MINERAL ECONOMICS AND BUSINESS

Prof. Bibhuti Bhusan Mandal

Department of Mining Engineering

IIT Kharagpur

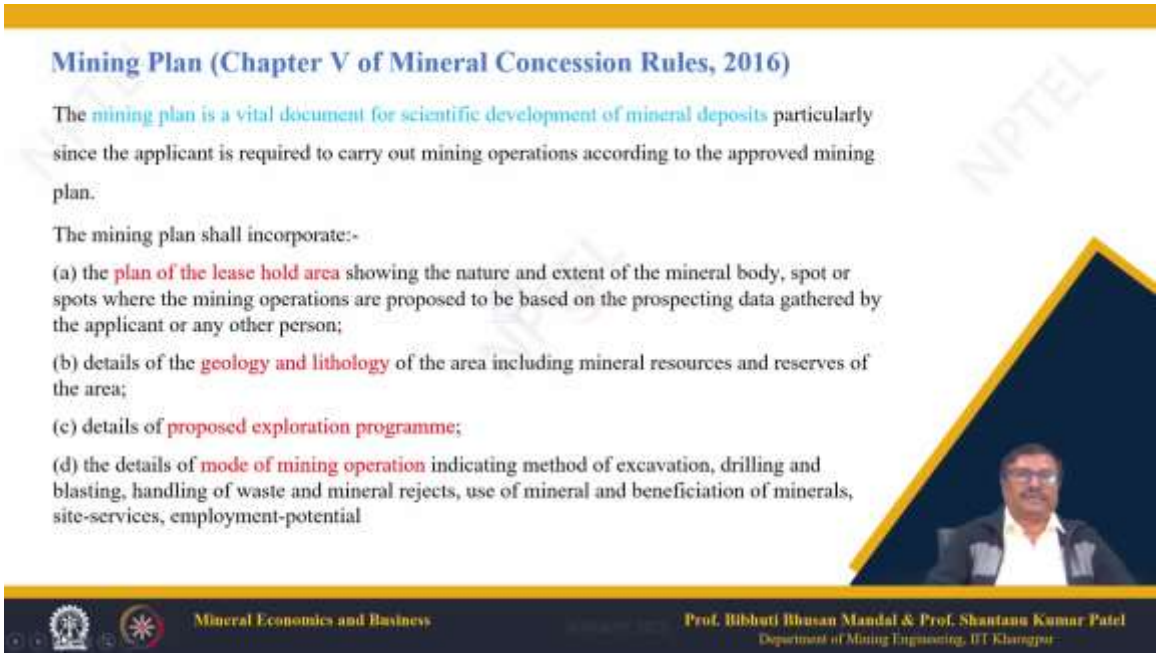
Week 2

Lecture 10: Mining Plan, Sustainable Mining and Mine Closure Plan

Hello once again, welcome to my class. In this lecture, we will be talking about the mining plan. Sustainable development framework, or sustainable mining, and the mining mine closure plan. Now, these are, at the moment, at this particular point of the course, relevant to discuss once we have covered certain basic ideas about the reserve classification and certain provisions of the acts, rules, and regulations. Now, we will be switching over to certain specific things which are very important for the mining industry. Now, the concepts that will be covered include the outline of the preparation of the mining plan—that means the different aspects that must be covered in the mining plan—and then the sustainable development framework.

Sustainable development framework, which is basically a document or a process through which we try to enforce the sustainability of the mining operations through a statutory

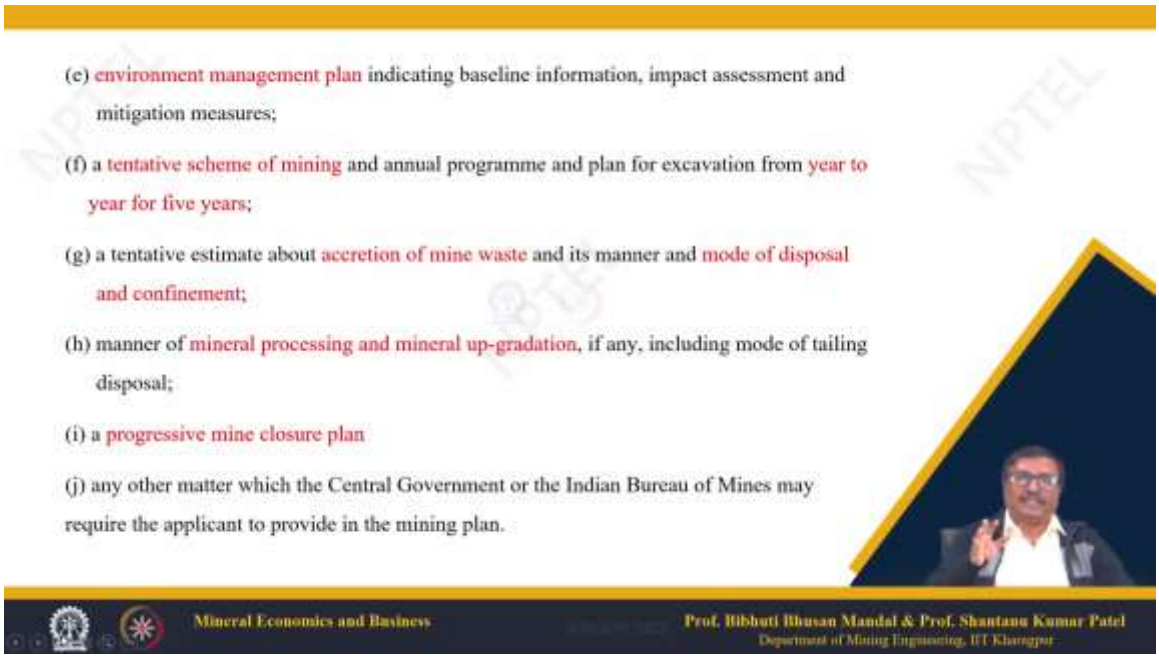
framework. So, that is a very important and significant development. In the regulatory framework in our country, and, of course, the mine closure plan. We will, to start with, take up the issue of the preparation of the mining plan. This mining plan is a vital document for the scientific development of mineral deposits.



Particularly since the applicant—meaning here the person who is applying for a mining lease— We have seen, or we have studied in our previous lectures, that when you are submitting an application for the grant of a mining lease, In that case, you are attaching or enclosing a copy of the approved mining plan. So, this mining plan is a very important document. So, the applicant who is asking for the approval of the mining lease or grant of mineral concession.

He has to follow or carry out the mining operations according to the approved mining plan. So, the importance lies there that it gives a broad framework of how the mining will be done in the entire period of the life of the mine. This mining plan shall incorporate or must incorporate the plan of the leasehold area. Plan of the leasehold area which shows the nature and extent of the mineral deposit spot or spots where the mining operations are proposed to be based on the prospecting data gathered by the applicant or any other agency or person. So, this will basically show our leasehold area and the locations of mining operations.

The mining plan will also give the details of the geology and lithology of the area, including mineral resources and reserves of that area. So, these resources and reserves have to be categorized or presented in certain Like we have studied the UNFC, United Nations Framework Classifications. We have to follow the formats that have been prescribed, and we have to document those things.



We have to include these mineral resources and reserves in the mining plan according to that format. The details of the proposed exploration program have to be included next, along with the details of the mode of mining operation. This is a very descriptive part and very concrete in the sense that it will indicate the method of excavation. So, whenever you are going for open-cast mining, how you are approaching the operation, how you are starting it, how you are slowly developing it, and then how you are going for the complete development of the mine in the full production stage. The drilling and blasting procedures, say, in underground mining, the entire development and mining operation—how you are developing different levels, how you are making the stopes, how you are drilling and blasting, and then removing the ore from the stopes, how you are handling the waste and mineral rejects.

and the use of mineral and beneficiation of minerals. That means how you are enriching the ore or mineral grid, site services and the employment potential. So, these things are to be categorically mentioned in the mining plan document. How much people will be

employed in that mine? And then there is a broad category of deployment of manpower in that mine.

All these things has to be recorded in the document. If you are say talking about mineral beneficiation, Then you have to give the entire process and your even circuit or the process diagram how you are feeding the ore, how it is being processed and what output you are getting everything has to be indicated in the document. Now next and very important is the environmental management plan it is known as as EMP. So, this indicates the baseline information that means before mining what was the ah condition then there is an environmental impact assessment that means EIA environment impact assessment and then what mitigation measures you are you are taking.

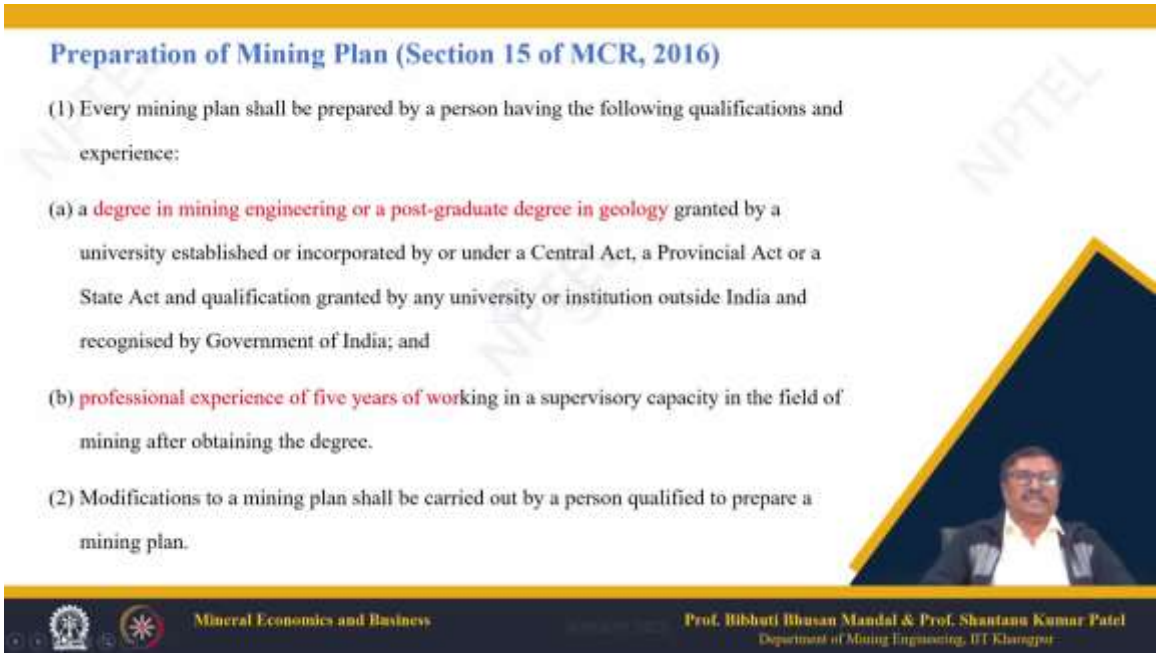
We are proposing in the mining plan to mitigate the adverse effects that may be due to the mining operations. Next is a tentative scheme of mining that means now we had a mining plan for say 20 years 30 years or 50 years ah broad ah outline how the what geology ah data what exploration what method of mining what development you are doing how the road connections transport everything you are giving for say the life estimated life of the mine. Now for the first 5 years Year to year you have to give a tentative scheme. Say we start the mining operation then from first year to the fifth year.

So, year to year for five years this part will be in details that means, every detail has to be included in the scheme of mining. Now when you are mining mineral deposit then you have to give a tentative estimate of the mine waste that you generate. And the way you are disposing of this waste and otherwise how you are confining. I will give an example if you are mining say copper or zinc or say lead. So you may be generating huge amount of tailing from there.

or uranium. So, you may be generating huge amount of tailing. So, are you disposing them? So, are you following the government guidelines how you are disposing them? And if you are not disposing then you are confining in a tailing dam.

So, that entire scheme of operations of handling the mines waste either in the process of disposal or confining the waste material that has to be mentioned in the document. Now the manner of mineral processing and mineral upgradation, this upgradation is nothing but enrichment. So, including mode of tailing disposal, here we have a complete

description of the processing and the beneficiation and the mode of tailing disposal, how you are handling, how you are transporting through pipelines, where you are dumping and then how you are gradually increasing the embankment. And how you are containing the entire telling that you are thinking that you will be generating. Are you using the telling for any other purpose that has to be mentioned there completely.

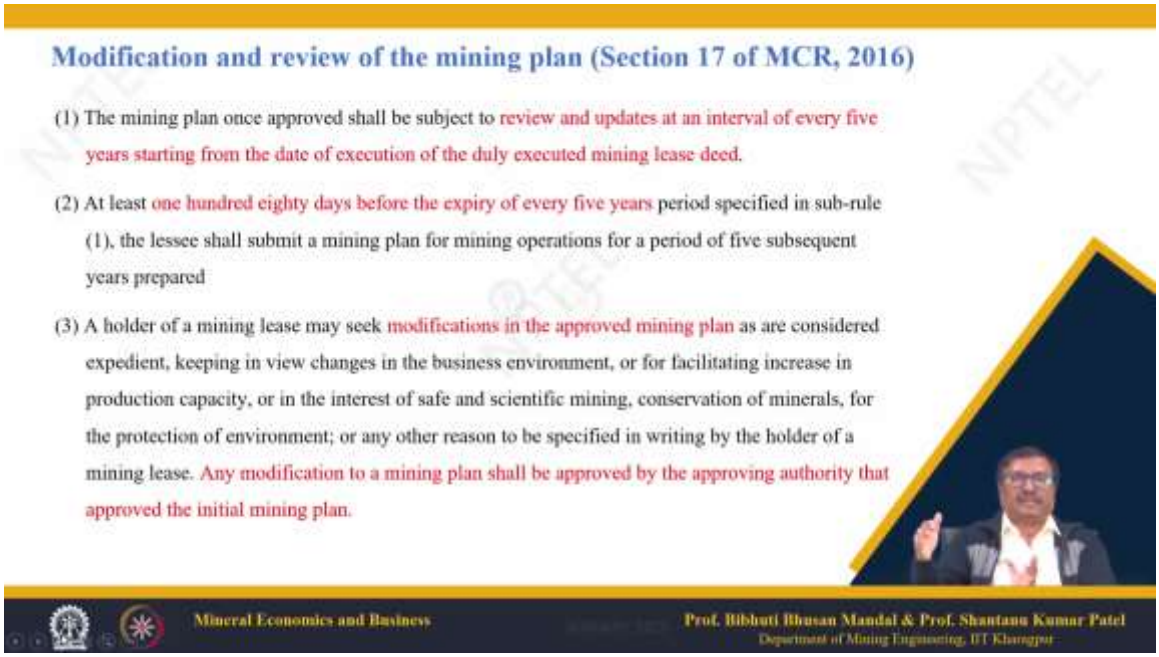


Then we have the progressive mine closure plan. We will be talking about the mine closure plan at the end of the lectures. But here, let me tell you that nowadays, if you start a mine, you need to think about the closure plan of the mine right from the beginning. That when you are continuing with or advancing the mining operation, you have to take the mine closure actions at every stage. That is why we call it a progressive mine closure plan.

That means it is not so that the mining is completed and then we go for the closure action—not at all. So, the closure action follows the mining operation. The mining goes on, and the mine closure actions are also following that. So, by the time you reach the end of the life of the mine, you are almost done with the closure. So, with a little bit of proactive actions, then you can complete the closure actions very quickly.

Other than this, depending on the case, the IBM or the central government may advise the applicant to provide certain information in the mining plan. Now, this mining plan, as we understand by this time, is a highly technical document and has to follow a specific detailed format. So, now, who are the people who are authorized to do this work? So, at least a degree in mining engineering is required or a postgraduate degree in geology. And then, the person must also have professional experience of five years of working in a supervisory capacity in the field of mining after obtaining the degree.

That means the person should be either a graduate in mining engineering or a postgraduate degree having a postgraduate degree in geology and must be having a 5 years professional experience in this field. Now when this document is submitted and scrutinized and approved by the government, so in future during the work you may think of a better method or some method which is some modification in the mining plan which is required depending on the specific situation that the managerial team must be facing. In that case you have to apply for a modification in the mining plan. So, these same people like the qualified people will prepare a modified mining plan that has to be again approved by the central government. Now, the mining plan once approved shall be subject to review and of course, updates at an interval of every 5 years.



So, you just before the expiry of 5 years that 180 year days that means, 6 months before the expiry of the 5 years period, we have to submit a mining plan for mining

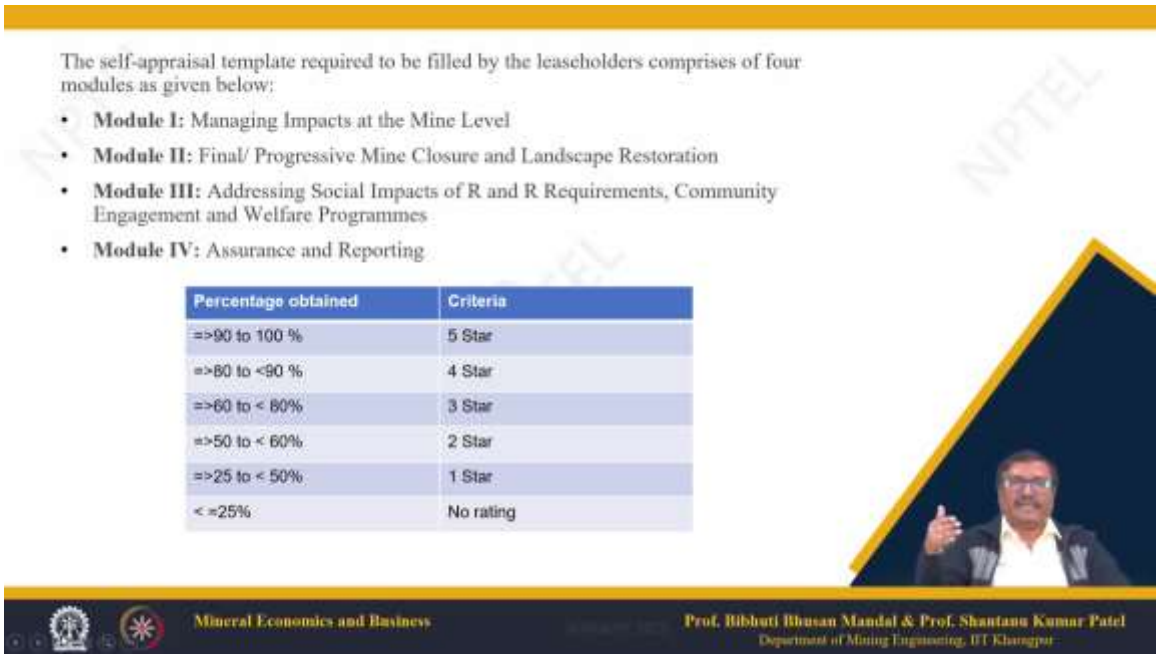
operations again for a period of 5 subsequent years prepared. That means now we will give another detailed for the next 5 years. Now we can ask for a modification of the approved mining plan as I was saying that as we consider expedient depending on case to case basis keeping in view the changes in the business environment or facilitating increase in production capacity or in the interest of the safety or scientific mining conservation of minerals we want to include certain information in the in the document we have to change certain documents which is required based on these parameters which we mentioned earlier.

So we have to now give them in writing and the holder will ask for a modification. So this modification of the mining plan shall be approved again by the same approving authority that initially approved the mining plan. Once we have talked about the mining plan which is a highly technical document and a guiding principle rather for the mining operations carried out by any mining company. We need to now think about this sustainable development framework or the how we ensure that the mining will be sustainable. That means the sustainability question mostly is linked to the environmental degradation.

or its adverse effect on the environment, flora, fauna, and the total ecological balance. That has been going on for decades after decades. So, now throughout the world, this sustainable development framework has been adopted. In our country also, we have

adopted sustainability into the mining operations, and since it is now through a regulatory framework, so it cannot be so easily avoided at all.

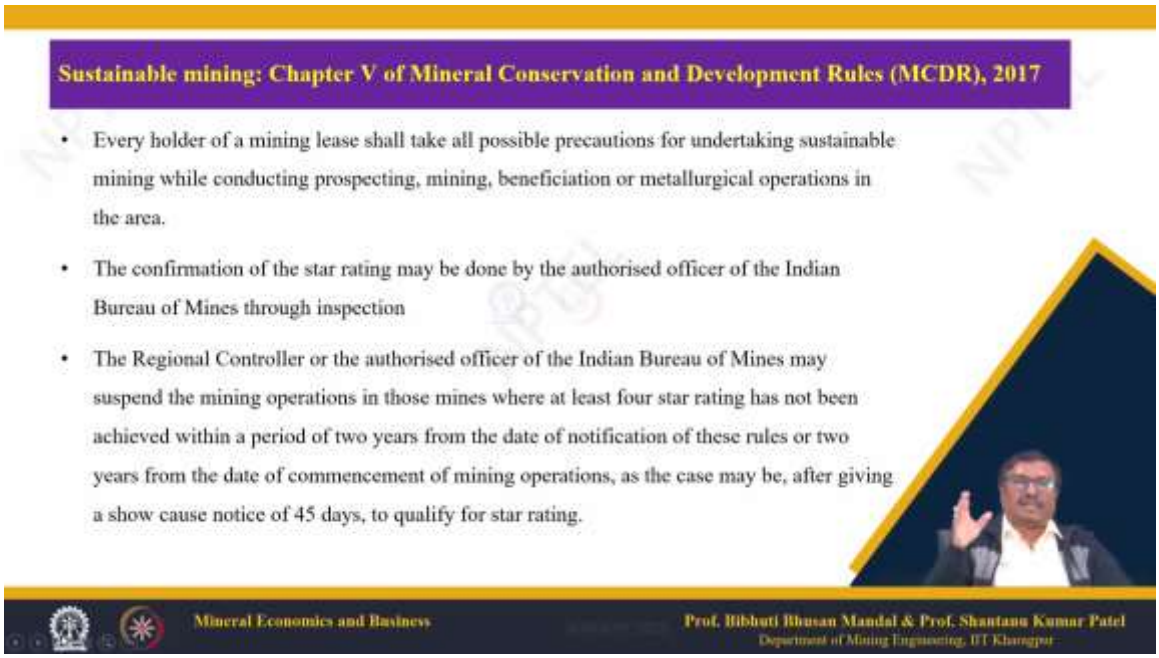
So, the mining companies are required to follow this sustainable development framework and the methods that are being advised. So that the environmental degradation is minimal or nil. So, this is the way, or this is the philosophy, that mining has to be done without adversely affecting the social, economic, or environmental well-being at present and also for the future generation. That means we are not degrading our atmosphere, climate, earth, or ecology, so that the future generation will not suffer due to the bad or negative activities done by us.



Now, keeping this in mind, the ministry has not only given a sustainable development framework—a broad advisory framework—but also evolved the system of star rating of mines. That means how much you are complying with these requirements. So, based on different aspects of this framework, the Ministry of Mines has started giving star ratings to mines. We will come to this. The mining management has to fill up certain self-appraisal templates, like Module One, where we talk about managing impacts at the mine level. So, we have certain charts to fill up, and from there, the star rating can be computed, like Module Two—final or progressive mining closure—what you have done so far, landscape restoration, and what the activities are.

Where you are in landscape restoration at a particular stage. Or, in Module 3, we address the social impacts of requirements. Reclamation and rehabilitation requirements. Community engagement and welfare programs. All this has to be recorded in writing in the document.

And Module 4 is the assurance and reporting of all mining activities. Based on the prescribed method, we can compute the percentage secured by a mining company. So, if it is between 90 to 100 percent, you get a 5-star excellent rating. If you are between 80 to 90 percent, You get 4 stars. Like 60 to 80 is 3, 50 to 60 is 2 stars, 25 to 50 is 1 star, and below 25 is no rating, no star at all.



Now, every holder of a mining lease must ensure that all possible precautions are taken for the sustainability of mining while conducting prospecting, mining operations, mineral beneficiation, or metallurgical operations in that area. So, this confirmation of the star rating may be done by an authorized officer of the Indian Bureau of Mines through inspection. That is when you are filling up. Nowadays, it has to be filled up online also. So now, the Indian Bureau of Mines will deploy an authorized officer to ensure that the star rating is correct.

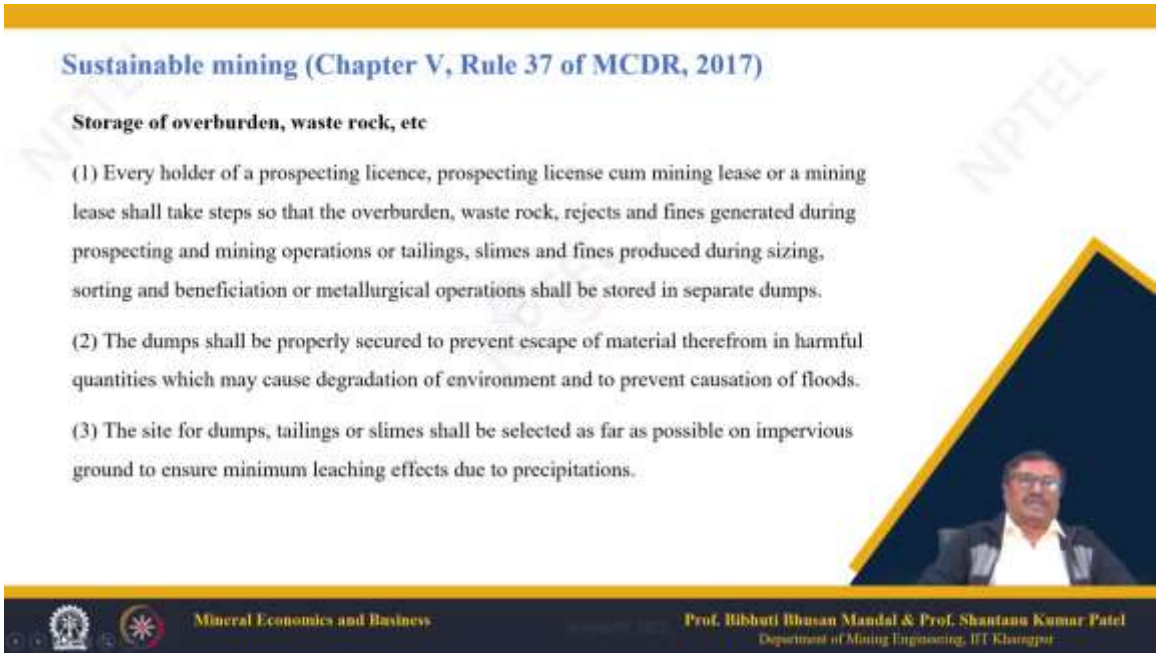
Now here the IBM may suspend the mining operation in those mines where at least 4 star rating has not been achieved within a period of 2 years from the date of notification of the said rules like 2017 MCDR or 2 years from the date of commencement of the mining

operations. So this has been made mandatory that you have to gain a 4 star rating depending on the stage where you are. So at that particular moment at that time where you are so in two years from the start you have to achieve the four star rating otherwise the mining operation will be suspended. Immediately you have to take all the operations so that you reach the state of four star and then only it can be restarted otherwise not. Now what are these we will be just touching those points which are very important like the removal and utilization of topsoil as per that sustainable mining activities under the rule 36.

Every holder of a prospecting license prospecting license for mining lease or a mining lease wherever topsoil exist is to be excavated for prospecting or mining operations remove it separately. that means, not to be mixed with this. The topsoil which is removed shall be utilized for restoration or rehabilitation of the land which is no longer required for prospecting and mining operations. That means, the topsoil that we are removing can be dumped there. For stabilizing or for landscaping the external dumps.

Now this has to be this waste is not to be is not a waste. It is being used for the restoration and rehabilitation of the land which is no more required for any mining or prospecting operation. So, whenever this topsoil is unable to be utilized concurrently, it should be stored separately for future use. That means, it is to be used, it is to be dumped

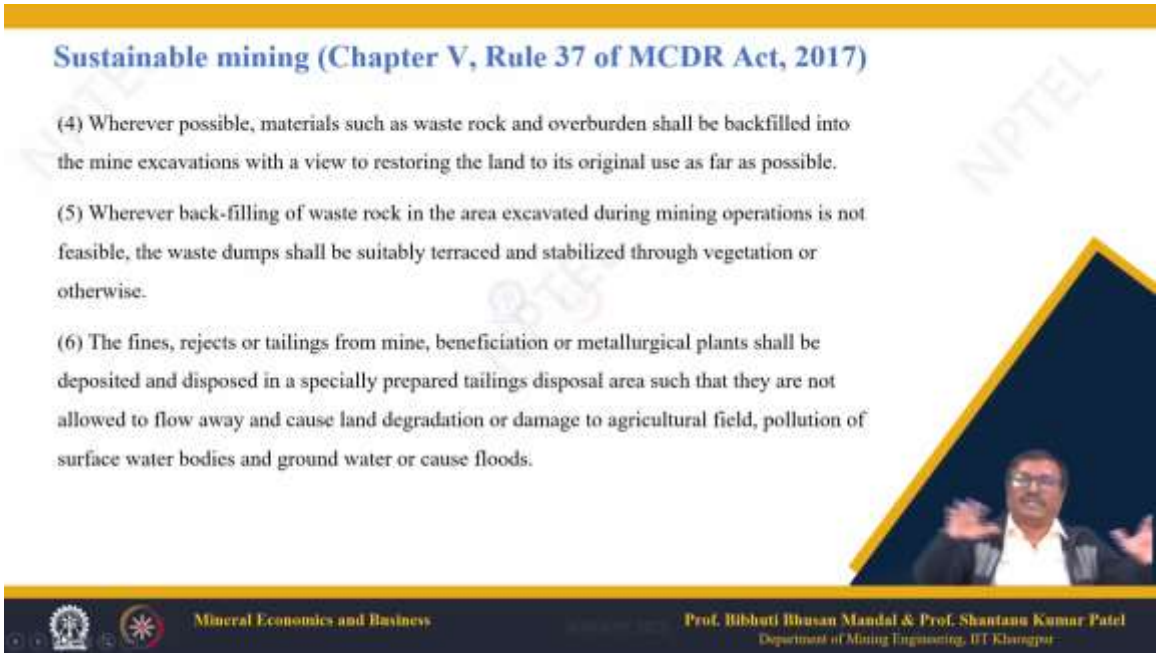
or stored in such a way that you can use it for any other, say for you want them for a new road construction in the villages or in that area. You should be able to approach that dump, take that material and use it gainfully for the society.



Now, the storage of overburden, waste rock etcetera, it is required that that the the ah license holder ah shall take all the steps. So, that the overburden waste stock and reject and fines generated during this when a prospecting or mining operations ah all these tailings, slimes and fines and the rejects produced during all sizing, shorting, beneficiation shall be stored in separate dumps all these things they should be dumped separately not everything mixed together. So, that they can be utilized when we think that some utilization aspect has been developed or some other party is interested to use those tailings, slimes or any fines or rejects for any gainful purpose. So, I have seen also that the waste stock generated by an underground mines that was sold for and the price was very good that was used for the preparation of the road.

preparation of the road that was used in the crusher. They were crushed in smaller size and they were used for ah for the preparation of the pavements. Now, the dams should be ah shall be properly secured to prevent escape of material therefore, So, what happens that if you are not properly dumping the material it will slide debris flow will cause run out will be completely destroying the or if it is we are unfortunate then life and property.

And also not only that it will not only cause harm to the life and property, but it can degrade the environment and prevent causation of floods. So, this thing to prevent causation of floods. So, this this this whatever you are say you are doing. So, now, if it is if the if the dump fails then what happens the run out material that will degrade the environment. And that may destroy or damage the embankment and cause floods with water and slurry materials.



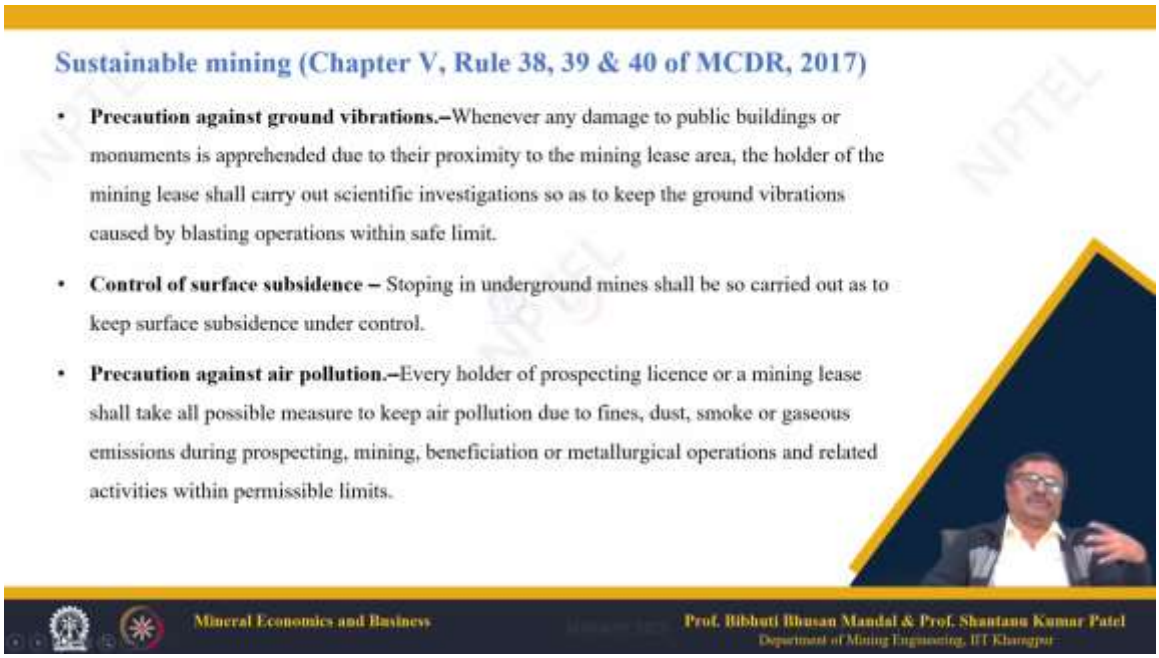
The site for dumps, tailings or slimes shall be selected as far as possible on impervious ground. That means it does not pass through it. So, what happens when you are dumping mineral on a ground? So, there can be leaching effect due to precipitation. If the rainfall occurs, then slowly that material gets leached and that can go through the impervious medium and cause contamination to the soil on which the material has been dumped.

So, this has to be selected in such a way as far as possible that it is impervious and does not cause no contamination to the soil on which it has been dumped. Now this material such as waste rock or overburden should be backfilled into the mine excavation. This is a very good use that you can use the waste rock as you see in manganese mines also or in copper mines where you we can see that I am fantastic use of the backfill materials for the purpose of filling in the stoves which has been mined out. or it can be used for restoring the land to its original use as far as possible. So, you can go for again when you

restore the land and then you go for landscaping and then you go for afforesting with the plantation of trees.

Now, wherever this back filling or waste rock in that area ah is not feasible then the waste dump shall be suitably terraced I mean a proper format. So, that we can stop ah you can prevent failure of the slope it should be stabilized further with the vegetation you add trees and plants or otherwise maybe some geotextile it has to make it has to be made stable. Now, the fines, rejects and tailings from the mine beneficiation of these plants that should be deposited or disposed in specially prepared tailing disposal area, tailing dams, tailing embankment. I mean the companies are spending in crores and crores to make the tailing dams. So, you can see the best examples with Hindustan Zinc Limited or the Hindustan Copper or go to the mines of Tata.

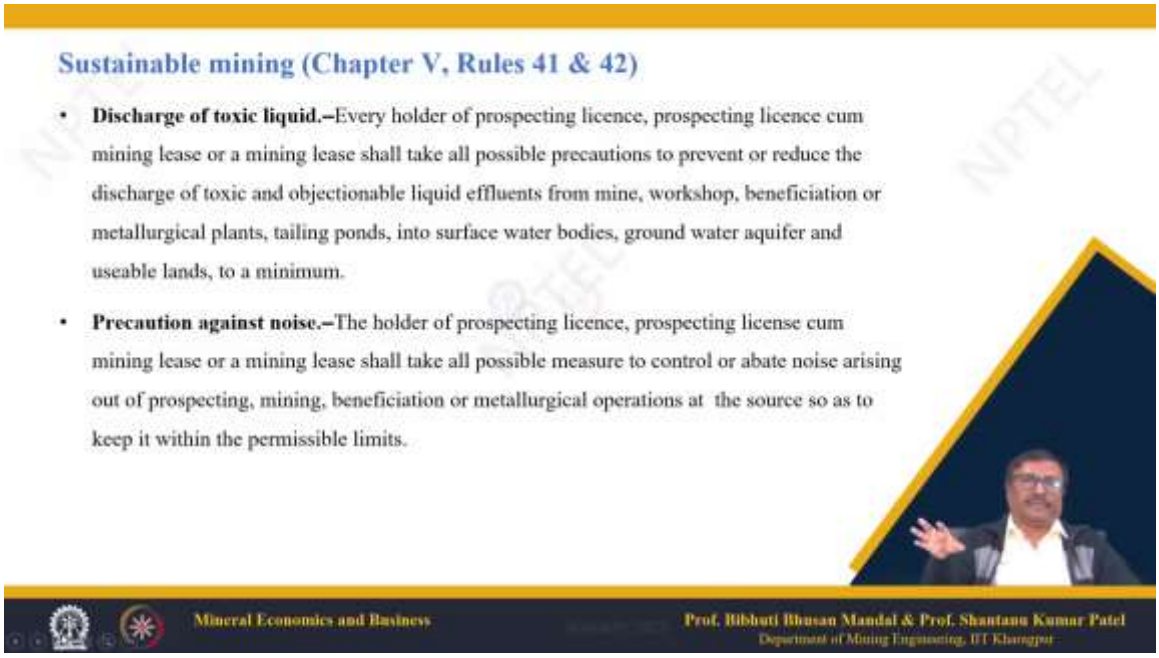
You can see how Nicely they are preparing the tailing dams and where the tailing is disposed of and how they are containing the flow so that it cannot damage the embankment and flow and cause floods. So, the idea is stop the land degradation and damage to the agricultural field. If it goes to the agricultural field, tailing will simply kill that field. It will completely damage and it cannot produce anything from that field.



It will cause pollution of the surface water bodies, rivers, nalas, everything. And and as I said it can cause floods also instantaneous floods and there are tailing failures and hundreds of people have been killed due to the sudden failure of the tailing dams.

Keeping all those things in mind the detailed guidelines have been given and we are supposed to take the mining companies are supposed to take actions so that such environmental degradation or damage is not done. Now about the ground vibration this is not only a part of the safety now there are so whenever it is a damage to public building or monuments. So we are also including in the MCDR also other from the directives that we got from the director general of mine safety.

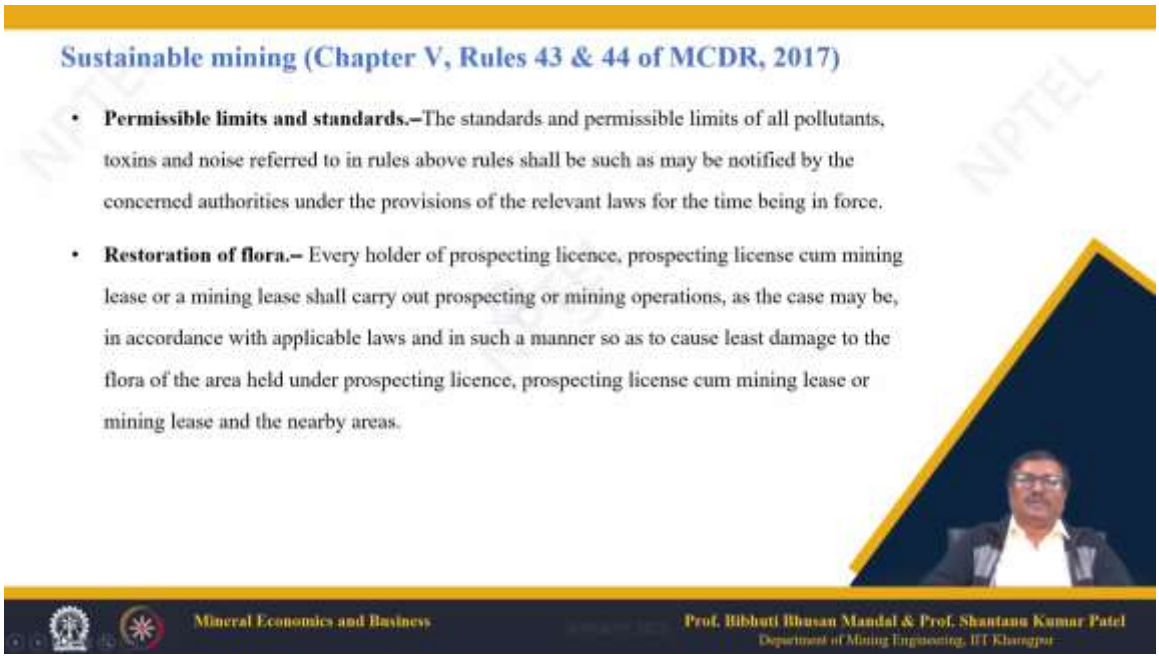
Here also we apprehended in this rules based on the apprehension that due to the proximity of the mining lease area from the place of the blasting. The holder of the mining list shall carry out scientific investigation. So that we can keep the ground vibrations under control. And the blasting vibrations should not affect the buildings, adversely affect or damage the public residential buildings or any area. So we have to conduct the scientific study, blast vibration study.



Based on specific methods that have already been suggested and follow scientific procedures to contain or restrict the blast vibration in such a way that they cannot damage any public building or monuments. Now, the control of surface subsidence—now, the stoping in underground mines shall be carried out in such a way that surface subsidence should not occur; it should be under control. So, what we do here is that before performing the stoping operation—or even in coal mining—when you are extracting the material or going for a depilating action, we carry out a subsidence study. That is, if I

extract the material—ore, coal, or any mineral from underground—then whether subsidence is occurring or not. If it is occurring, how much is it, and whether it is within the permissible limit or not.

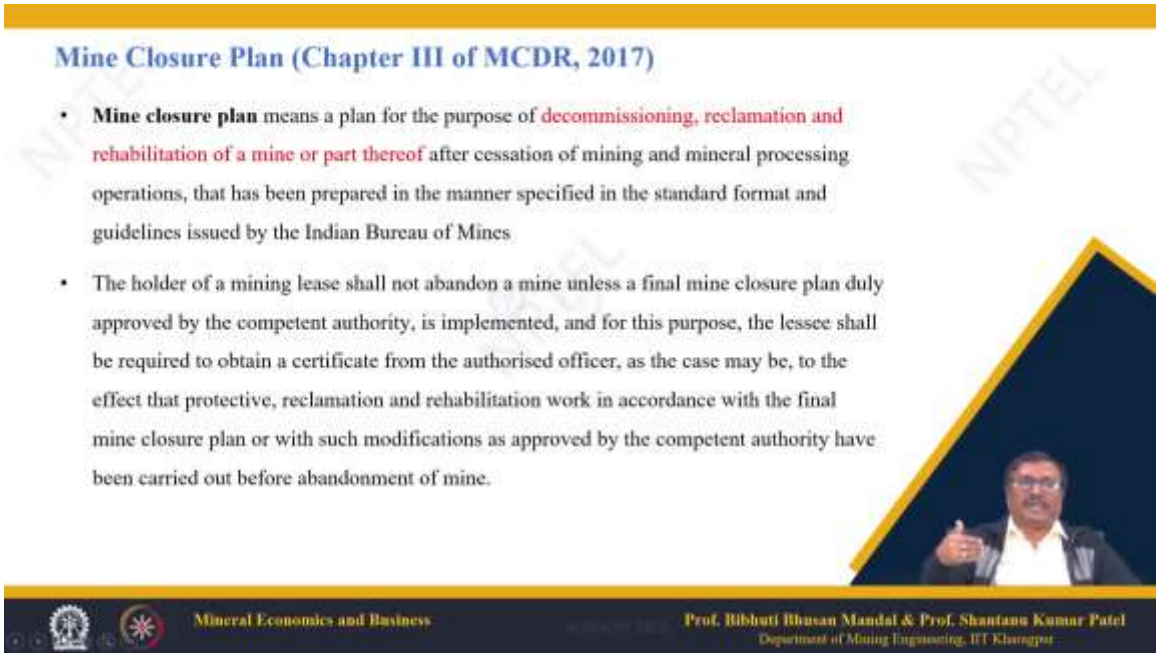
Or whether you are following certain methods, like block caving or sublevel caving, where you intentionally allow certain parts to subside. What precautions are you taking? What legal procedures have you followed in that method? So, all these things are to be—this is called the control of surface subsidence—that has to be taken care of. Now, the precaution against air pollution.



Every holder of a prospecting license or mining lease shall take all possible measures to control air pollution due to fines or dust. These are part of mining operations. So, all the stages—like prospecting, mining, beneficiation, or metallurgical— Then, it has to keep air pollution under control. That means you are taking all possible care to prevent environmental damage, degradation, or to protect the environment.

Next is the discharge of toxic liquid. Every holder of the prospecting license and mining lease etc. shall take all possible precaution to prevent or reduce the discharge of toxic liquid effluents from the mine or other part of the mine. And you have to restrict to a minimum or nil. You cannot discharge this to the environment and completely damage and cause contamination and pollution.

Precaution against the noise. So, as we know that this is a part of the mechanization. So, at any stage right from prospect or the mining operation. So, we have to take measures to control and abate the noise arising out of all these activities. So, as to keep it within permissible limits.



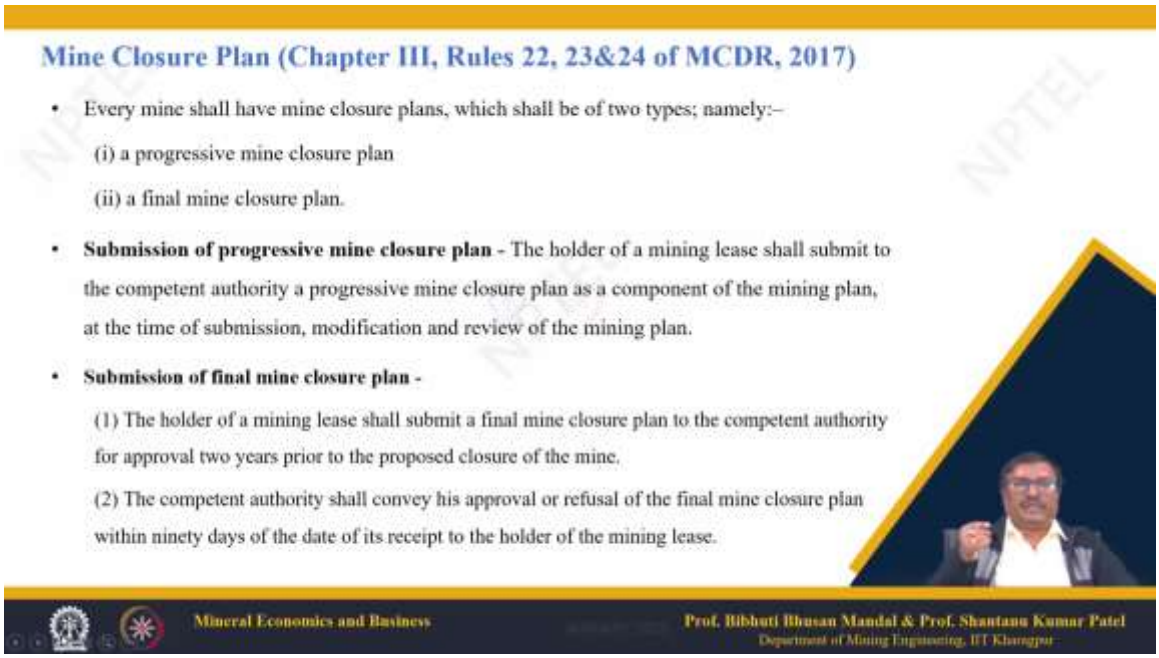
The permissible limits in our case has been already prescribed by the director general of the mine city. Now the permissible limits and standards for all pollutants, toxins or noise as we have said shall be such that may be notified by the concerned authorities which is applicable in each case. And the restoration of the flora in this case under rules 44 every holder of prospecting license or mining lease who is operating in that area so as may be applicable according to the laws. So, we should not cause any any damage or should cause rather least damage to the flora of that area that means the vegetation, the trees, plantation in that area. So, we must ensure that we should not damage any forest, any vegetation in that area.

This is very important for the future generation, which means we are protecting the environment and not causing any degradation to it. The last part of this is the mine closure plan. This is And it is nothing but a plan for the purpose of decommissioning. That means, so far, you have been commissioning things.

And then the mining operation is going on. So now we are decommissioning. We are moving toward the closure. And reclamation and rehabilitation of a mine or part thereof. After the cessation of mining or mineral processing activity in that area.

So it has to be prepared as per the standard format. This has been given. I mean the procedure for preparing the mine closure plan. So, unless you have submitted and got approval for a final mine closure plan, you cannot even start the mining operation. In the beginning, you have to obtain a certificate from the authorized officer.

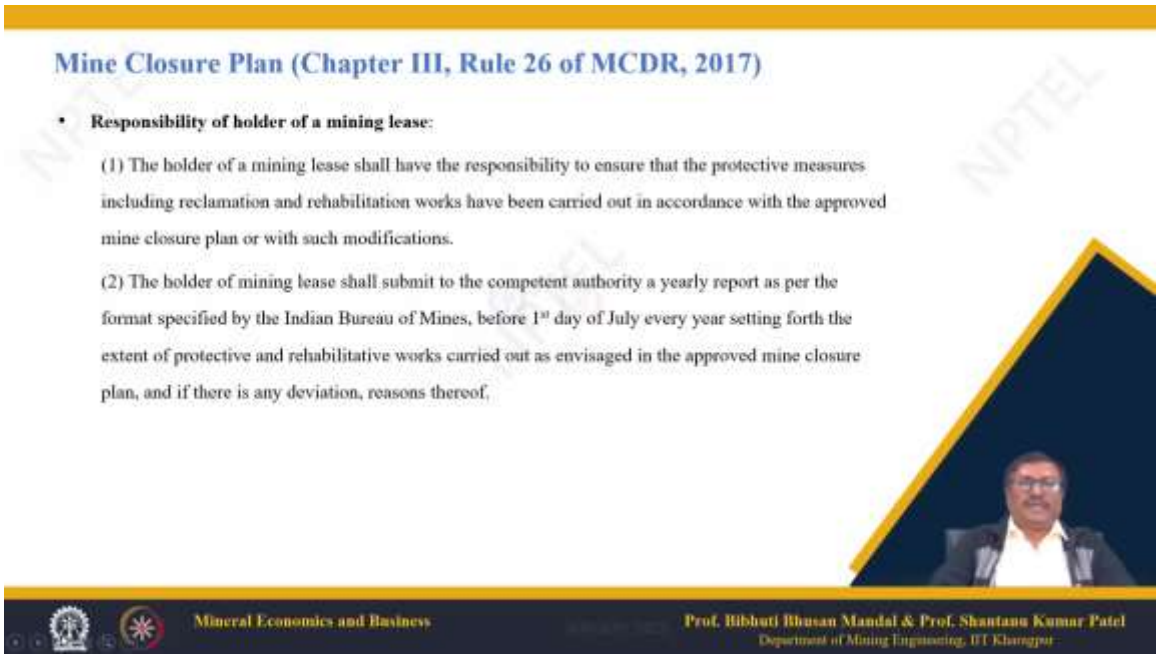
to the effect that the protective, reclamation and rehabilitation work in accordance with the final closure plan or with such modification have been carried out before abandonment of the mine. That is in the beginning you have started and then slowly you have used the progressive mine closure actions and at the end you need to get a certificate from the authorized officer from the Indian Bureau of Mines that you have taken all the actions Related to the reclamation, rehabilitation of that area in accordance with that plan and then only you can abandon the mine. Otherwise the mine cannot be abandoned at all. So we must have two things, first thing a progressive mine closure plan and then a final mine closure plan.



So the holder of the mining lease must submit to the competent authority a progressive mining closure plan. So this has to be prepared and depending on different stage that at every stage what actions you are taking for the mine closure at that stage. This is a

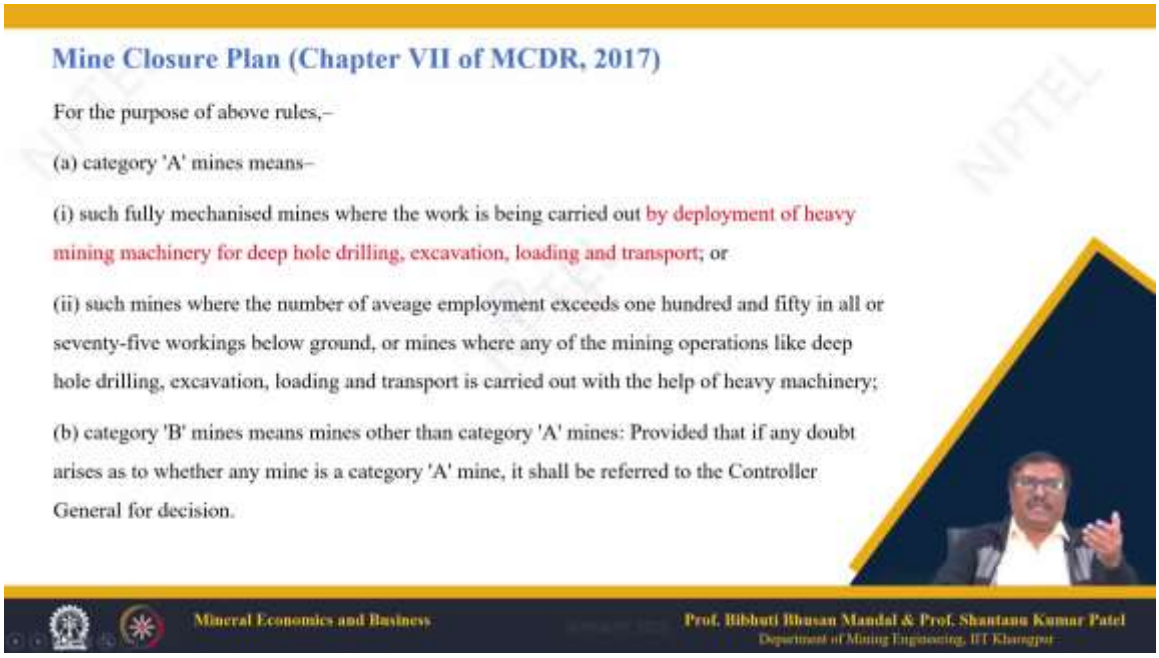
progressive mine closure plan. And for the final mining closure plan which must submit a final mine closure plan to the competent authority for example, in Indian Boor of Mines. For approval 2 years prior to the proposed closure say we have if you are if you are apprehending that after 2 years the mine will be finally closed in that case you have to take approval 2 years before.

Now this approval or refusal will be conveyed and then you have to take corrective action so that you can legally close that mine. This is a legal closure. So this the mining leaseholder will have the responsibility to take all the protective measures for as I said reclamation, rehabilitation works and according to the plan that we have submitted. And every yearly yearly report has to be given also in the format prescribed by the IBM before first day of July every year for the works carried out as per the approved mine closure plan. Now, for this purpose as we have categorized because this is related to some financial matter also that we have category A mines and category B mines.



So, fully mechanized mines where the work is being carried out by the deployment of heavy machinery for default drilling, excavation, loading or transport. or mines where the number of average employment is exceeding 150 in all or 75 below ground then it will be called a category A mines. Then the category B mines are those which are not the category A mines provided that if any doubt arises you may get a clarification from the controller general of the Bureau of Mines. So, why this category A and B? remember that

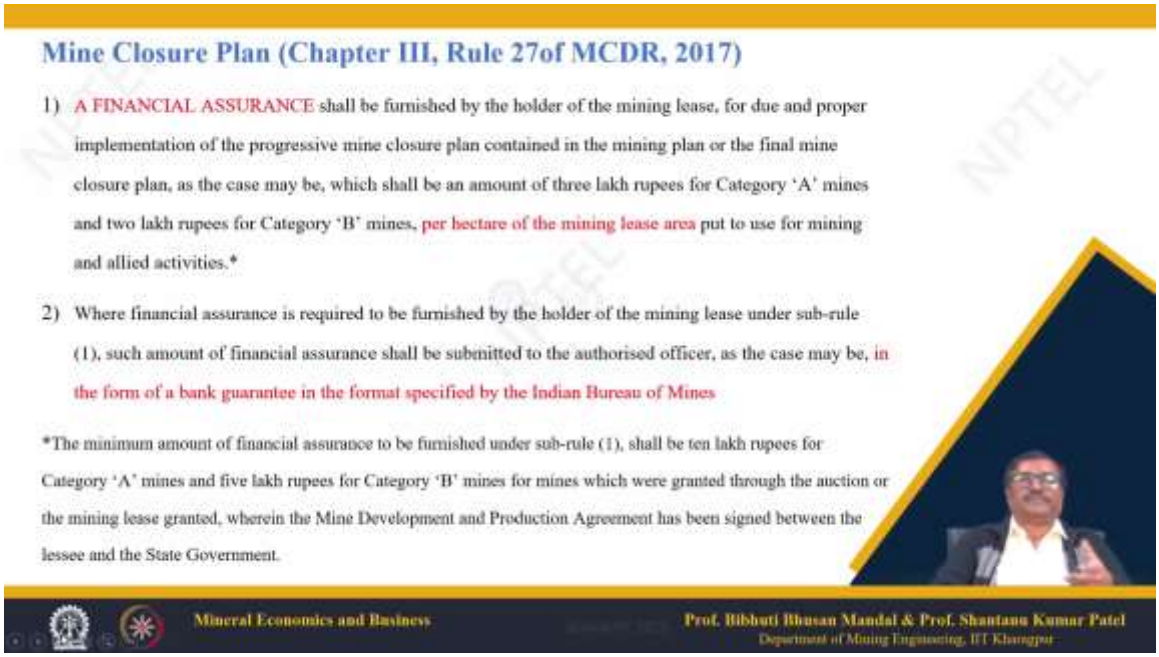
the closure plan is associated with a financial part the closure action requires fund so if you are just mining and then abandoning that area then who will spend this money who will do the the financial liability for closing the actions which is as such illegal now so a financial assurance should be furnished by the holder for due and proper implementation of the closure plan content in the mining plan for the final mine closure plan. So, this has to be an amount of 3 lakh rupees for category A mines or 2 lakh rupees for category B mines per hectare of the mining lease area. Remember that 3 lakh rupees for category A mines per hectare, 2 lakh rupees for category B mines for use for mine closure and allied activities. Now, where financial Assurance is required to be furnished by the holder of the lease under this.



Then this has to be submitted to the authorized officer as the case may be. See in the form in which form you are giving? You are giving in the form of a bank guarantee. That means, if you are leaving that area the bank which is giving the bank guarantee will provide us the fund for that. That means, even if somebody leaves that area the government can take hold of that of that area and get the money from the bank and initiate closure actions for final closure.

So, this is given as a financial assurance that sometimes you cannot just access that area from that area after the mining. So, in the process, we not only stipulate the different

procedures related to mine closure actions and progressive mining closure actions, but also ensure that environmental quality is not degraded and all reclamation and rehabilitation activities are carried out as per the plan. Additionally, we provide a financial assurance that we will be doing this. In case we fail to do so, we will have to provide a bank guarantee.



This ensures that the government can take necessary actions easily and in a scientific manner. The materials are sourced from the Indian Bureau of Mines or the Ministry of Mines. We have followed the Mineral Conservation and Development Rules, certain provisions, and the Mineral Concession Rules of 2016, which you can read for details. These are only the important aspects we have discussed today, not all the sections or rules. This will be very important for understanding, as these are the key aspects of the rules and regulations.

With this, we will be concluding this particular lecture. Thank you. Thank you.