Drilling and Blasting Technology
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Lecture – 02
Introduction to Blasting Technology

Welcome to the second lecture of the Drilling and Blasting Technology.

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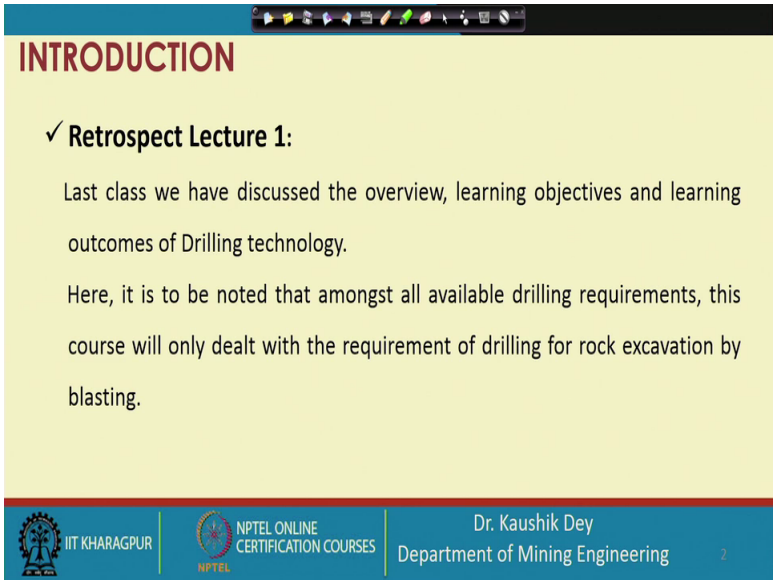

In last class, we have discussed about the drilling and the introduction to drilling is already discussed to you. You have understand the overview of drilling what is the present status in the world, what is the history of drilling in the drilling in the world as well as the rational status also. You have understood the learning objective why you should read drilling part and what is the objective of this course; and if you carry on this course what you can do in your professional life related to drilling. So, that was the retrospect of the last class.

And last class we have also mentioned properly that this drilling technology is limited to the drilling in the rock for excavation purpose this is the drilling in the rock for excavation purpose. Other drilling requirements though it was shown in the last class, but it is not the within the per few of this course.

So, this is for the rock excavation drilling for the rock excavation and the drilling is carried out only to place the explosive inside the rock so that the explosive can be exploded for rock excavation. So, basically that is why this course is drilling and blasting and now let us see; the overview of explosive.

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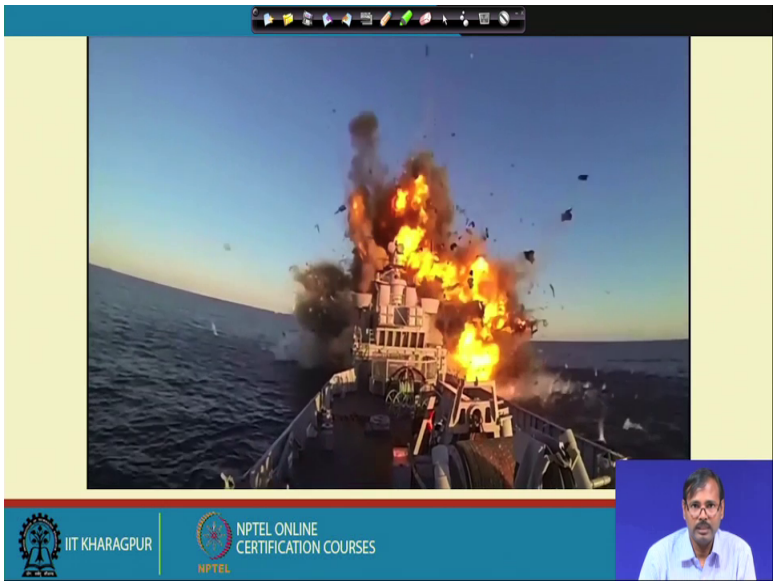

So, you can see the moment we talk about explosive you understand that something has to be exploded.

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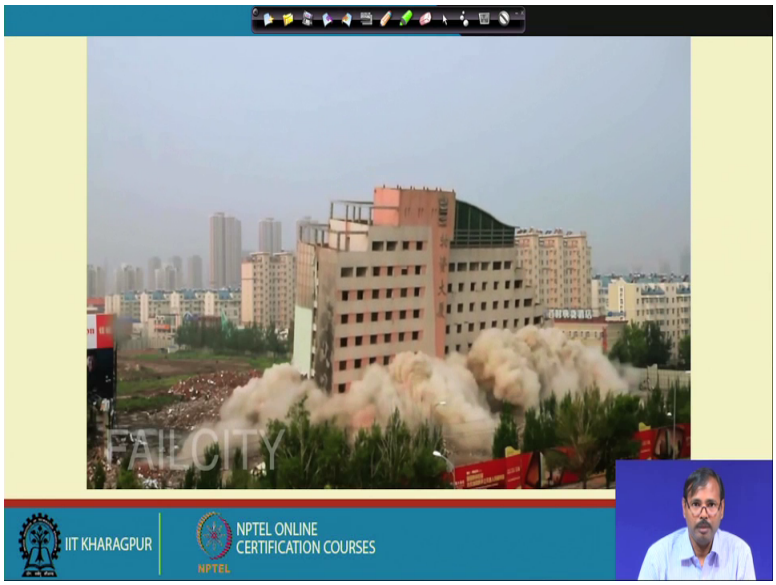

So, in this video you can see we are exploding a Military Amonisha, then we are exploding a building intentionally this building is being exploded because it is damaged it has to be exploded it has to be demolished.

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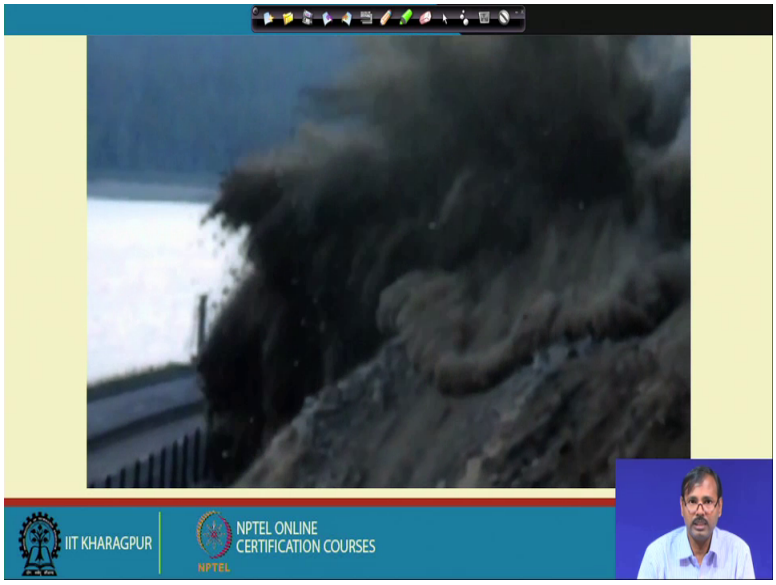

Similarly you can see in this video we are going for the excavation of the rocks for civil construction purpose. You see this rock is being excavated so that a newly road can be constructed in the Hilitera.

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So, this rock excavation is carrying out for civil construction purpose.

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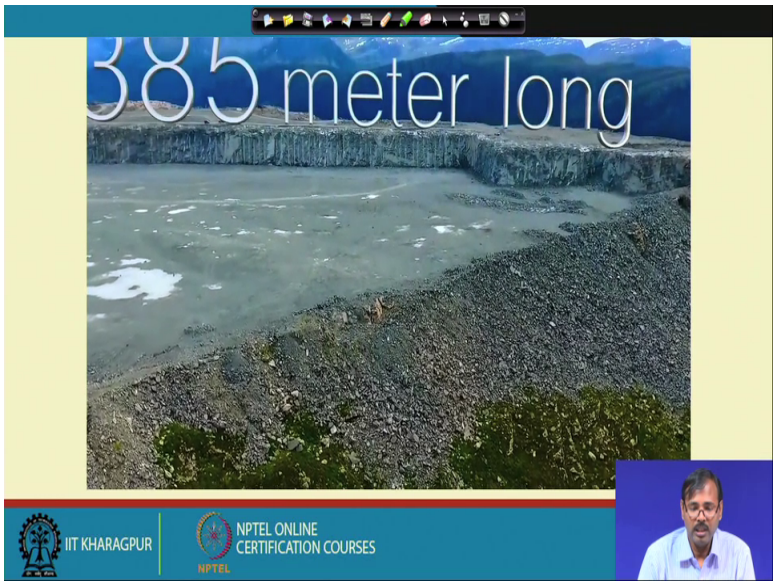

So, this you can see this is a mining case where the excavation is being carried out for the mining purpose.

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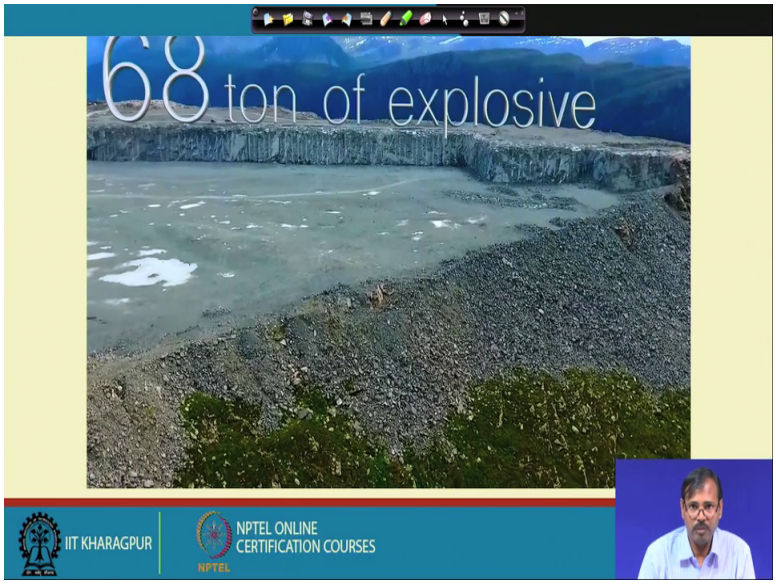

And this is a very good video you must observed this with a little bit patience.

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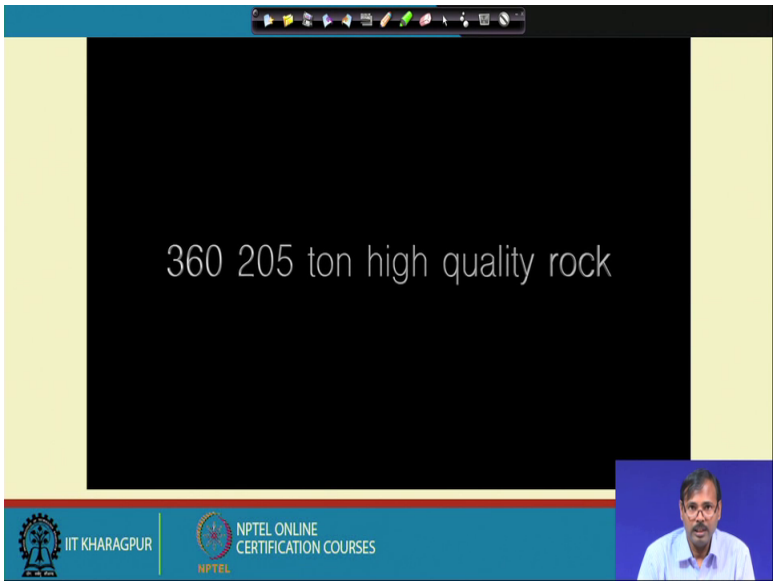

And I must tell that this is one of the very very good quality of blast.

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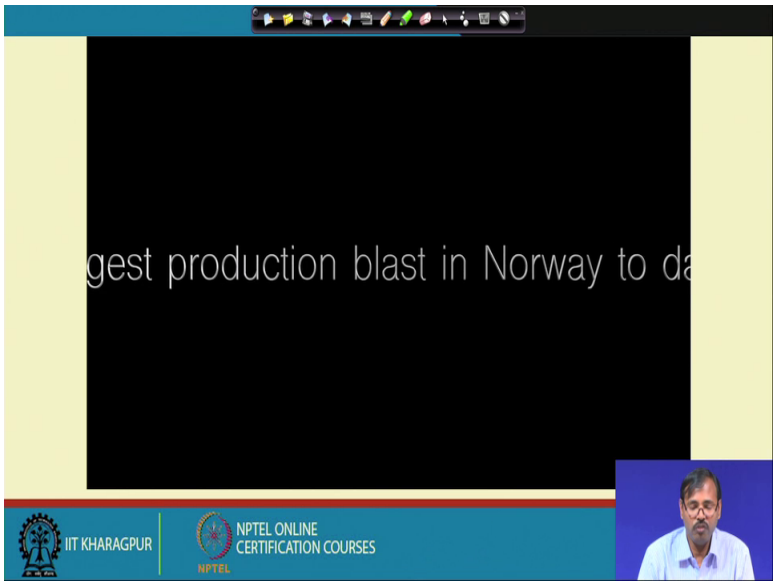

If anyone ever ask you can see and you can tell them that this is a very very good quality blasts carried out in this case.

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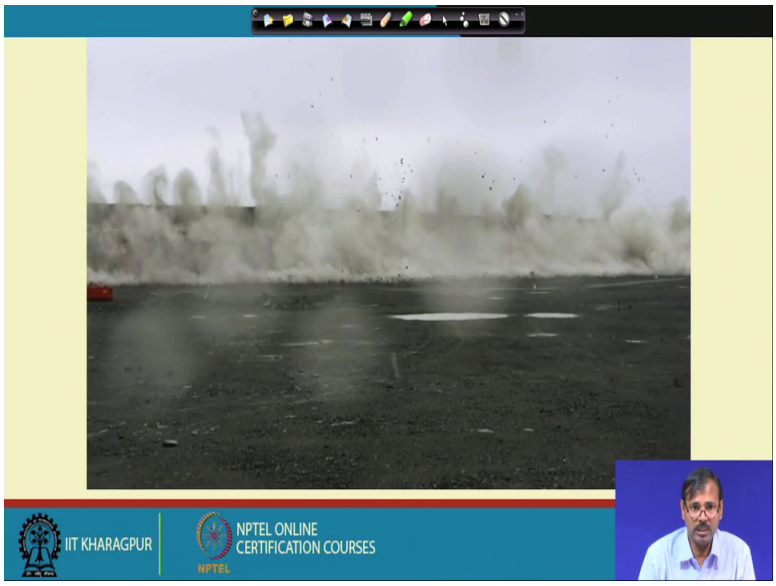

You can see so many explosive is being blasted, so many explosive is being blasted and the rocks are being fragmented.

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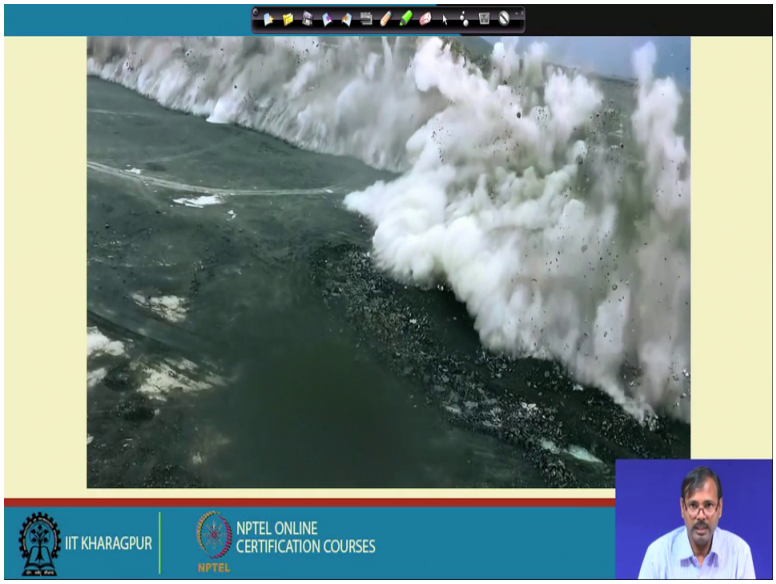

So, what is happened here, the drills are creating the holes in that hole explosives are given and the explosive when it is exploded the rocks are fragmented. And such a beautiful fragmented rock you can see the moment this gas will be goes out.

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You will find out how the explosion occurred and how the rocks are moving this is in a not in a real time this is a slowest time. This is showing in a very very slower mode and how fantastic fragmentation occurred. So, that is why I told earlier this is a very very good quality blasting.

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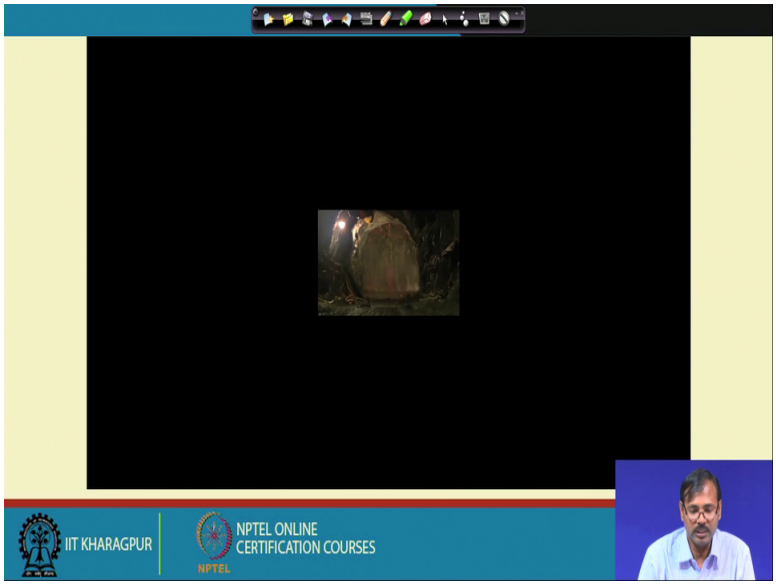

This is the explosive explosion in the underground case. You can see the holes are there and it is now initiated the connections are being blasted now, and after this blasting of

this connection you will find out the rock will be broken by the explosion of the explosive.

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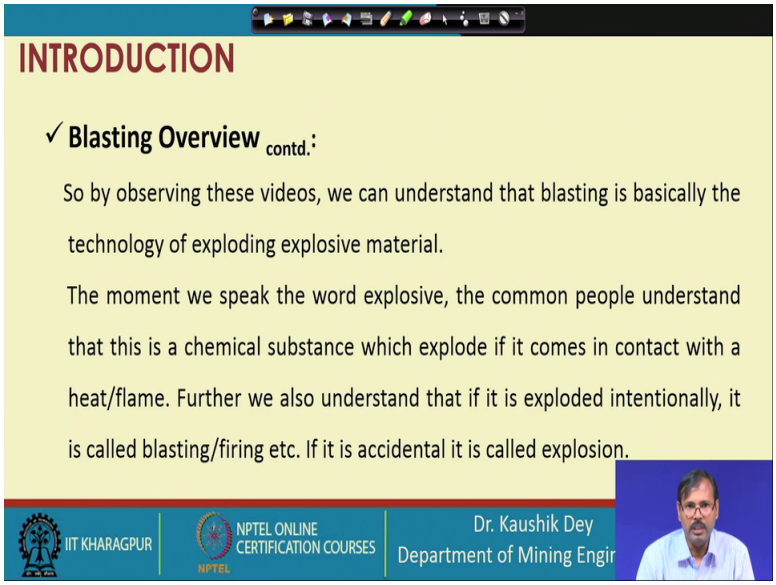

So, you understand that explosive is a chemical if it comes in the contact with the flame or something stimuli then it explores. And we commonly know this we know the explosive also which comes into the contact of heat or flame and exploded. And what is happened when we intended to do this when we want the there must be some explosion created by the explosive that is called blasting.

If it is accidently occurs that means, if the chemical is exploded but not as at our intention, but accidently that is called explosion. So, often you have heard that is may be some oil tanker is going on the street and it is exploded because, of some stimuli or some fire comes into the contact of the oil it is exploded that is unintentional that is why it is called explosion.

If intentionally it is being done then this is called blasting. So, basically explosive the moment which utter this term we find that this is this causes the people they are very very sensitive by hearding this term explosive. The reason is explosive is a small chemical and huge quantity of energy is stored in this. And the most problematic is the moment this energy is released it is released almost instantaneously. So, these instantaneous release of the energy from a small source make it so dangers, that is why people are afraid of this. People do not like to touch it, do not like to come in close to

this and the moment some explosive is recovered from some place the total area has been asked bracketed. So, because of this enormous storage of energy explosive is so many, so dangers. So, that is why this explosive handling is very very careful and explosive must be taken care by the authorized person who knows the details of the explosive.

In fact, this course is such so that after going through this course a person should be considered about the expert in explosive and blasting, and he can be considered as a competent person who can handle explosive for any case. It may be during the rock excavation case, it may be during the handling of explosive case, it may be during the manufacturing of the explosive case. So, that is why this attending this lectures in this course is very very important to know the details of the explosive and blasting of this.

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So, let us see the history of the explosive first. What was happened in the ancient china first explosive was discovered and no one knows who has discovered it, but the explosive still which we are using in our crack as our crack are etcetera that explosive was developed in the ancient china and they develop that for their amusements. And that is the first discovery of explosive and that was the only explosive since the middle age, later on those formula were stolen by the European people.

And then those formula were used in the Europe for a long time and the further development or related to explosive were occurred in the Europe, USA, Australia etcetera. And this explosive history is very very interesting and you will find out most of

the time the new explosives are developed from some accidents. So, explosive basically a chemical which is storing huge quantity of energy, people are afraid of that and it is essential that we should know how this energy should be released from that small chemical and how that can be in the controlled manner will be utilized for as far our intention.

Basically a rock excavation is also one type of that. We utilize this huge energy for some good of the civilization where we break the rock for the development of the civilization. But as you have seen the video there we have found the first video was shown to you that one navy ship was releasing one missile which is carrying the explosive. So, this is basically the use of explosive for the war or terrorism.

And see this is very very unwanted use of the explosive, probably that scientist who discovers those explosive never thought of this type of utilization but anyway this is not within our hand. But we classify this type of use of explosive as the military blasting so that we this is completely unwanted for us.

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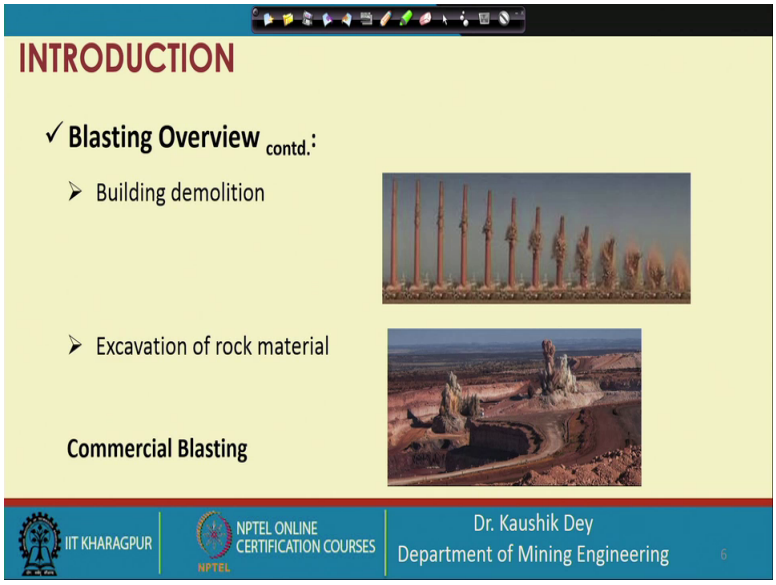

We are morely interested in the use of explosive for the blasting of our commercial requirement, one requirement is the building demolition; one building demolition video is already shown to you. This photograph I am showing to you where n n number of chimneys are there which are being blasted for demolishing so that the economically the structure will be demolished. And another requirement is the excavation of the rock

material some of the excavation of the rock material videos are shown to you this is one similar type of use of explosive. And this type of use of explosives are called commercial explosive.

But this is not the limitation of the use of the explosive, apart from this there are other use of explosive. Say one very good of explosive is being carried out by the geological exploration people where they explore the explosive inside the earth crust to generate the seismic waves which they utilize for their seismic exploration of the earth crust.

In fact, say oil are being explode of that type of cases, exploding some explosive inside the earth crust seismic waves generates the reflected seismic waves are measured and the resources of the oils are identified like that way. So, there are n number of such type of utilization of the explosives are there which are commercial use, but not for the military purpose not for the excavation purpose, but for other purposes we are using.

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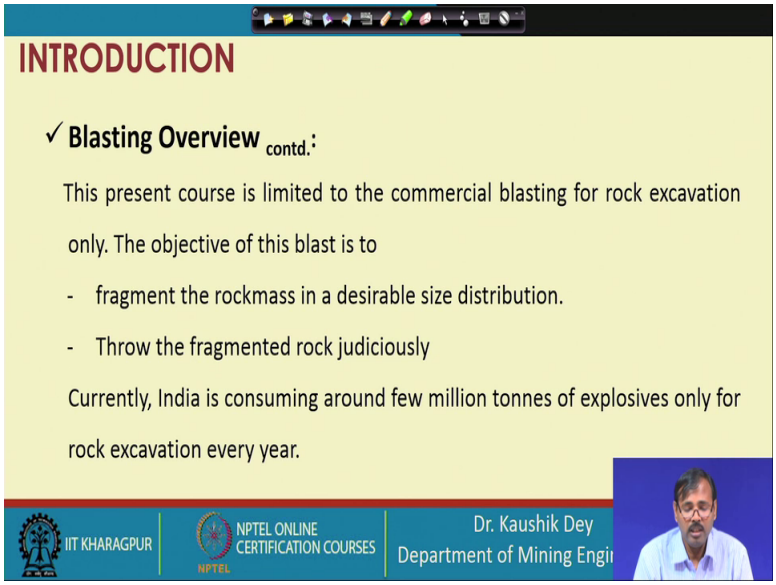

This present course is limited to the commercial blasting of the rock excavation only and the objective the, of this blast is to fragment the rock mass in a desirable size distribution. This is very very important. This is not that we are fragmenting the rock mass in some few number of very large species and few number or huge quantity of dashes that is totally unwanted, we want that the fragment size should be there that means, the rock mass will be fragmented in such a manner different size of fragment

should be generated. So, this generation of different size of fragmented rock is called fragment size distribution.

So, we want the explosive should be use such a way, so that the rock mass will be fragmented and fragmented to a desirable fragment size distribution. So, that is the main objective of use of explosive for the rock excavation. There are other purposes also of using explosive in the rock excavation, but the primary purpose is that we want to fragment the rock to our desirable size distribution. So, this is our essential requirement that we must use explosive place those explosive in our drill holes such manner so that the explosives explode the explosive energy is will be utilized for fragmenting the rock.

We want to throw the rock also. So, that it is fragmented and it is dislost or moved a little bit but we do not want that it should move a lot. We want that fragmented rock should move a little bit so that some loading machine some gathering machine should come and take out the next processing or next handling of the fragmented rock.

So, this throw of fragmented rock is wanted and it is wanted judiciously and if you look into the present days scenario. In India only for rock fragmentation purpose we are using few million tons of explosive every year. So, let me give you some account of rock excavation what we are carrying out in India, not the world scenario in Indian scenario. In Indian scenario we are excavating more than 2 billion tons of material that means, 2000 tons million tons of material we are excavating every year from more than 4000 mines. And we are utilizing few million tons of explosive for excavating those rocks, this is for the mining purpose only.

Apart from that huge quantity of explosives are also required for the civil excavation purpose, in the tunnels in the road ways, in the trenches in the metros all those places we need to excavate the rock using the explosives only. But there are some problems of using explosive as a source of energy for the excavation purpose.

The firs problem is that explosive is chemical source of energy we utilize that in blasting for releasing the energy utilize that for fragmenting the rock. But what is happened this release of energy from chemical to the mechanical shock energy or to the heat energy which is being carried out in the explosive is very very uncontrolled. That means, the release of energy from explosive is very very uncontrolled and that is why a knowledgeous person, a technically competent person is essentially required to design

this explosions. Unless and until this explosions are designed to be termed as blasting this explosion can go to anyway, it may lead to a positive way to the negative way.

So, that is why we do not want that should be any injury, we do not want there there should be any fatalities while the blast is being carried out, while the explosive is being handled. And that is why this course is very very important for generate the competent man power, to generate the competent man power in the field of drilling and blasting technology.

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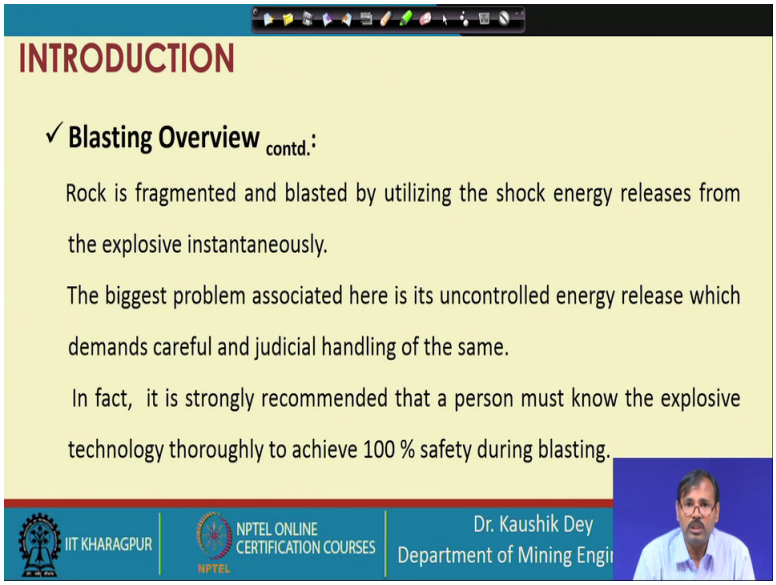

So, rock is fragmented by blasting utilizing the shock energy releases from the explosive and; remember this release of energy is instantaneously. If you look into the intension of the releasing of energy from explosive it is almost less than a millisecond. So, that is why this release of energy can be considered as the instantaneous release of energy and this is very very high. Often the pressure which is generated by this release of energy exceeds 2,50,000 bar so that means, this is very very high this is more than 250 kilovolt pressures are generated by the explosions which if something comes in front of that explosion it will reverse it that one.

And this biggest problem of uncontrolled energy release demands very very careful and judicial handling of the explosive. Therefore, it is very strongly recommended that a person must go through the basic courses of drilling and blasting prior to be considered

as a competent person as the blaster or as a blasting technologist who can give 100 percent safety during the use of the blasting.

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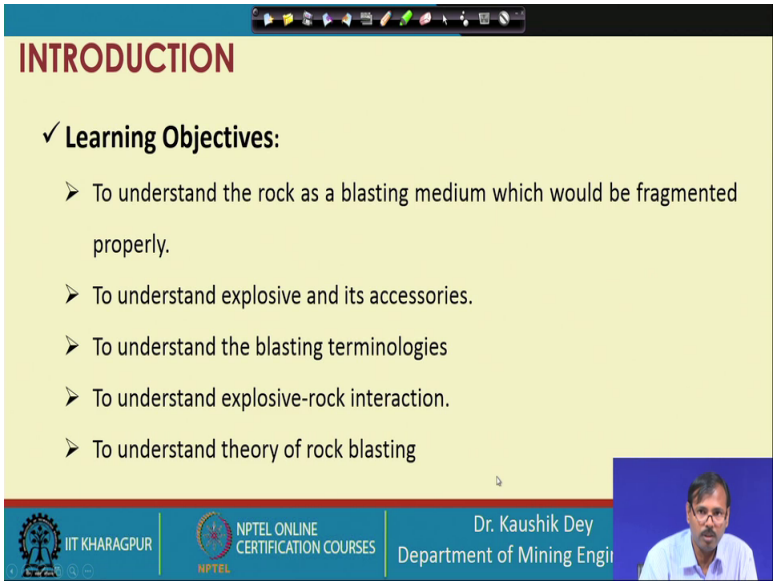

In fact, use of explosive or handling of explosive by in competent persons are strictly banned as far the low of the country nowhere throughout the world it is allowed to handle hold use explosive by any incompetent person. So, this course is designed to achieve the objectives, first again as we are using explosive to fragment the rock here the rock is the medium. So, first we need to understand the rock as a blasting medium which would be fragmented properly, so that means, we have to place the explosive inside the rock. How it will be placed? It should be distributed inside the rock mass. How it will be distributed? It will be specially distributed that means, it will be distributed in space.

If you think imaginary that to achieve the best fragmentation what we want? That, we want that every small cube of rock should have a very small element of explosive, so that it can be fragmented properly and that explosive must be placed at the center point of the block. But practically this is not possible we have to drill as per our desired drilling pattern. So, that we can distribute the explosive specially inside the rock mass and this special distribution this special distribution will give us good distribution which can give us the better fragmentation which can give us the desired fragmentation of the rock mass on exploder of this explosive.

We want this course one of the objective of this course again that the student should understand the different explosives and the accessories. Say explosive is the requirement is the storage of energy which is the requirement to release the energy for the blasting but explosive need some accessories also. These accessories are essentially required to provide the safety of the people who are handling.

This not only that this will also provide the tool to the user where he will control the release of energy from one position to another position; That means, this accessories is the tool this accessories are the tools for the blast designer blast engineer where he will control the release of the energy inside the rock mass apart from that he is achieving his own safety using this accessories. So, these accessories are very very important in the explosive and its use in the commercial blasting.

Blasting always associated with some special terminologies say I am giving one example say burden. Burden means if you are coming to the literally term burden, burden means something which is dumped on to you are unable to withstand the load of that that is called burden you may tells us that is giving more burden to us more that means, I am giving more task to you. So, this burden, but if you are using a burden term in the blasting then the burden term is different, because here burden is the, a specified length of rock mass which is intent to be blasted by one group of explosive. So that means, the terminology is little bit different in the blasting and a blasting technologist a blasting engineer must know the use of this terminologies.

So, one objective is to understand these terminologies. Then next which is very very important and personally I believe without this knowledge and explosive engineer should not be considered as a explosive engineer that is the understanding of their explosive rock interaction. That means, the moment explosive is generating the seismic waves, explosive is generating the mechanical wave, how that mechanical wave is interacting with the rock, how that is propagating, how that is fragmenting the rock mass, how the fragmented rock mass are disperse from the place or move from the place. If explosive engineers are unable to understand this then they cannot be considered as the competent person. So, this is very very important objective of this course I want each and every student must understand the explosive and rock interaction.

And this explosive rock interaction will lead you to the understanding of the theory of rock blasting, how the rocks are being blasted in different conditions different special distributions, how the rocks will be blasted that is the theory of the rock blasting. This is one of the main objective of this course.

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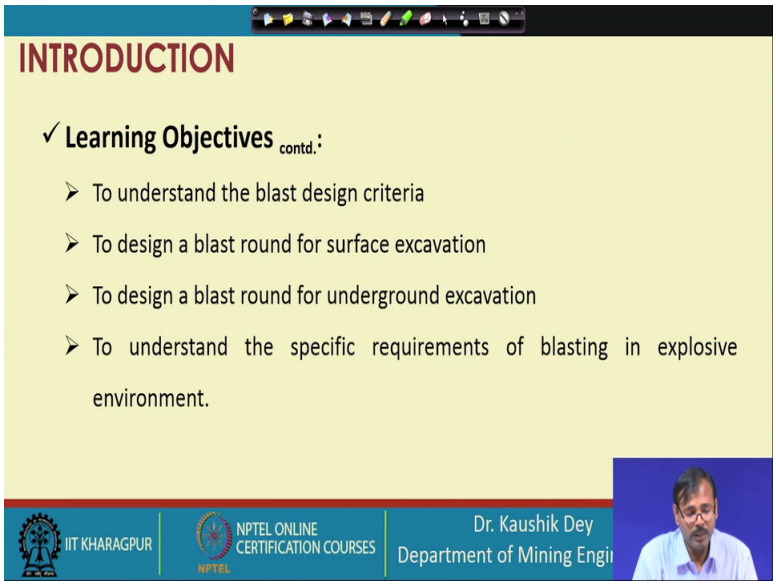

This based on this blast theory one has to know the blast design criteria. Then if the better is like this a blasting engineer should be given task a blasting is engineer should be given task that you have to address you have to address this solution that means, you have to address this fragment size distribution with this quantity of through and with limitation or with the constant of these are the other environmental parameters. So, this is the constant which you need to address this is the target which you need to address and for that you have to design a blast. So, understanding of the blast design criteria is very very important.

The next point is to design a blast round considering criteria one person has to design the blast round. Again it is for surfaces excavation that means, the second one is underground excavation that means, whatever is the excavation whether it is in the surface or it is in the underground the laydown target is there desired fragment (Refer Time: 27:16) issues, design control breaking, desired throw all these targets are there. Constants are there film characteristics constants are there, vibration constants are there,

throw of the rock, fri rocks etcetera all those constants are there one has to address those constant, one has to address those target and considering that he has to design the blast.

Apart from that specific requirement one has to understand which leads to the, which is required in the blasting in the explosive environment. That means, if you are considering the case of the underground coal mines where because of the occurrence of the methane etcetera it is the environment itself is the explosive environment still the blasting has to be carried out for excavating the rock.

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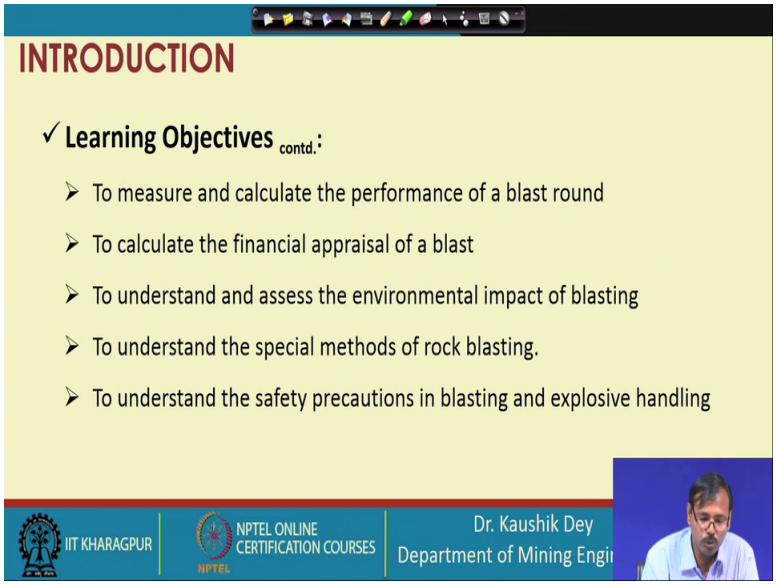

So, the special requirements are there and the blasting engineers should understand those requirements. Then the next objective is to measure and calculate the performance of a blast. I strongly believe if the performance is not measured, performance is not calculated then the technology cannot be approved, their technology cannot be accepted. So, the moment a blasting engineer is designing some blast he must able to measure or calculate the performance of this, he must able to calculate the financial appraisal of the blast.

So, that either that blast is economically acceptable or not that can be addressed. And not only the end of that performance, but also essential it is required that the student must able to understand and assess the environmental impact of the blasting. So, that is very very important the blasting should not create any nuisance to the environment.

There are some special blasting methods required that has to be one of the objectives student should learnt. And the last, but very very important the safety precaution requirement in the blasting, and in the explosive handling; This is essentially required because the explosive is the huge source of energy and that immature release of that may lead to any type of fatality.

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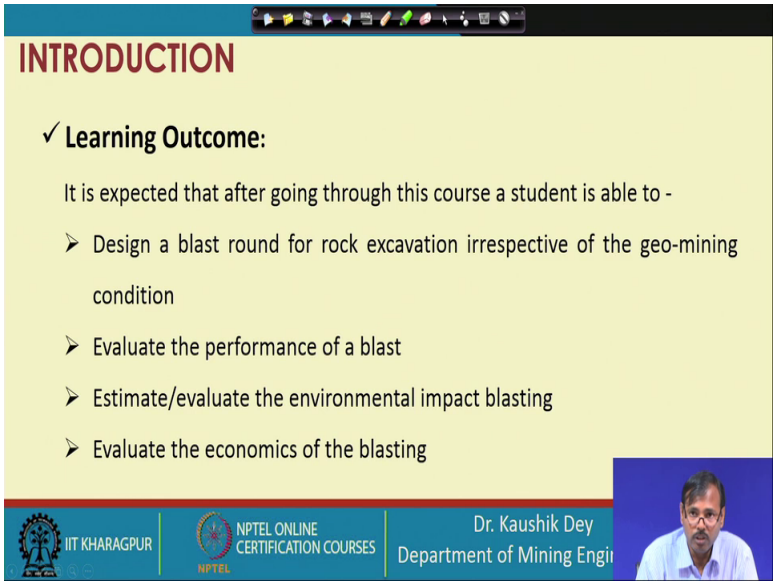

So, what is the expectation? My expectation that if a student is appearing in this course studying it well he must able to design a blast round for rock excavation, irrespective of the geo mining condition. It may be strong rock, it may be weak rock, it may be in the underground case, it may be the surface case, it may be a surface case where the inhabitance are very close we do not want that rock should fly to his house. It may be the surface case where some in a sensitive structure is there historical structure is there. It may be the case where explosive environment is there like underground coal mines, but we need to blast it. So, in this all type of cases rock has to be excavate because it is the need of the civilization and our student must address by designing those rock excavation by blasting after going through this course.

I must want that a student also should evaluate the performance of the blast what he has designed. He has designed a blast if is enable to evaluate its performance, evaluate its economics, evaluate its safety, a precautions then it is very difficult. So, that is why the students should know how to evaluate the performance and they must evaluate the

performance in economic term, in safety term in environmental term. They must estimate or evaluate the environmental impact of the blasting; they must evaluate the economics of the blasting.

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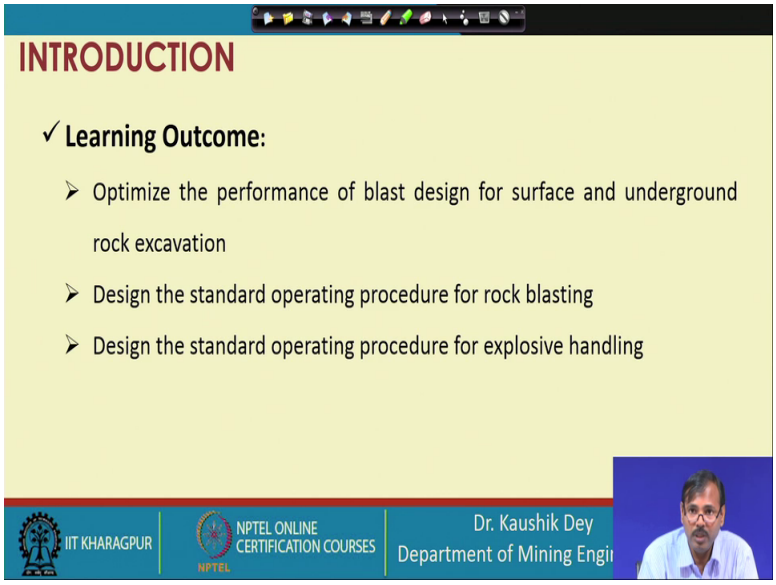

They must know how to optimize the performance of a blast in case of surface and underground mines. Say this is very very very important part say always having the highest profit may not give you the optimized one say highest profit may be may be achieved in the blasting unit operation only but that may lead to loss in other unit operations

So, optimization is very very important where all the unit operations will be considered and the overall costing will be minimized. So, optimized performance by a blast design for both surface and underground excavation is very very important and I want my student must know how to do this one.

And this must lead to two sop standard operating procedure our the student who are attending this course should able to design the standard operating procedure for the rock blasting. Because everyone in the vicinity of the blasting area everyone associated with the blasting practices should know this standard operating procedure, because there may be a small mistake by a person that may lead to the parolity of 20-30 people.

So, that is totally unwanted we do not want any ignorance should go for that one that is why standard operating procedure must be developed and must be followed for every blasting practice. And not only in the blasting practice, but also it is essentially required for the explosive handling. That means, the moment you are releasing you are issuing the explosive from the magazine from that moment till the explosives are being used in the mines for the blasting.

And the excess explosives are return back to the magazine again for their storing purpose till then the magazine the explosive everything has to be handled with the standard operating procedure. There should not be any deviation allowed in the standard operating procedure, and I want the people who are attending this course should know how to design this sops.

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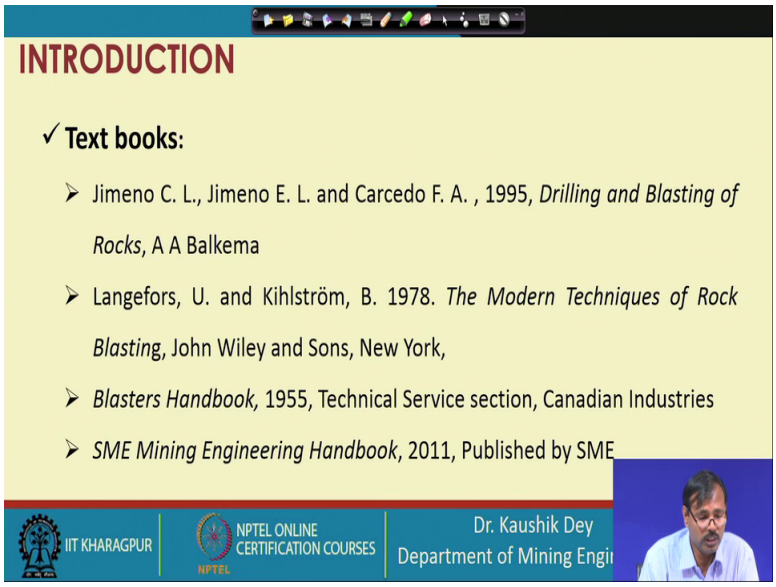

Now, let us consider the textbook and reference books. So, these are the books students must follow during this course. These books are very good; these books are available in the internet, available in the most of the libraries.

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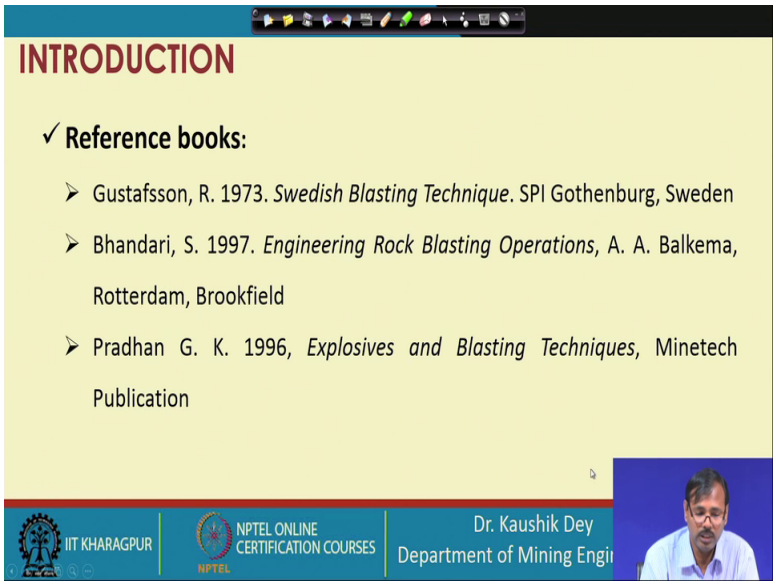

There are some reference books also which are available very commonly available to the libraries and the internet resources. Apart from this lectures produce that could be helpful for the students for their using this in this course.

Thank you.