is detonating fuse and down the hole connection is Nonel it is used and the initiation is taken from the corner point. So, this is alternate designing technique. So, in this case this will be different.

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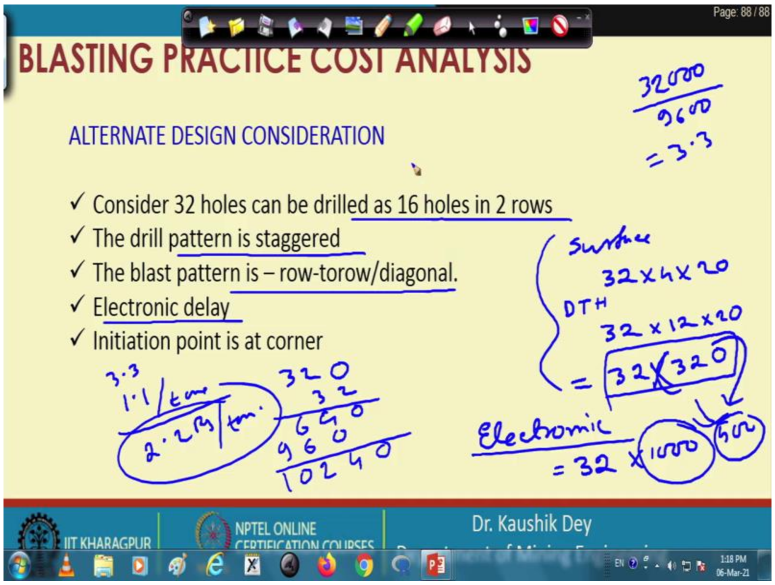

And this is again also possible with some different aspects 32 holes, 16 holes 2 rows, drill pattern is staggered and blast pattern is row to row or diagonal, you can use electronic delay. Now, suppose if you are using electronic delay, then your all surface connections will be removed. So, instead of having that surface Nonel which is 32 into 4 into 20 rupees, down the hole Nonel which is 32 into 12 into 20 rupees, so all together it is coming 32 into 16 into 20, so that is 320. So, that is the cost of using Nonel.

But if the electronic detonator is used then the costing will come 32 into say 1000 rupees. So, the costing is coming. There is a little bit difference in this. So, what, how much it is coming? Then if you are considering this, so this is almost coming 1 rupees per tonne and in this case it is coming 32000 divided by 9600, so it is almost coming 3.3 rupees.

So, that means using electronic detonator is directly adding a 2.2 rupees cost per tonne of blasting in this case. So, this is a little bit costly, but maybe the benefits are much more than that. You can have a better fragmentation. You can have better muck profile, which may be beneficial for the operations of the shovel and you can save a lot of money on that.

In fact, currently Indian manufacturer and etc. this price of Nonel has been found decreased significantly into a level of say 400 rupees, 500 rupees. So, in that case probably the cost difference will not be a significant one and the mine authority may think of changing from this Nonel system to the electronic detonator system. So, this is becoming a suitable, will be suitable technique. In fact, APEX bodies are seriously thinking about making the electronic delay a mandatory initiation system for surface blasting.

So, this is more or less related to the cost calculations of the blasting. I believe that if alteration of the designs is there, these participants can carry the cost calculation. I request all the participants to think of some alternative exercises, do those exercises in personally at your end and that will be instill confidence in you for calculating the drilling and blasting cost as well as designing the surface blast for particular mining operations. Thank you.