**Surface Mining Technology**
**Professor Kaushik Dey**
**Department of Mining Engineering**
**Indian Institute of Technology, Kharagpur**
**Lecture 60**
**Closure of Surface Mines II**

We are now in our final lecture of this Surface Mining Technology course. In NPTEL online certification course, this will be our final and last lecture. So, this is the last lecture or second lecture or last lecture of the closure of surface mine. So, we are continuing this topic. So, let us start with this.

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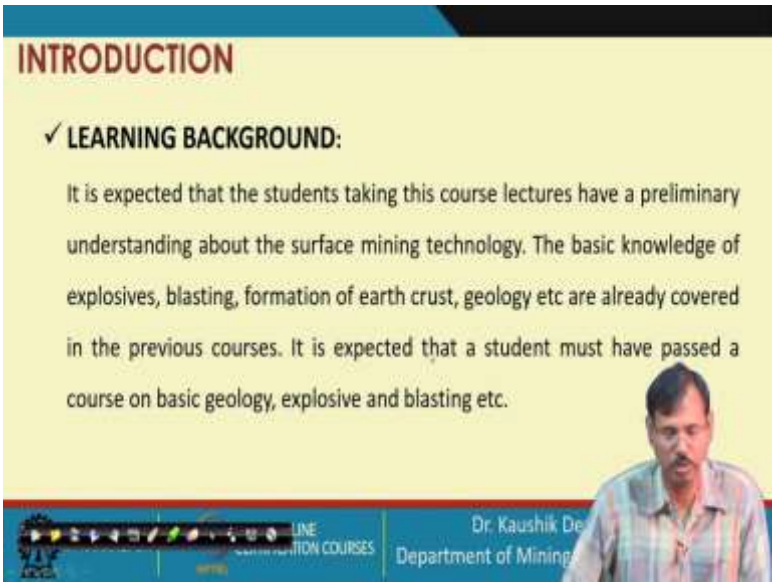


And as you know these are our learning backgrounds.

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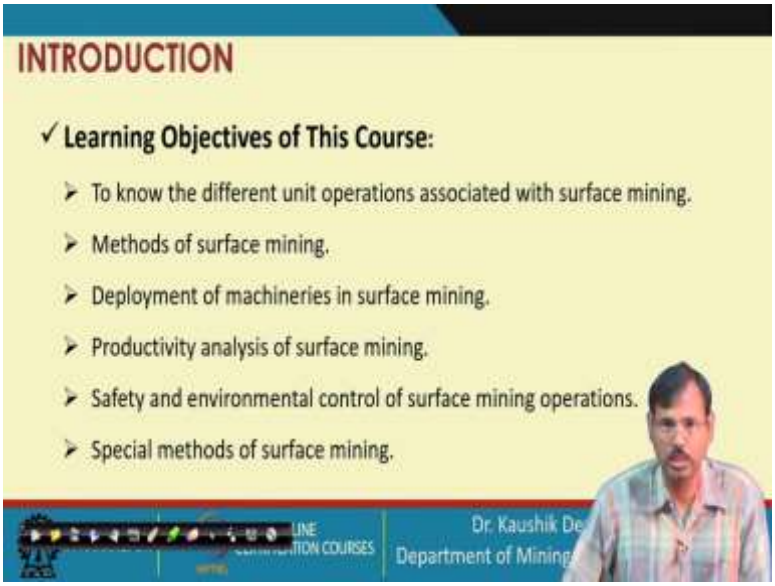


These are the learning objectives for the surface mining technology course.

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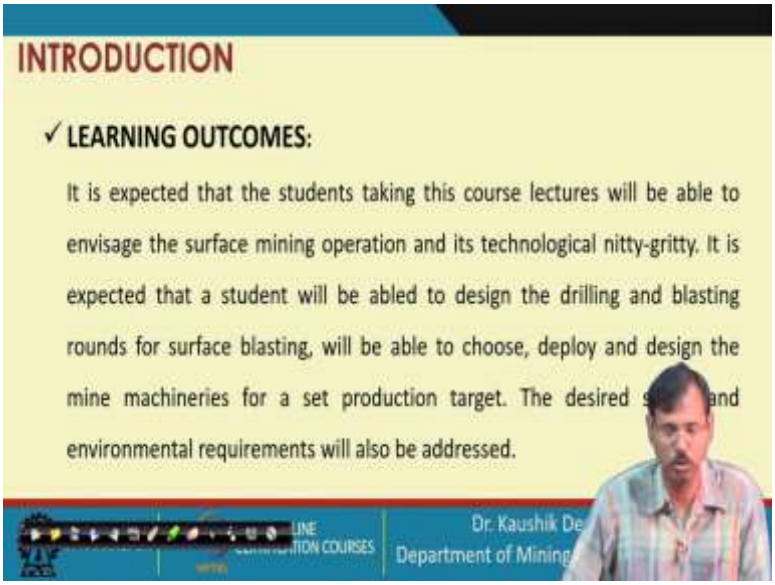

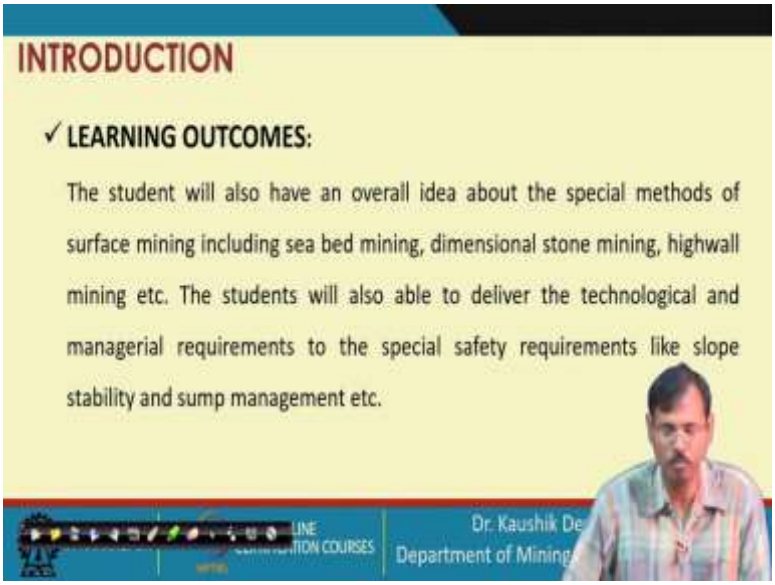


These are the learning outcomes.

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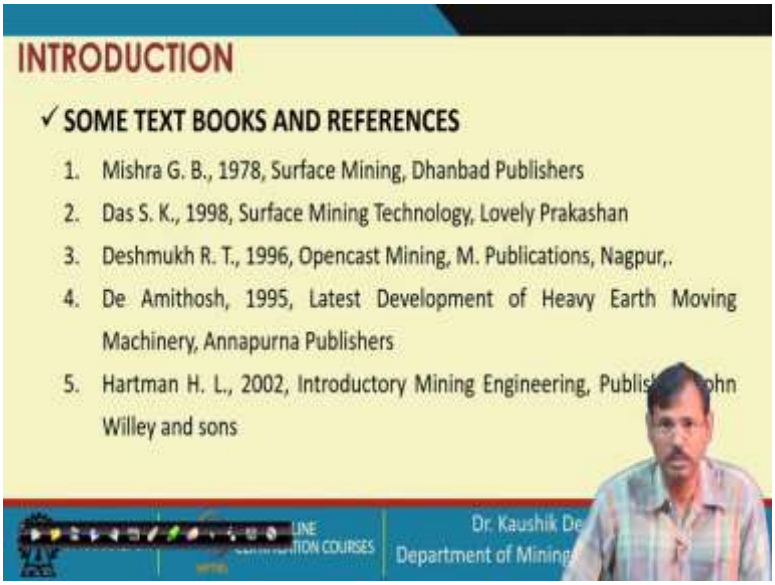

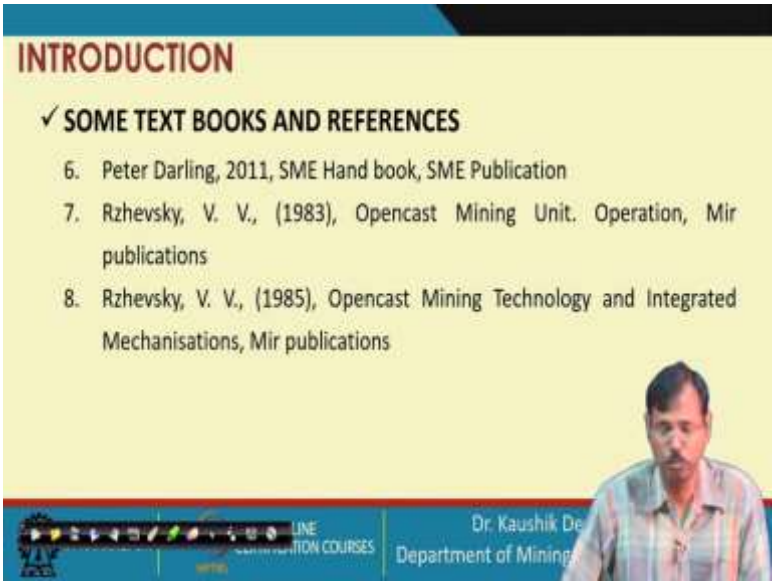


These are the textbooks and references.

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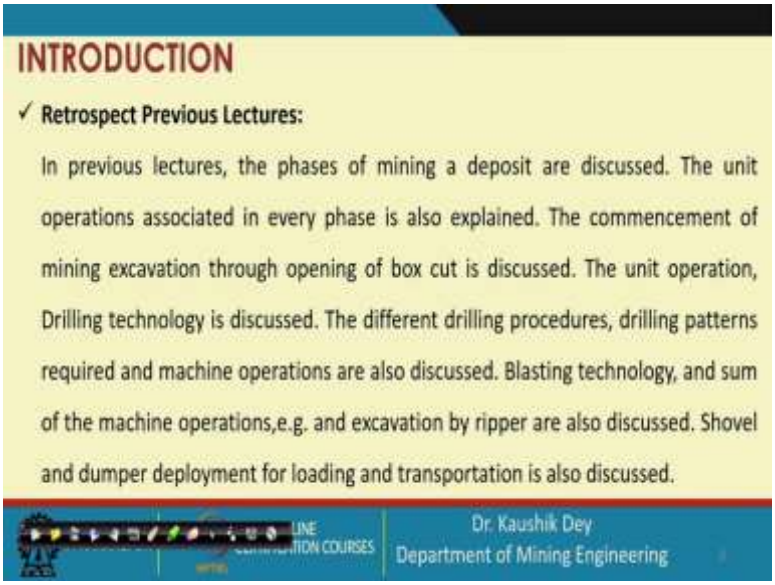

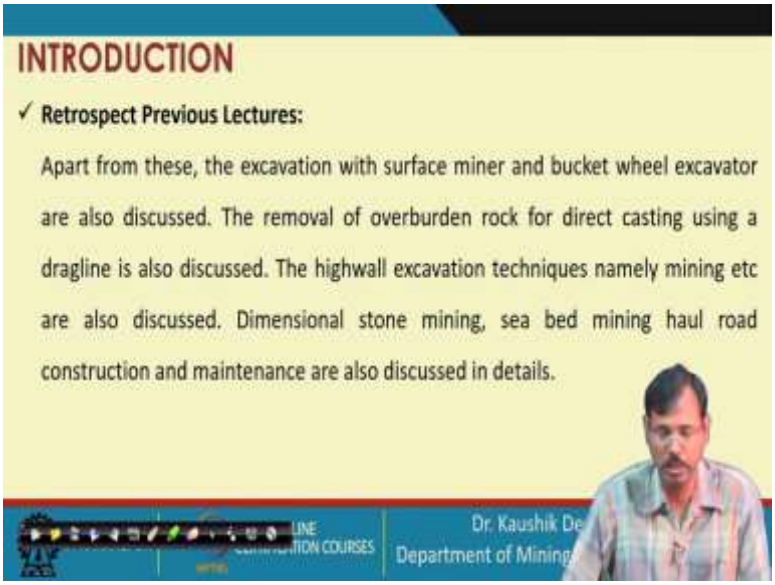


And we have already completed almost all the topics related to surface mining.

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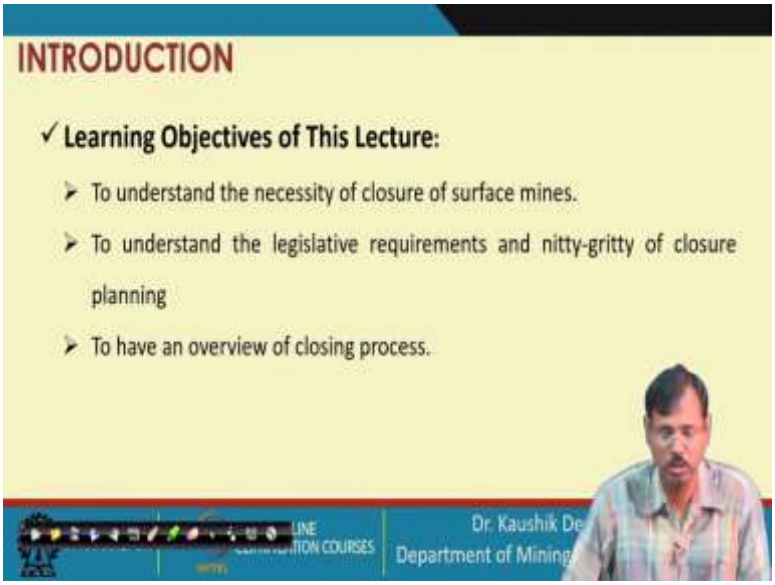


And we are continuing with our objective of the closure planning lectures to understand the necessary of closure of surface mines in the last class we have already discussed this, to understand the legislative requirements and nitty-gritty of the closure planning and have an overview of the closing process with the examples. We are continuing with this one in this lecture from the last lecture.

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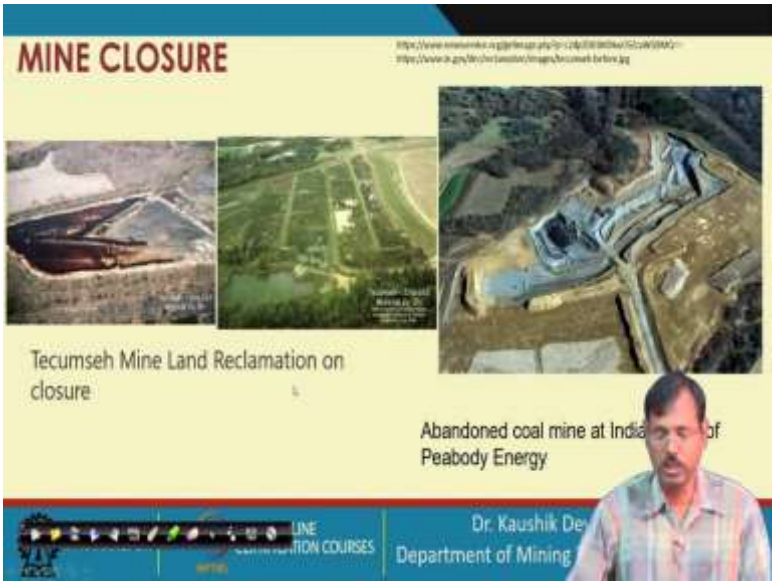


Now, mine closure, this we have seen how the this is the closing and this is the abandoned mine.

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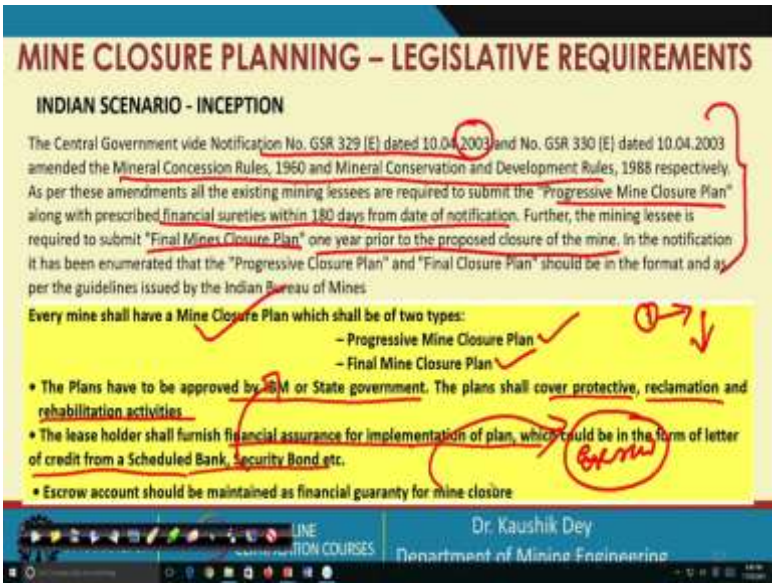


And we were in this slide where we are discussing about the legislative requirement for the mine closure planning and as per our Indian scenario. In India, with this government notification number 2003 onward, all the Indian mines, for all the Indian mines, mine closure planning is made mandatory and in the 2003 notification it was told for all the new mines before the opening of the mines, mine closure planning has to be provided and for all the existing mines before 2003 they had to provide the mine closure planning as the earliest to

the authority and this is made mandatory in the mineral concession rule and mineral conservation and developmental development rules.

And financial sureties is also made mandatory. For this progressive mine closure plan and final mine closure plans, one year prior to the proposed closing of the mine need to be provided that is made mandatory during this notification. So, every mine must have a closure plan of 2 types, progressive mine closure plan and final mine closure plan and these plans have to be approved by the IBM and state government, plans shall cover the protective reclamation and rehabilitation activities. Leaseholders shall furnish the financial assurance for implementation of the plan which could be the in the form of a letter of credit from a scheduled bank or security bond.

Now, 2011 onward, this escrow account has been made, account has been made in which from the day one onward the mining along with the mining activities, closing fund has to be placed in this escrow account and progressively those funds has to be utilized for the closing activity. So, that financial guaranty which was in 2003 was asked for a security bond is now converted to the escrow account and that is now mandatory so all the mine is currently having the closing fund from this starting of the mine is now made mandatory.

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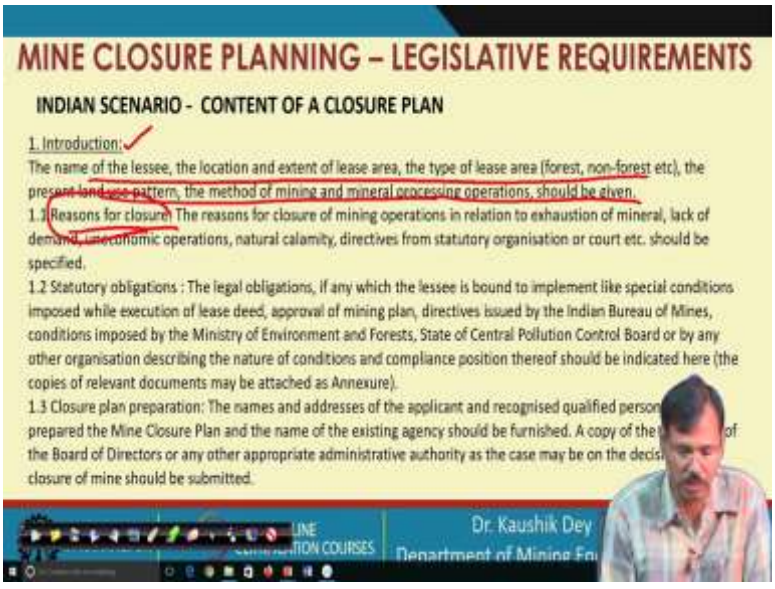

# MINE CLOSURE PLANNING – LEGISLATIVE REQUIREMENTS

## INDIAN SCENARIO - CONTENT OF A CLOSURE PLAN

1. Introduction:

The name of the lessee, the location and extent of lease area, the type of lease area (forest, non-forest etc), the present land use pattern, the method of mining and mineral processing operations, should be given.

1.1 Reasons for closure: The reasons for closure of mining operations in relation to exhaustion of mineral, lack of demand, uneconomic operations, natural calamity, directives from statutory organisation or court etc. should be specified.

1.2 Statutory obligations : The legal obligations, if any which the lessee is bound to implement like special conditions imposed while execution of lease deed, approval of mining plan, directives issued by the Indian Bureau of Mines, conditions imposed by the Ministry of Environment and Forests, State of Central Pollution Control Board or by any other organisation describing the nature of conditions and compliance position thereof should be indicated here (the copies of relevant documents may be attached as Annexure).

1.3 Closure plan preparation: The names and addresses of the applicant and recognised qualified perso prepared the Mine Closure Plan and the name of the existing agency should be furnished. A copy of the of the Board of Directors or any other appropriate administrative authority as the case may be on the deci closure of mine should be submitted.




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Now, let us look into the when the mine closure plan is made, what are the chapters there in a mine closure plan. So, that the apex body or the government can scrutinize that easily to see what are the contents of the mine closure plan there. So, in the introduction chapter, the name of the lease location, these things, lease land type, proper use mining methods all has to be given.

Then the reason for closure has to be disclosed. Basically, this is giving the idea whether the mine chances of the area where that mine has to be reopened or not this has to be clearly mentioned in this otherwise government authority cannot decide whether they will go for abonnement or they will go for the closing and exhaustion of mineral, lack of demand, uneconomic operations, natural calamity all these are the could be the possible results.

Then statutory obligations whatever they are there like special conditions imposed on execution of lease deed, approval of mining plan, directives of IBM, MoE of restrictions, SPCB restrictions all these restrictions has to be considered as the statutory obligations and the closure plan preparation, the details of this who are associated with this that can be given in the introductory part.

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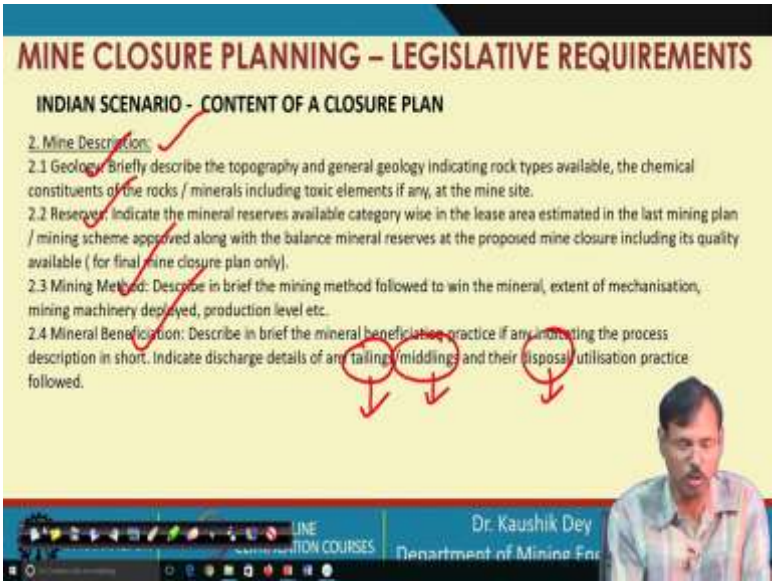


In second chapter the mine has to be described in detail that is the geology, reserve details mining methods, which are used, how the mineral beneficiation is made and along with that, it has to be plans and sections has to be given so that how much is mined, how much was proposed that can be obtained along with that, any other tailings, middlings, disposals, all these are made during that beneficiation that has to be found because these can be considered

as the waste material or maybe valuable material that can be a potential source in the future also. All these considerations can be provided with the government authority.

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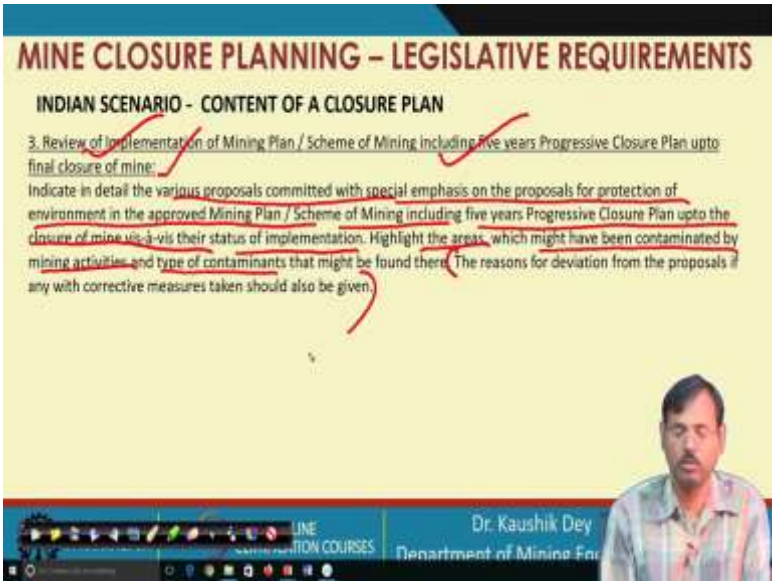


The next chapter implementation of the mining plan, scheme of mining including 5 years progressive closure, plan up to the final closure plan has to be given. In this the details of various proposal committed, with special emphasize on the proposal for protection of environment and approved mine plan, scheme of mining including 5 years progressive closure plan up to closure of mine vis-à-vis their status of implementation must be maintained.

In these cases, the area which might have been contaminated by mining activities and type of contaminant must be disclosed so that the rectification measures can be taken out and if any deviations occurs, during this work that must be mentioned in this so that that can be incorporated in the final closing.

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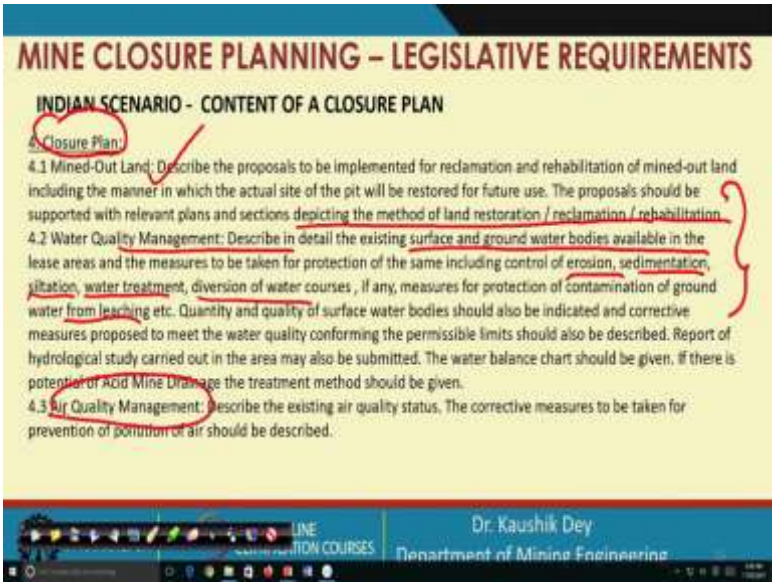


So, now the final closing plan has to be given. There the details of mine-out land has to be given, then the proposed land restoration, reclamation, rehabilitation plan has to be given, then the water quality management, surface and underground waterbodies, how that is being managed, then erosion, sedimentation, siltation, water treatment, diversion of water bodies whatever is carried out, leaching, those details has to be mentioned in this case. And air quantity management has to be also given during the mining life and post mining life how that can be improved has to be mentioned here.

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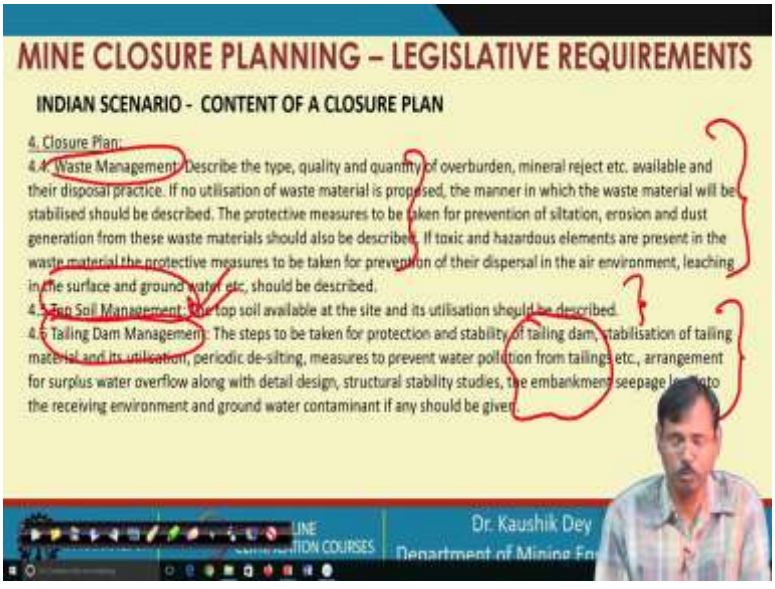

Then waste rock management, topsoil management, tailing dam management. These three parts need to be elaborated during the closing that how the topsoil before mining was conserved and that how that was utilized after the mining for revegetation of the area. How the waste rock material or what are those type of waste rock material that has to be disclosed and how that is managed whether that will pose any problem environmental problem in the future or not, and the tailing dams which are basically possibly having more contaminants their management plant, environmental management plant and along with the technical management plant must be provided in this chapter.

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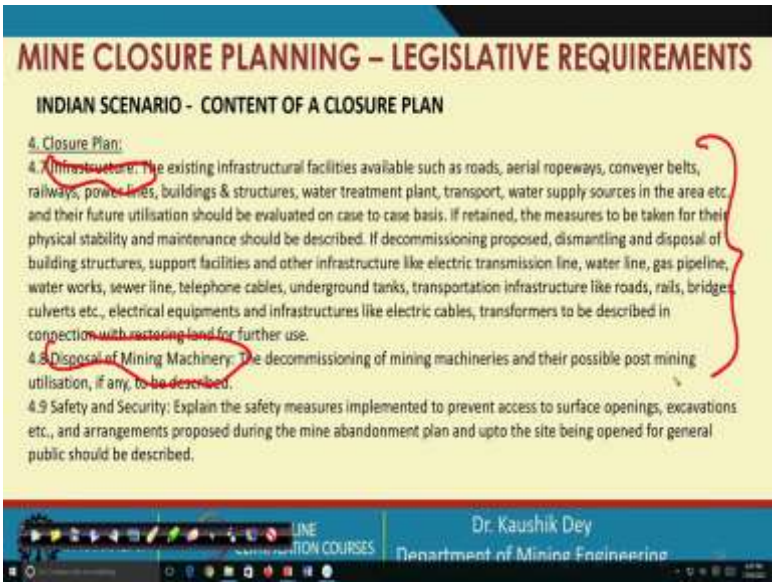


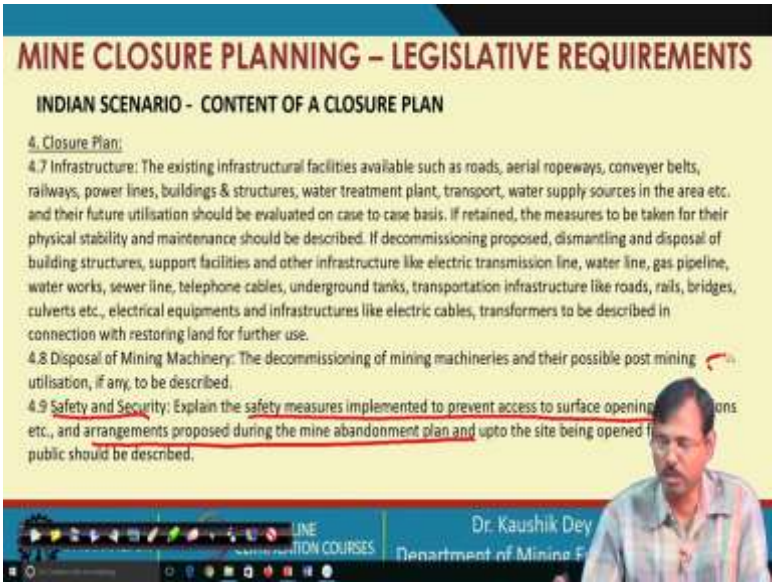


And then the decommissioning what are the infrastructures developed, how those are decommissioned and how that can be taken out similarly for the machineries and all these

must be given in details so that any degradation of the land, any degradation of the area because of this can be well addressed in this.

And finally, the safety and security, that how the safety measures to prevent the surface openings if it is opened in the surface, how that can be controlled safety can be controlled so that no one will fall down on to that surface openings, how that can be controlled, what are the safety measures, all this has to be disclosed here. And any arrangement made during the mine abandonment plan those things has to be made in public should be given in details in this position.

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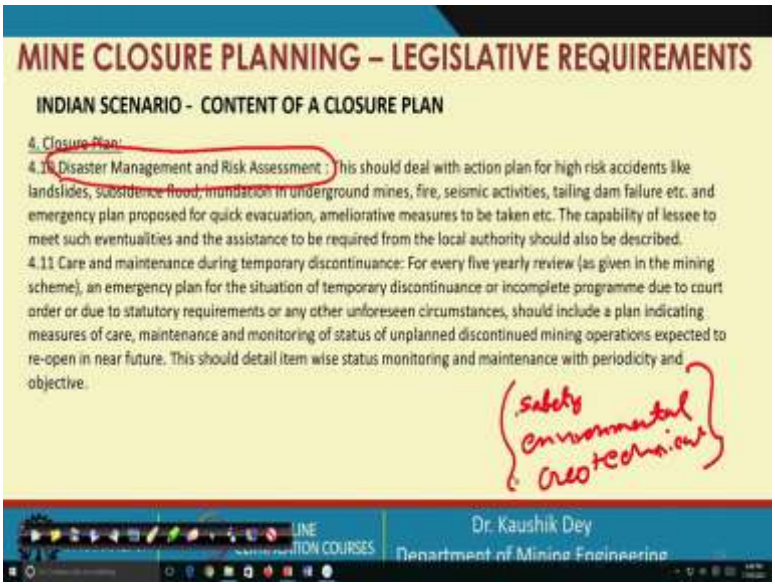


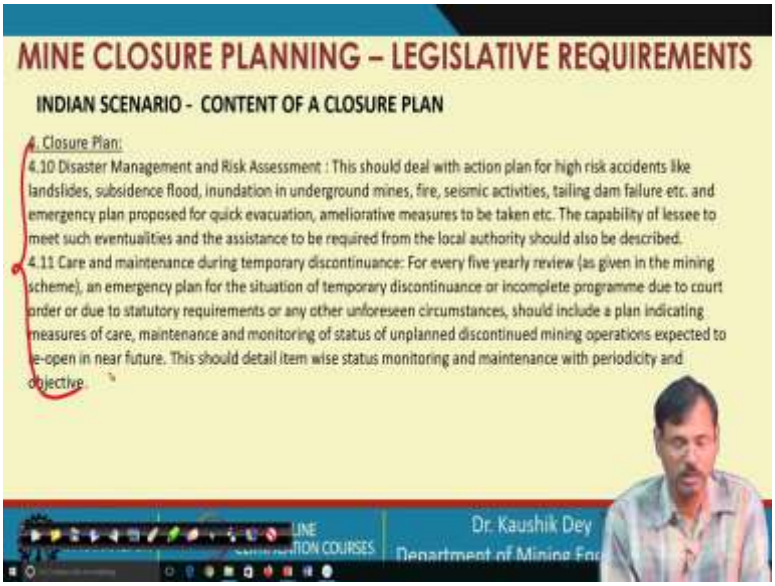

And finally, any risk assessment associated with this, whether what are the possible risk after the closing with the situation it is being kept, whether that is creating any further risk and these risks are safety, these risks are environmental, and these risks are geotechnical. So, these 3 risks will be mentioned, must be mentioned in this place so that that can be assessed probably, so these are the flood subsidence all these are considered in this place. And what are the care and maintenance required and the chances of reopening also in near future there. It is there or not that has to be also mentioned in this case.

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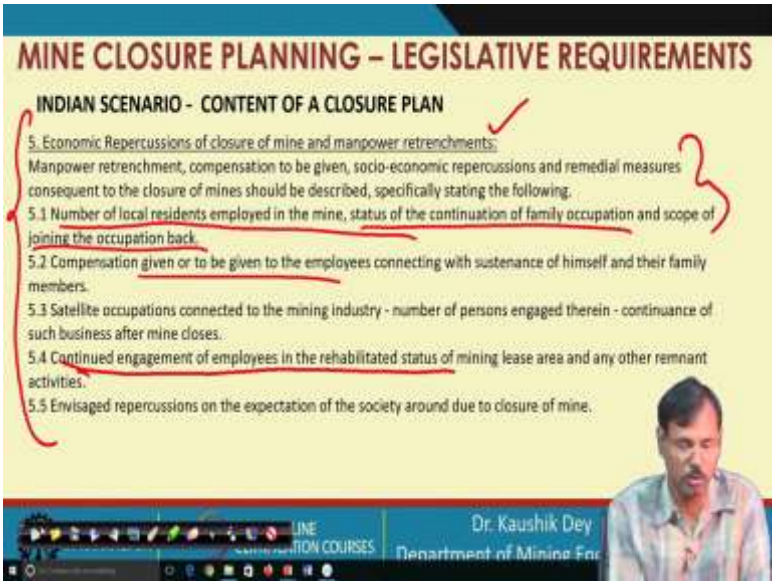


And this chapter is very, very important that is the economic repercussion for closing of mine and the manpower retrenchment. So, the manpower retrenchment plan, how the man powers are gradually superannuated or the man powers will be terminated with the VRS scheme or the future life support system, all these aspects has to be given in this case and the effect of withdrawal of mining to the local residents, the status of continuation of the family occupations, scope of joining in the occupation back, compensation, all these must be surveyed and declared in this case and continued engagement of the employees of that mine to any others mine or any other mining lease area that possibilities must be disclosed in this part and that is basically the economic repercussion and that must be considered.

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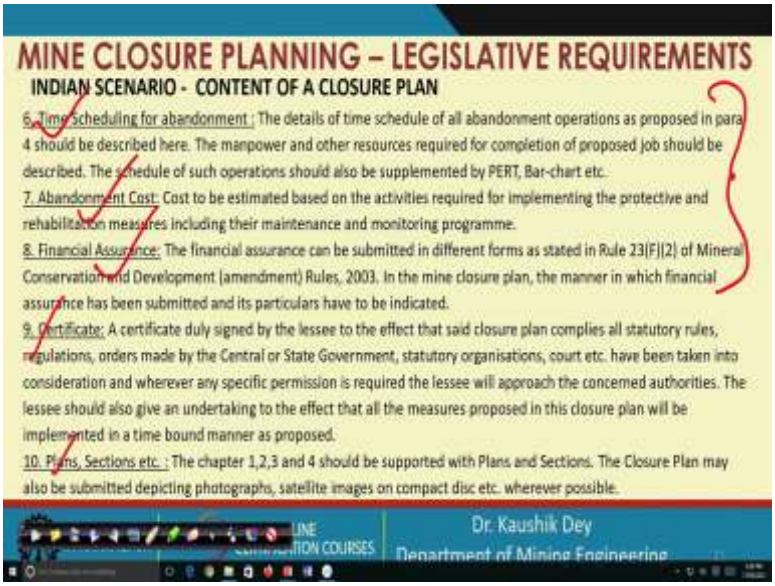


So, these are the other aspect time schedule, abandoned cost, financial approval and these are the certification plans or sections this part is very, very important and this must be accepted by the apex body for accepting the closure plan and allowing its implementation in the actual case is required.

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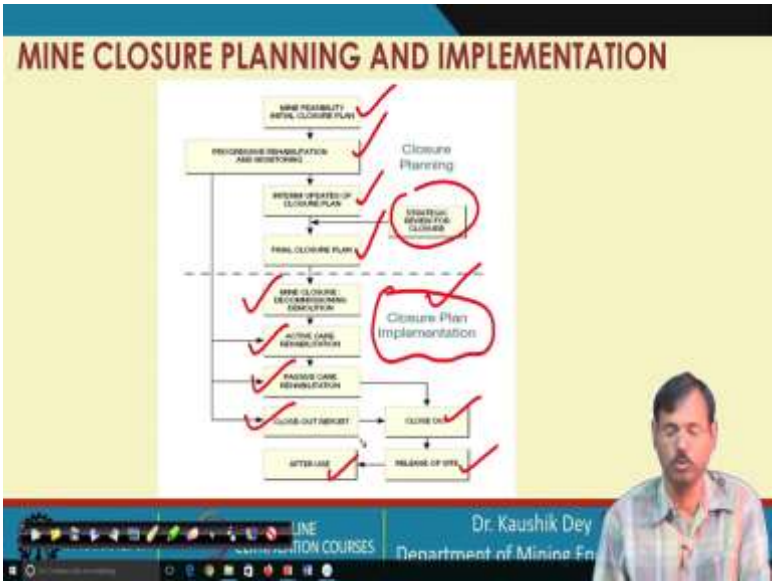

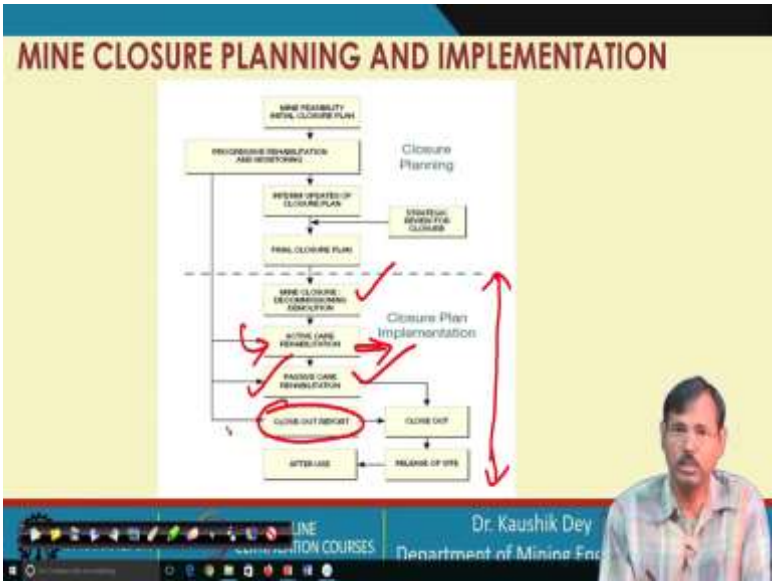


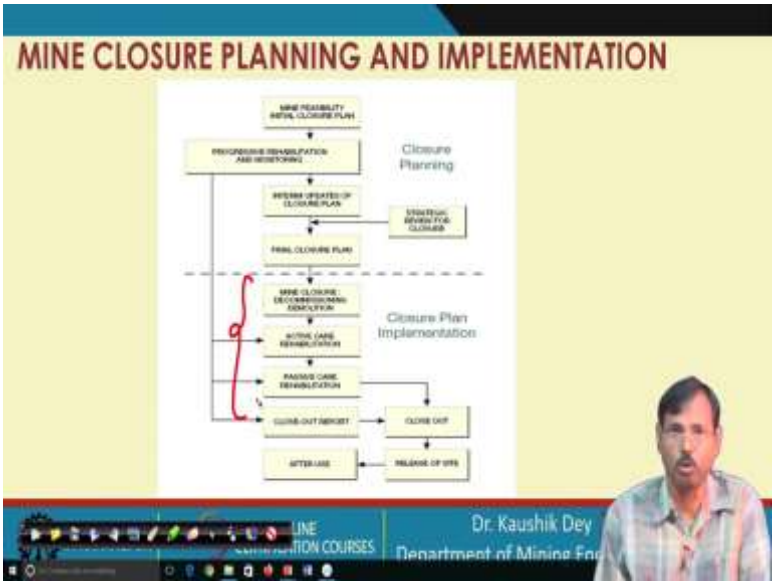


So, in a nutshell this is the closure planning where feasibility and initial closure plan is made. Then the progressive rehabilitation, monitoring etc. is basically envisaged, then interim updates is mentioned in the closure plan, strategic review of closure, and final closure plan is made.

Then the closure plan is implemented. One closure plan is made during the feasibility study. Then the before the closing final closure plan is made then the final closure plan is being implemented. So, the implementation started with decommissioning then the active care rehabilitation then passive care rehabilitation then close-out reports, close-out, release of site and after use. These are basically the steps followed and I would like to emphasize in this part now, planning part is carried out. You see first the structures are withdrawn, machineries are withdrawn, technical closing is made.

Now, the socio-economic part that is the rehabilitation, rehabilitation of the environment, rehabilitation of the man powers, rehabilitation of the area that is actively carried out initially. These activities are required to make it the self-sustained. Suppose a tree is basically planted then initially that has to be fed with the fertilizer, that has to be fed with the waters etc.

When the trees are basically grown up after say 10 years 12 years or similar to that 3 years, 4 years, 5 years, that is creating the environment of self-sustained one. So, that time passive care rehabilitation is required and gradually there is no caring is required it will become the self-sustained one so that time close-out has to be carried out. No future interference of the mining people in that particular area is required.

So, this not only for the tree. This part is required for all the cases, initially maybe the local people need the support, all these things maybe required, all other say the access road maintenance initially maybe some expenditures has to be made later on that maybe gradually handed over to the state authority. So, all these requirements whichever is there that can be continued for a little more period and after that a self-sustained environment has to be created.

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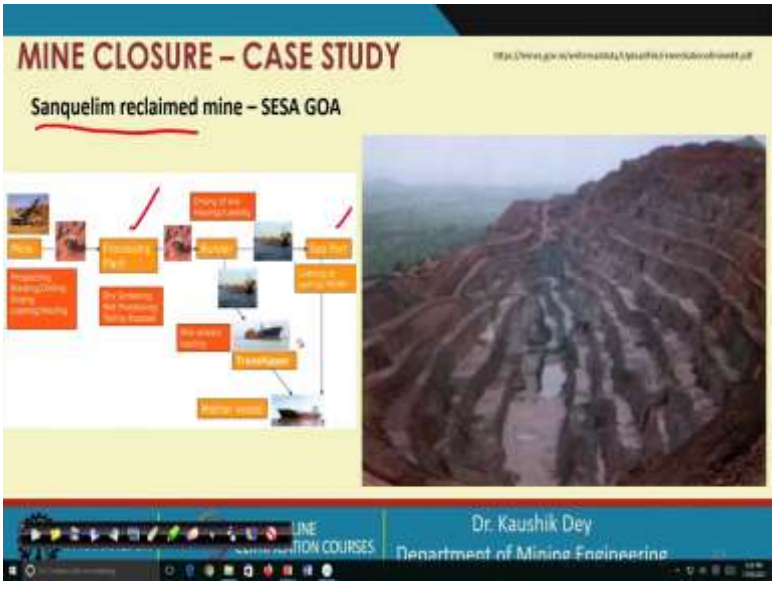


So, these are the some case studies, I would like to discuss here or show you this is these are the source from where it is taken so this is the Sanquelim mine of SESA GOA. So, this is the complete activities of the mining. You can see the mine and this mine has processing plant also, port also and this is the way the mining is carried out.

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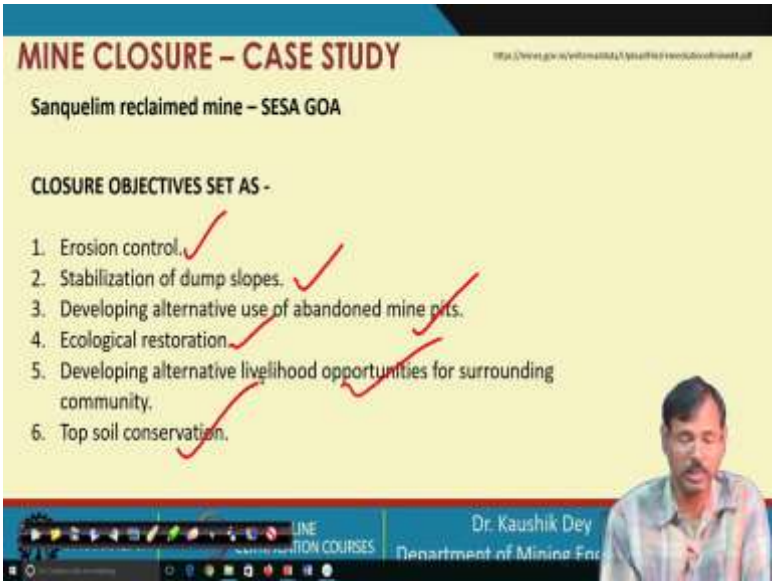


This is the mine and after the mine closure objective was set as the erosion control stabilization of the dump slope, alternative use of the abandoned mine, ecological restoration, developing alternative livelihood opportunities for the surrounding community and topsoil conservation. These are the objective set.

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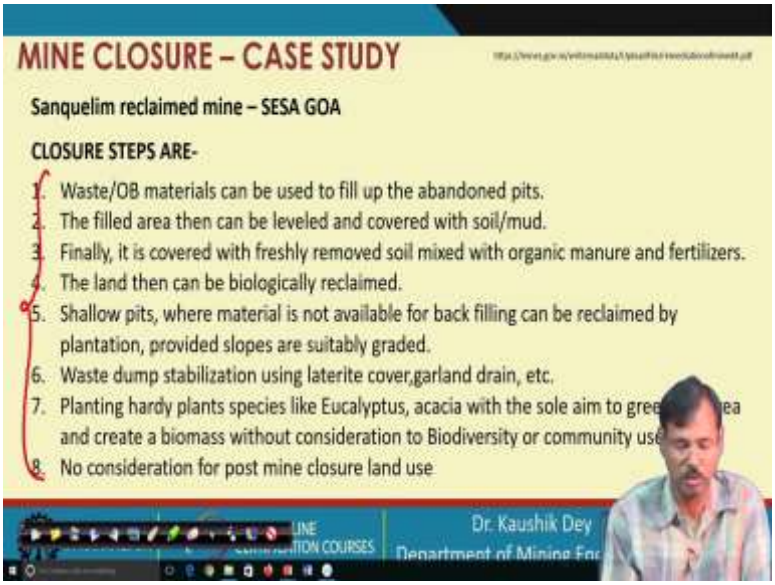


And closure steps are made these steps are considered.

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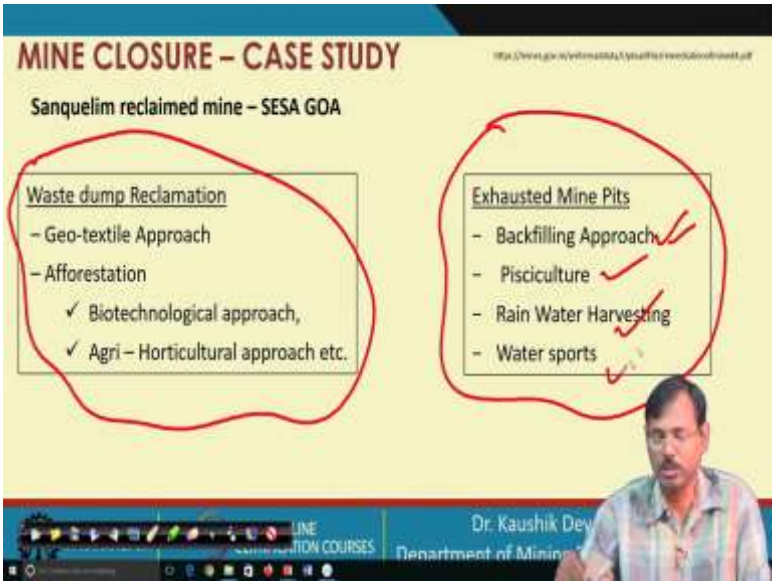


These are the waste dump reclamation. Mine pit backfilling is carried out and after that the depth of the mine is just reduced little bit so the shallow depth mine is kept then there pisciculture is made, rainwater harvesting is carried out and water sports is developed that was the proposal for that.

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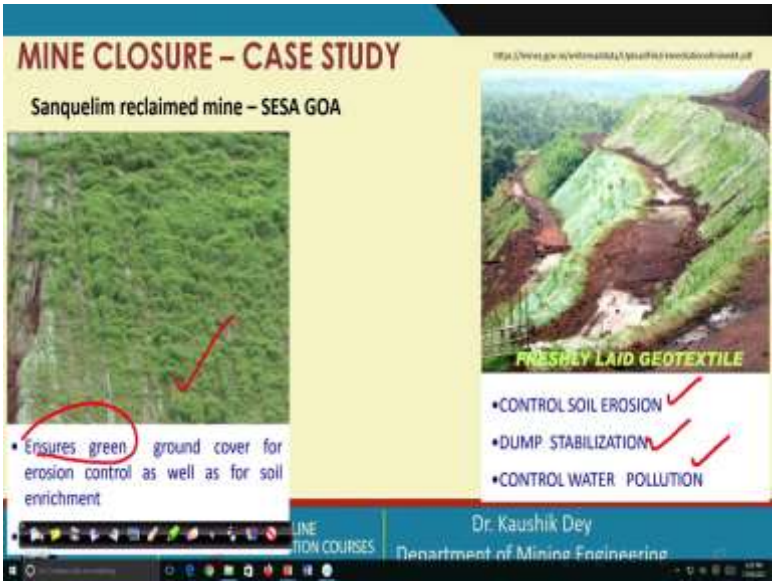


So, you can see the how the geotextile is used for ensuring the greens, controlling the erosion, so soil erosion, dump stabilization, and water pollution is controlled.

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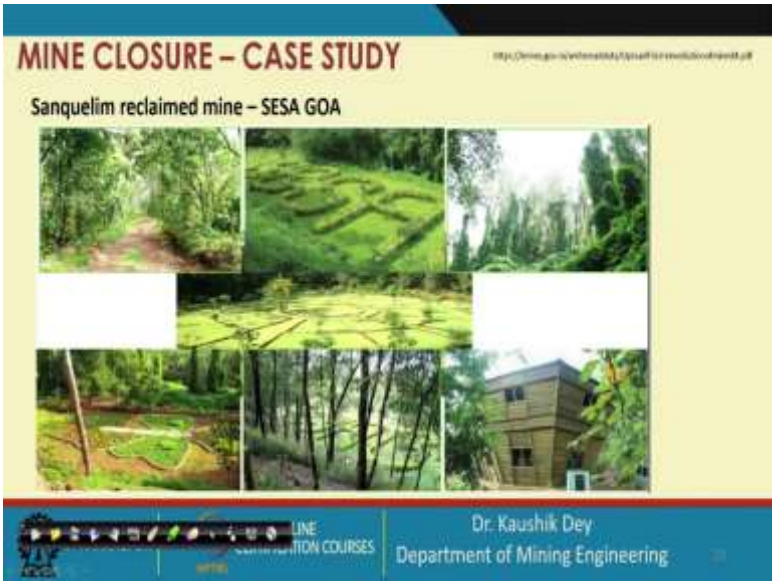


And this is the reclaimed area can be seen which is developed as a good forest, land area.

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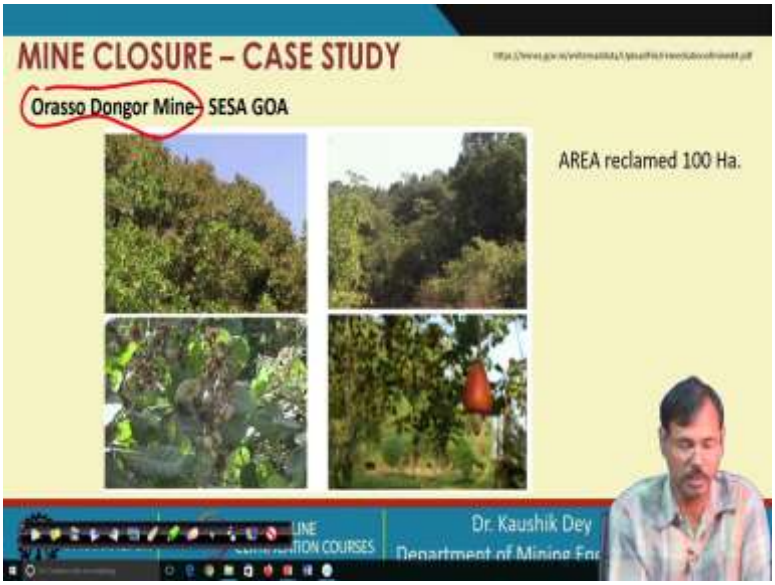


This is another mine where reclaimed 100 hectare area. You can see these are the beautiful fruits are also these are the cashew nuts.

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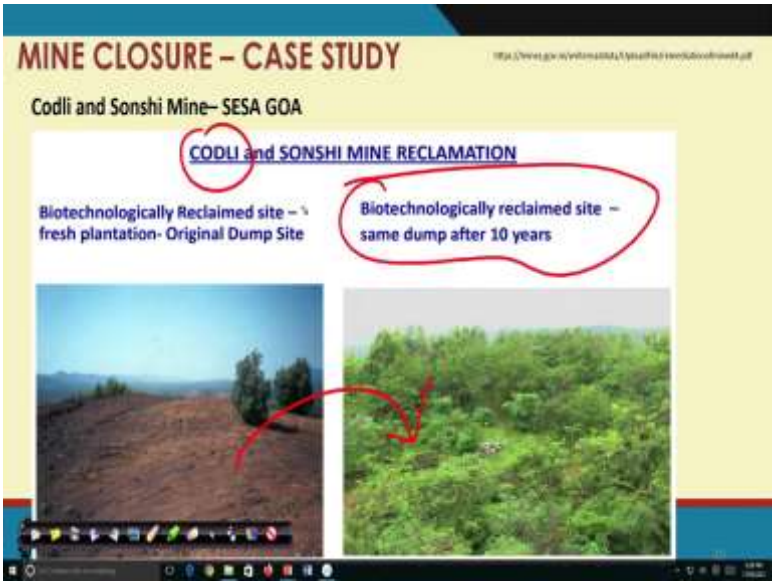


This is for the Codli mines. You can see the conversion of the mine from this to this in 10 years. So, this is the beautiful conversion of the overburdened dump material of that particular mine, so this is one Indian case study.

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There are some fantastic exceptional closing can be seen. This is a Shanghai Quarry hotel. It is a proposed reclamation site for this particular query so the query is proposed to convert into the query hotel. This is one case for the U.S. It cannot be no one can guess that this was a mine area.

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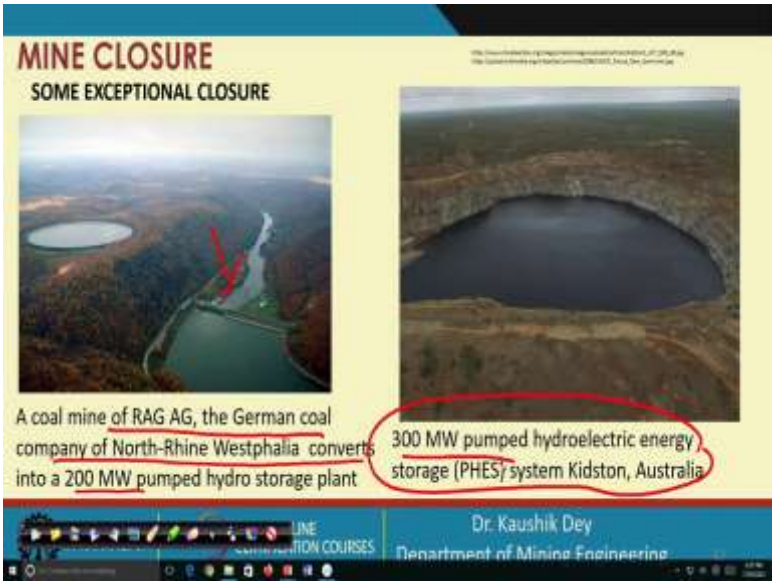


This is a coalmine, German coalmine company, converted into 200-megawatt hydropower plant storage plant and this is another one in Australia which is 300 megawatt pumped hydroelectric energy storage plant in Australia. These are the websites from which we have taken out this.

So, this is the end of this syllabus. I hope the course was interesting to you. We have tried to cover almost all the part of this course. We have started with the rock mass parameters, tried to give you some little bit knowledge related to the ore grade, all these things. Then we have discussed the different phases of mining how the ores are searched out, how those are the tested then after how the financial appraisal is made to check whether it is it will be profitable or not.

Then how the mining can be carried out through the opening of the box-cut then we have seen the excavation processes. We have seen the different pit layouts and after that we have seen the special methods of mining like high wall mining, dimensional stone mining, proposed concept of seabed mining etc. These are covered.

We have also tried to cover some of the other aspects like slope stability, haul road maintenance, auxiliary activities. These are also tried to cover and a number of tutorials are solved so that the machine combination can be made, unit operation costing can be carried out so these things are tried to give you the idea as much possible as from our side.

Apart from that, it is expected that participant will go through the different textbooks. There are good quantity of YouTube videos are available. Some of them are shown during this course but there are good number of videos available especially the operations of the shovel-blasting, n number of different types of blasting are available like say we have not discussed about the cost blasting techniques.

We have not discussed about the blasting for the dragline phases because time was limited so those videos are available. Those sources are available in the website. It is expected that student will go through those things from the websites and I think this course was enjoyable to you. Thank you.