Surface Mining Technology
Professor. Kaushik Dey
Department of Mining Engineering
Indian Institute of Technology, Kharagpur
Lecture – 28
Transportation in Surface Mines - 1

Let me welcome you to the 28th lecture of the surface mining technology NPTEL online certification course. In this lecture, we will start our new topic, that is transportation in surface mines. There will be three lectures on this. This is the first lecture, and we will consider the in pit transportation system. What are the possible transports and systems available for surface mines? We will look into those in detail.

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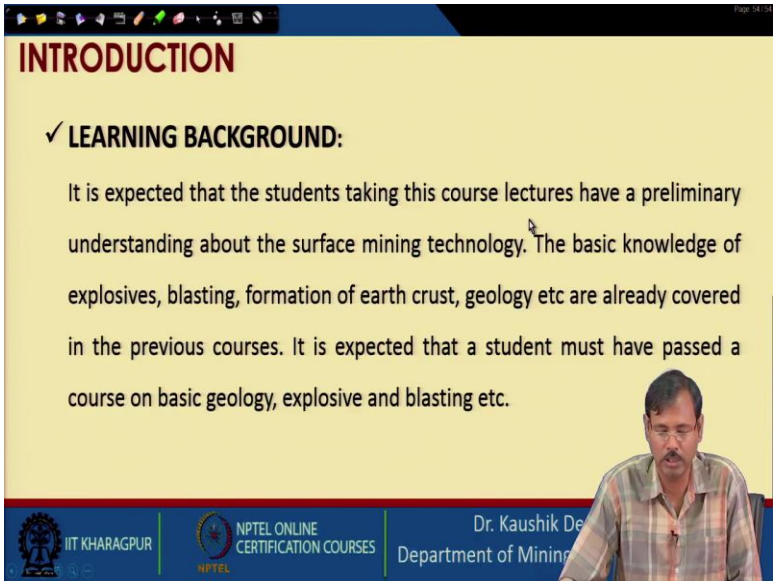

But as we do, let us look into the learning background required for the surface mining technology course.

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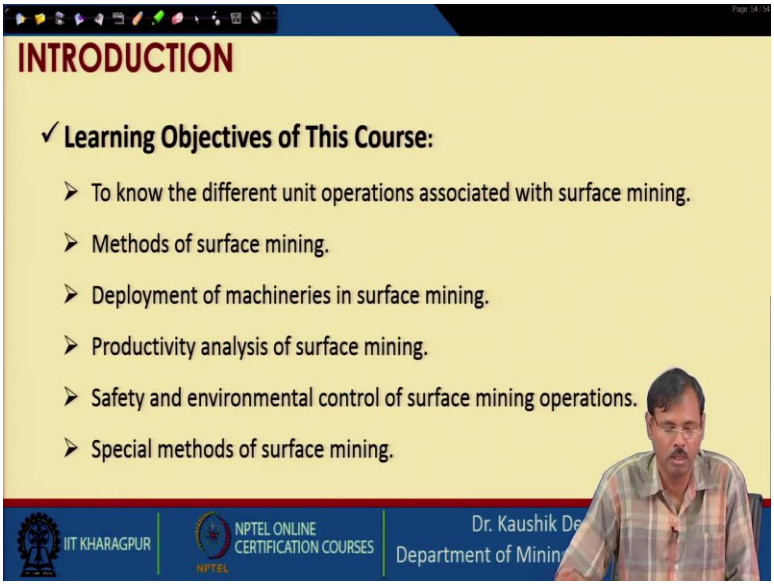

Let us look into the learning objective of the surface mining technology course.

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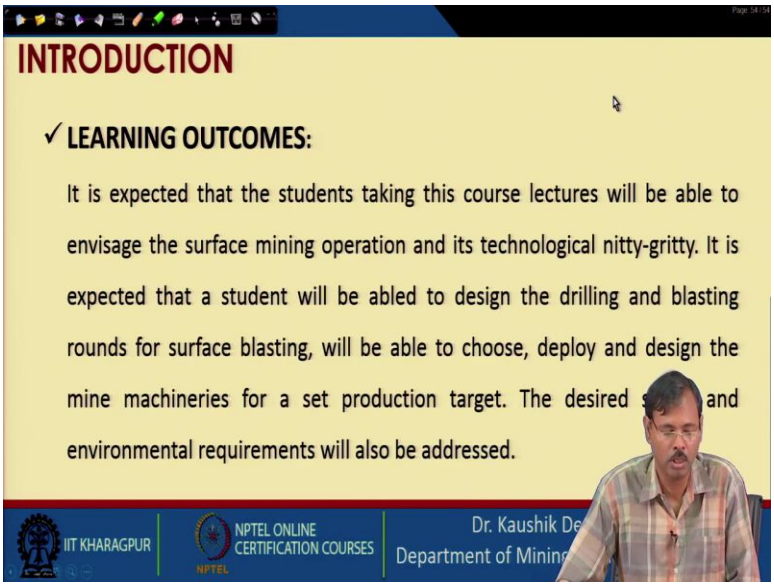

And learning outcomes expected learning outcomes from the participant of the surface mining technology course.

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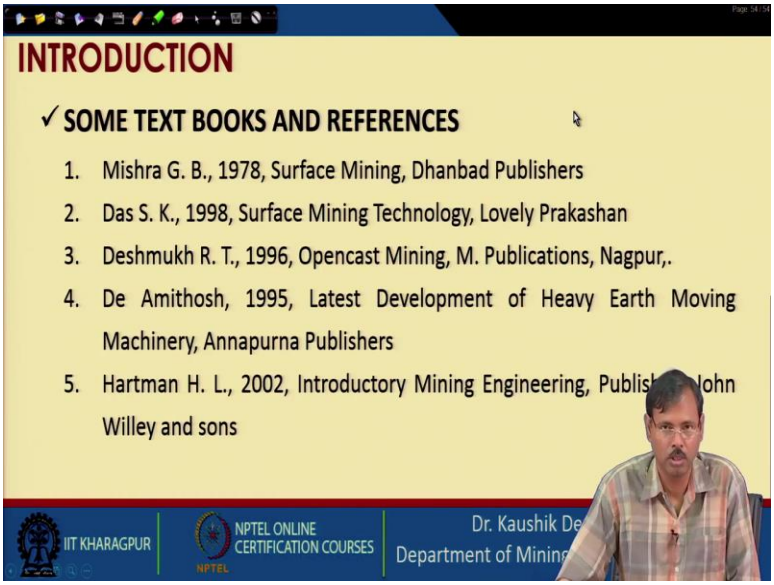

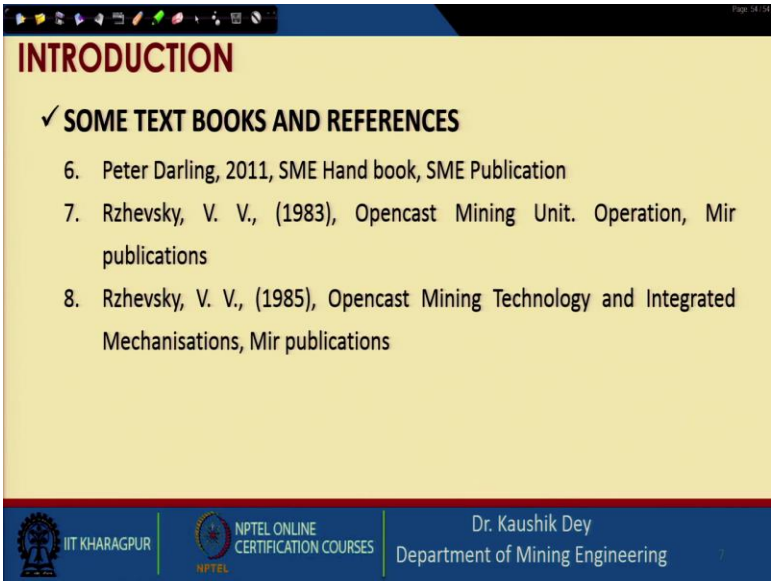

And these are some of the textbooks and references that can be followed in this course.

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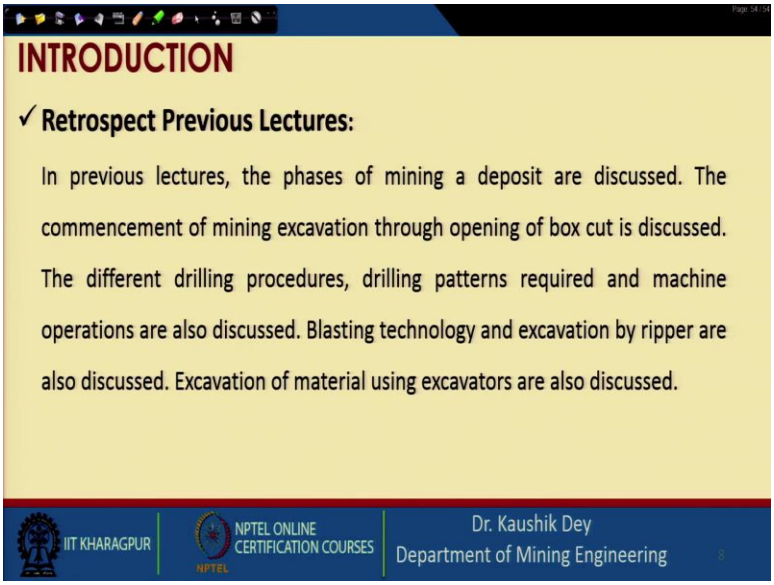

And let us retrospect the previous lecture. So far, we have discussed the phases of mining and deposit. We have also seen the commencement of surface mining through the opening of box cut and the different drilling procedures and drilling patterns required. The machine operations are also discussed blasting technology and excavation by ripper, which is a blast-free technology for excavation are also discussed. And excavation of the excavated material by the ripper or the blast fragmented material. The excavation using the excavators is also discussed.

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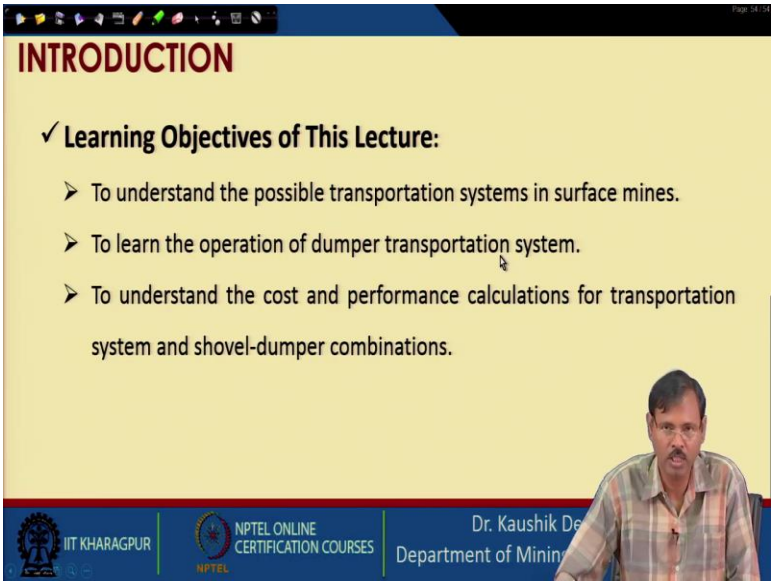

The objective of these lectures on the transportation system in surface mines is to understand the possible transportation system. To learn the operation of the dumper transportation system to understand the cost and performance calculation of a transportation system and shovel dumper combinations in the surface mines.

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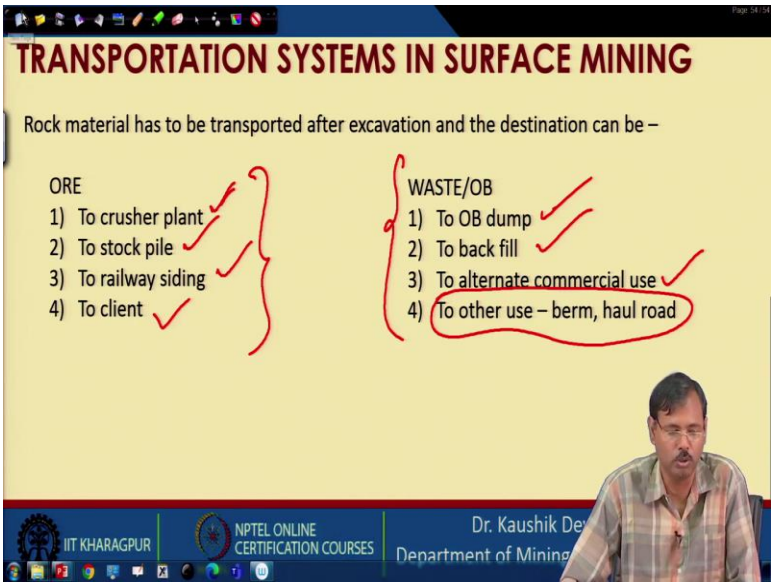

Now, let us look at the possible transportation systems in the surface mine; let us understand what we are getting out in the surface mine. In surface mine, we are excavating two types of material: ore and waste or overburdened rock. Now this ore these are useful material.

So, we have to send this material from the mine that which after the excavation that this material has to be sent to some special cases either to the crushing plant or to the stockpile or railway siding or maybe sometimes directly to the client, say like coal mines, etc. sometimes we can send the material using the truck from the mine itself to the power plant if it is situated nearby or so.

So, these are some possible cases where the useful materials are being sent like this, or the waste and overburden rocks are either to be sent to the overburden dump, or we use those materials to backfill the void area in the mine, or we can send that material if there are some alternatives commercial use of this material. So, sometimes, if the overburdened rocks are comprised of sandstone, that material can be sent to the especially operated crushing plant, which can be crushed to make the aggregate or crushed to make the sand.

So, this type of alternate commercial uses are there; if those are there, the material must be sent to that plant. Otherwise, that can be used for other purposes like construction of the berm and construction of the haul road itself in the mine. So, these are some of the special use in those cases those materials are waste, but those are not shifted to that place but are utilized for construction of these things. So, these are the destination of the material after it is excavated in the mine. This material must be transferred to those places, which is how this can be carried out.

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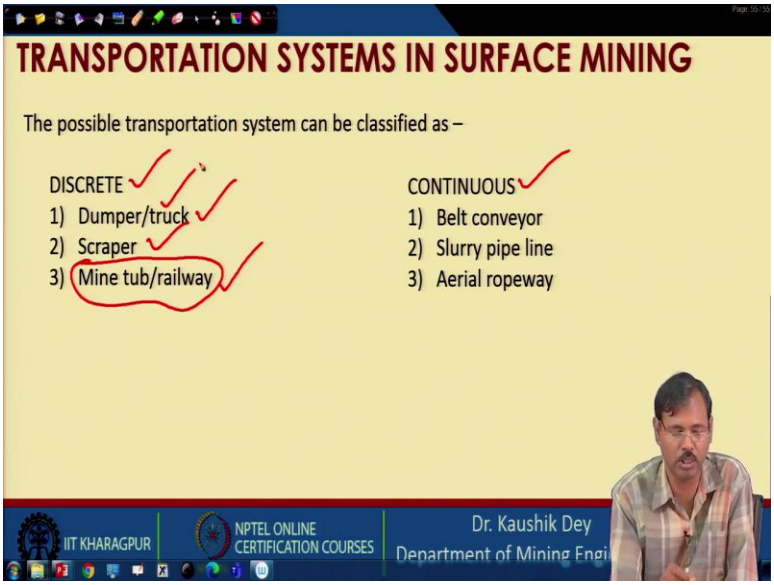

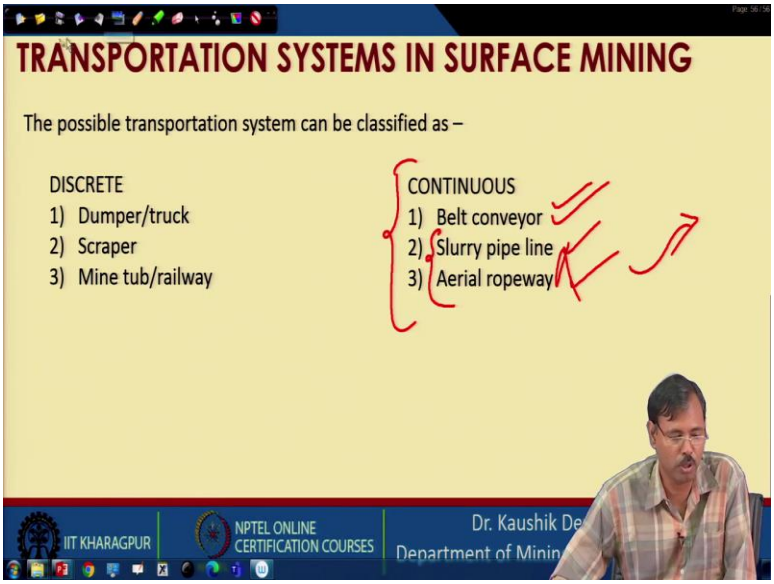

Now, what are the means of transferring these things? We are having we broadly classified in our surface mining system. Also, you have discussed that this broad classification is either

discrete or continuous. So, in discrete, we have dumpers or trucks used for transporting the material. We have a scrapper. Also, you have already seen one video in our ripper where the scraper is utilized to take the material excavated in the ground lift. The scraper transfers material and simultaneously the material to the destination.

Or sometimes you can use mine tub or railways where the tracks can be laid down in the mine benches and those can be used for transporting the material. This was earlier a very common system. Before this, dump trucks were popular; this was a very common system in mining transportation. We have a continuous transportation system: conveyor, slurry pipeline, or aerial ropeways.

But these are not so common because these are required huge installation and other requirements. So, these are not very common as a mining transportation system. Though it is technically possible, some other constraints arrest their use; these are transportation systems carried out post-plant use, but these are not used in mining. But in some cases in mining, Belt Conveyors are found as a transporting system in the mine itself. So, these are a broad classification of the transportation system in the mine.

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And before going to the discrete one, let us discuss some conveyor transportation systems. This conveyor system is called a shiftable belt conveyor system, where this belt conveyor system is

allowed to shift from one place to another gradually as the pace is moving; this is the Main belt conveyor system. This conveyor system is, in general, placed along the access road of the mine.

So, as the dump trucks etc., move through the access road in a similar access way, we provide this main belt conveyor. All the branch belt conveyors like this shiftable converse are moving along with the pace and discharging the material onto the main belt conveyor. This main belt conveyor takes the material from the mine to the outside pit. So, these are some of the converse systems.

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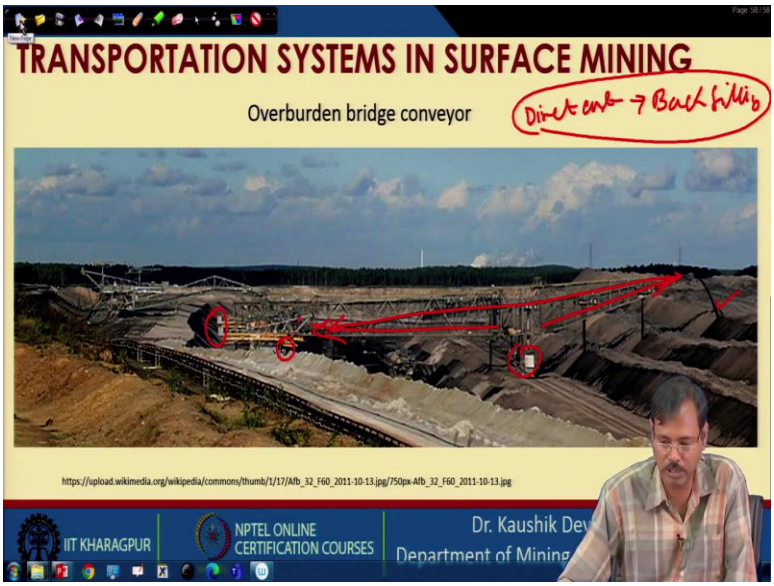

This is called an overburden bridge conveyor. In this overburden bridge conveyor, as the material is removed at this position, this material is directly taken in this overburdened bridge, and this long bridge conveyor is taking this material. These are supported like this, and this material is transferred to the overburden dump. So, this is the way this material is working. You can see this is one long discharge boom.

This is wrong receiving boom, and this one supported at this point is on another supporting as this position by this machine is being operated. So, it is a long bridge conveyor, and this system is high-speed and effective for transferring the material overburden material where the direct casting for the backfilling is practiced. So this is a very useful and first technique; however, this essentially requires a higher capital investment.

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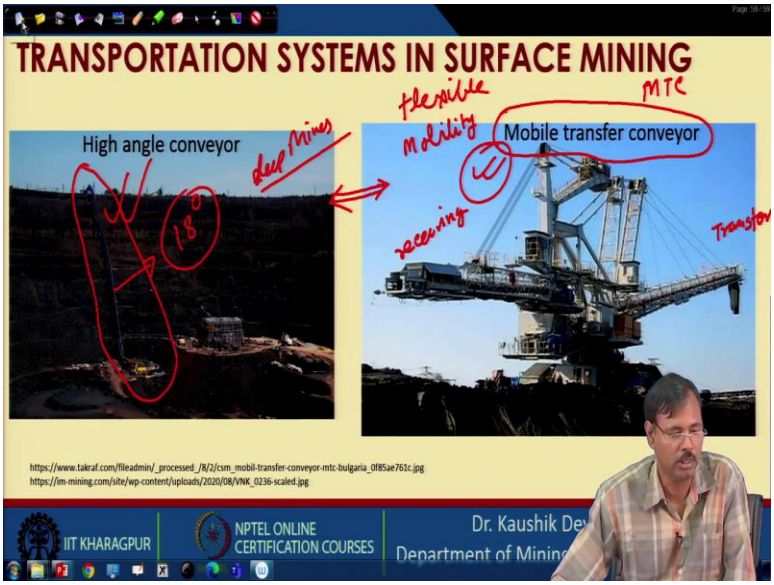

And this is a high-angle conveyor where the material is transported at an angle higher than 18 degrees up to 18 degrees. The conveyor is the normal conveyor, which is practiced and above 18-degree high angle converse is sometimes used it is sandwich belt convert sometimes it is different other types of conveyors are also available. So, this is the high-angle conveyor system and the mobile transport conveyor system.

This is mobile equipment, and a number of mobile transfer conveyor systems are available. So, if one machine is operating and the machine moves between that machine operating phase and the main belt conveyor phase, we have a flexible conveying system. So, these Mobile Transfer conveying systems are very, very flexible. These have high mobility and flexible high mobility; one-sided is the receiving end, and this is the transfer end.

So, in one boom, it is receiving the material directly from either another mobile transport conveyor that is MTC. It is discharging either onto an MTC or to the main conveyor that is either receiving from a bucket with an excavator or similar type of excavating machines or from the in-pit crusher and transferring that to the main conveyor or MTC something like that. So, it is acting as the intermittent transferring system.

So, that can be utilized here, which is very, very popular and gives high productivity in the transportation system in the mine. And high angle conveyor is a perfect system to negotiate the

inclination high inclination for the in case of deep mine in case of deep mines high angle conveyor is a very popular and valuable technique for transporting the material.

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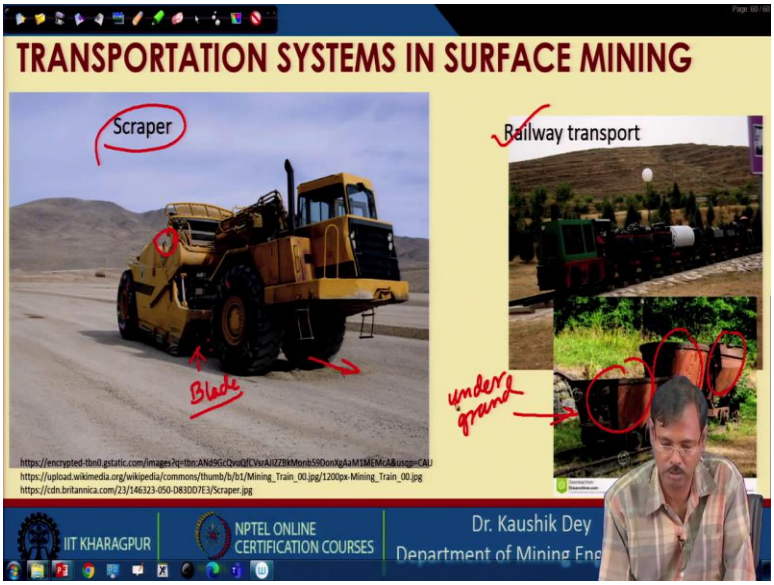

Now, let us discuss the discrete system. In the discrete system, we have already discussed, the scrapper can see the scrapper having a scrapping blade at this position; this is the scrapper blade, as the scrapper is moving in this direction. The scraper blade is taking the material flows loose, fragmented material from the ground, and this bucket of this scraper or pan of the scraper is filled with that material.

And once it is filled, the scrapper takes that material and discharges it into the discharging point, either a crusher or the dump yard where the scrapper is dumping the material. This is the railway transportation system. This was very common earlier. These are the small tubs different types of tubs are shown here. The small tubs were utilized for transferring the material. And nowadays, this method is popular in the underground mines, but on surface mines, these are replaced in surface mines these are replaced by the dump truck transportation system.

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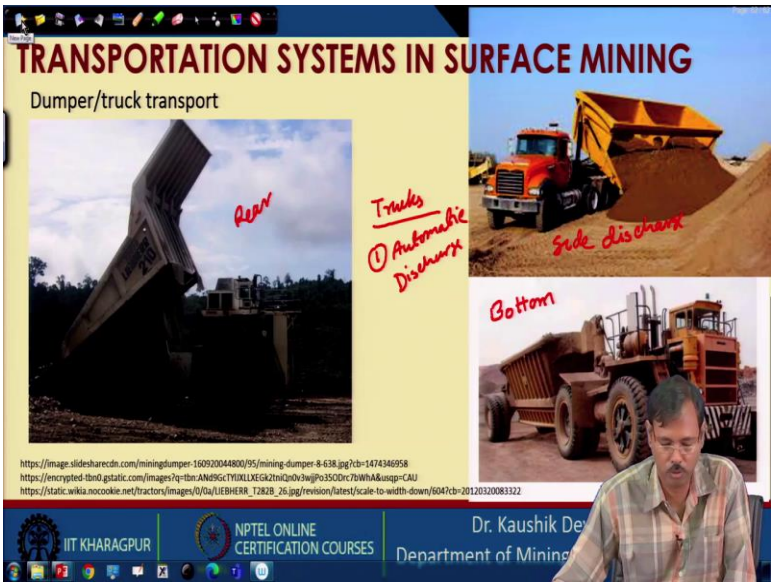

So, now let us look into some of our dump truck transportation systems. In the dump truck transportation system, we have different types of dumpers. There are some of the dumpers discharge arrangements. So, dumpers are the trucks that are featured with automatic discharge systems. So, these are automatically discharged; this is a side discharge dumper. These are the bottom discharge dumper, and this is the rear discharge dumper.

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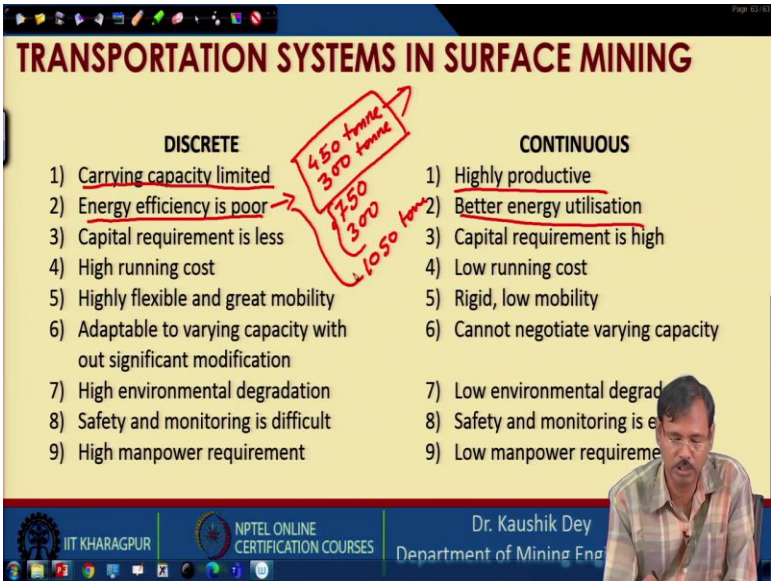

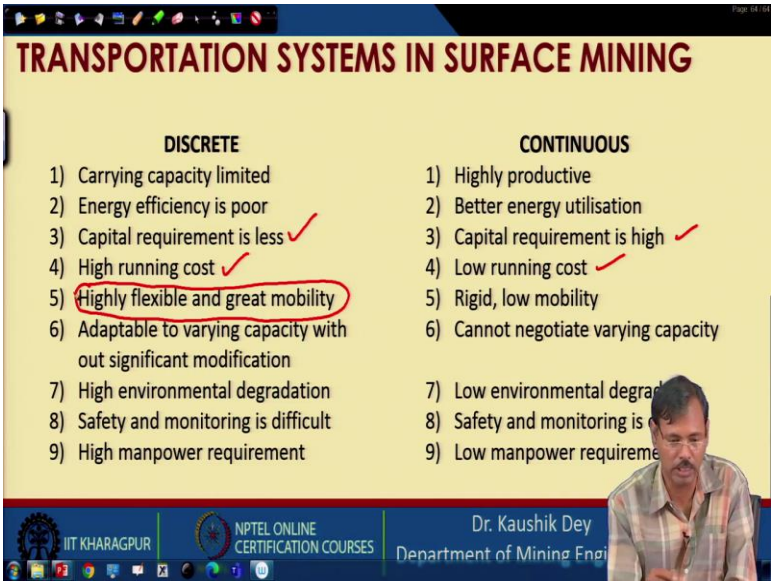

TRANSPORTATION SYSTEMS IN SURFACE MINING

DISCRETE	CONTINUOUS
1) Carrying capacity limited	1) Highly productive
2) Energy efficiency is poor	2) Better energy utilisation
3) Capital requirement is less	3) Capital requirement is high
4) High running cost	4) Low running cost
5) Highly flexible and great mobility	5) Rigid, low mobility
6) Adaptable to varying capacity with out significant modification	6) Cannot negotiate varying capacity
7) High environmental degradation	7) Low environmental degrad
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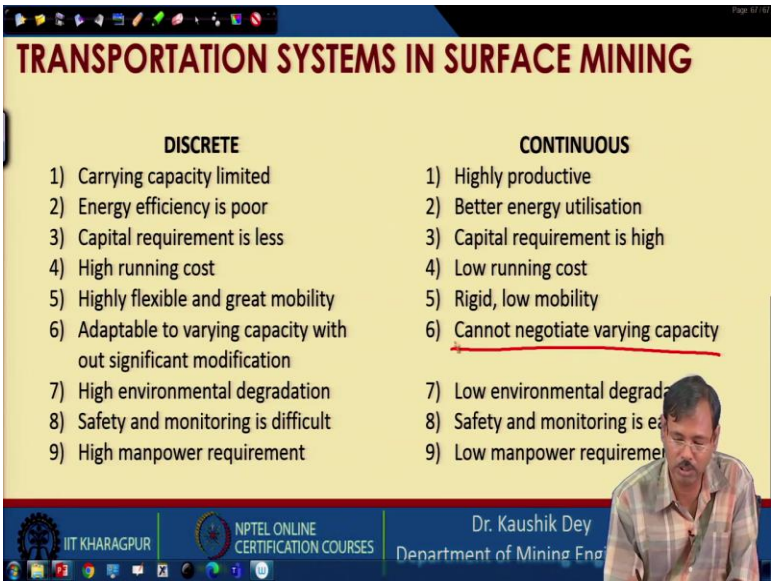

Now, if you compare this discrete and continuous system of transportation, the discrete system is carrying a smaller unit with limited capacity, but this is highly productive. Energy Efficiency is extremely poor for the discrete system especially for the dumper transport system, but it is having better energy utilization. If you look into this, we will find out suppose the dumper is having to say the capacity of 4050 tonnes.

So, the dumper carrying capacity is 4050 tonne and tare eight is say 300 tonne. So, that means when the loaded dumper is moving, the time, energy required for propelling the dumper is for 750 tonne whereas, the dumper is returning back empty that time the energy required for the propelling is 300 tonne. So, that means together for shifting say 450 tonne material the energy required for shifting is said 1050 tonne if you are considering turn kilometers so, this is the tonne kilometer energy is required for this.

So, that is why the transportation system is this transportation system is not very energy-efficient system. But these are having facilities the capital requirement is less than the installation requirement for this continuous system like conveyor etc the capital requirement is high. But running cost for the discrete system is high most of the time it is diesel-powered etc. So, that is a costly system here is an electrical system so the running cost is less.

But this is also having some flexibility, mobility is very great your shovel can change the position the dumper can negotiate the changing in the position from one phase to another phase one bench to another phase, one dumping point to another dumping points stockpile to the

railway siding all these changes can be immediately negotiable in this case. But here it is not possible it is the mobility is very very difficult.

That is why we are discussing about the Mobile Transfer conveyor. All those intermitted systems are required to negotiate with this mobility only and this is adaptable for varying capacity which means suppose today our production requirement is less say 1000 ton per hour is today's production requirement. And we are deploying say seven dumpers for that tomorrow if the requirement is for 200 tonne we will deploy to the dumper, will not deploy seven numbers in that case.

So, that can be easily negotiable in this case, but in this case that cannot be possible the conveyor which is 1 meter wide and running at a speed of 2 meter, we have to run that in the same speed through the quantity requirement is reduced from 1000 to 200. But we have to run the installation with the same capacity. So, that is the problem with this system. And we cannot have any control here.

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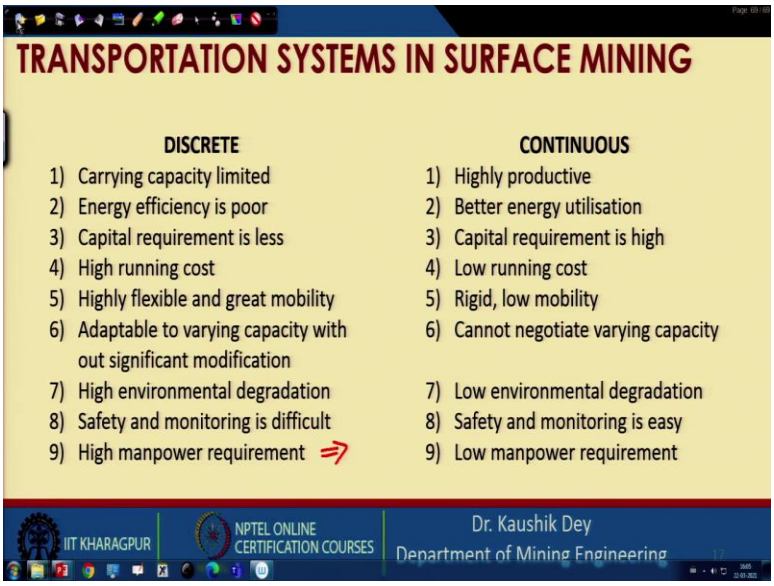

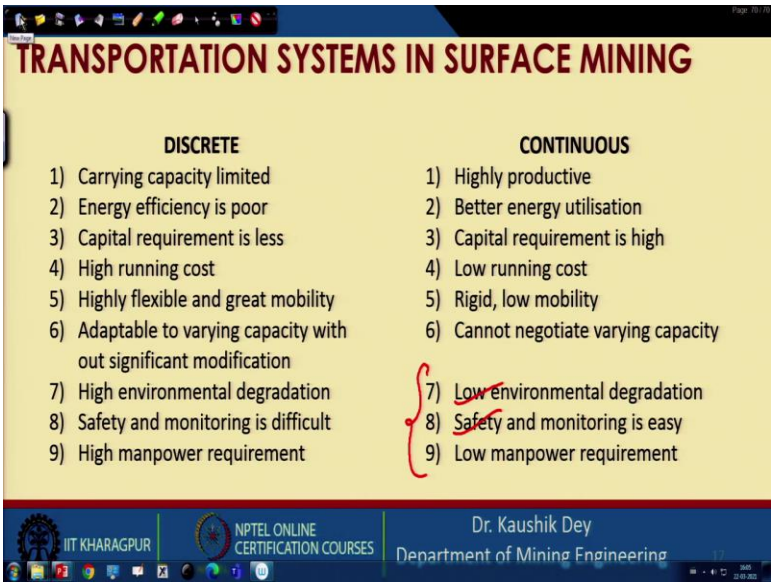

This is having high environmental degradation mostly diesel operated on the movement of the dumper on a haul road it is generating dust, it sometimes often it is budging the horn that is also creating noise pollutions. And this is also the problem with the safety and monitoring is difficult as the dumpers are moving it is not a rigid system moving flexibly or driver skill is essentially required.

And most the Surface Mining accidents are pertaining to haul road accidents only. So, that is why this is a very, very difficult one for controlling these things. And we need high manpower requirements automation is difficult, though now, it is good to research work is getting out on the automation of the dumper transportation system.

But these are the facilities with the continuous system especially for the environmental degradation, safety and manpower requirement and automation these are greatly available in the continuous system and the main is that continuous system is highly productive. And that is why very very efficient.

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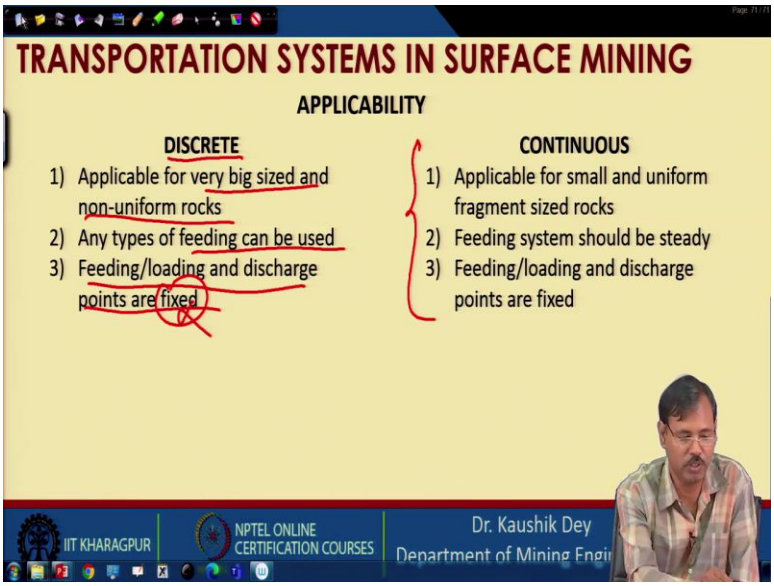

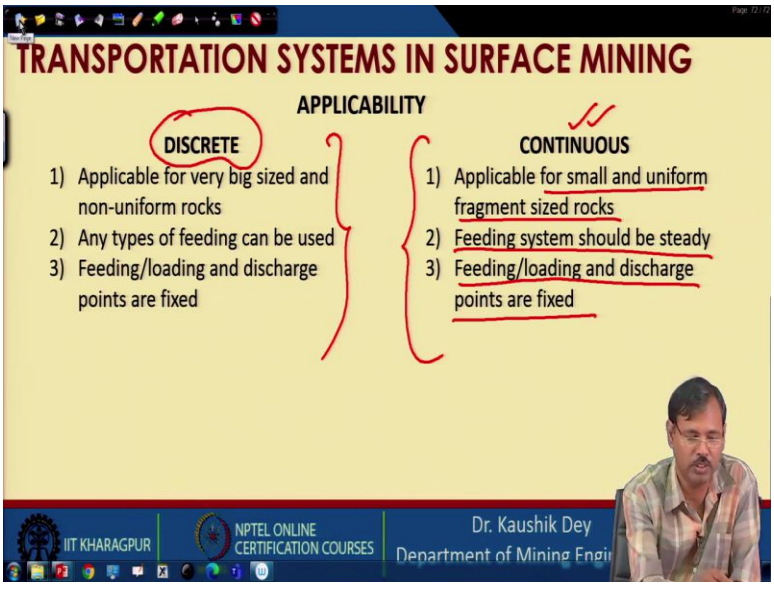

But when we are looking at the applicability, the discrete system is applicable for very big-sized boulders and non-uniform rocks which means that fragmentation distribution if it is poor also. Then also that can be negotiated with this dumper dump truck transportation system. Any type of

feeding can be used, it can be fed with the shovel can be fed with the front-end loaders, and all those feeding systems it can be fed with the conveyors also.

So, whatever the means, that is negotiable to those, and the feeding and discharging points loading or discharging points are not fixed in this case it is very, very flexible. So, this is very very flexible and you can immediately change the moment one damper is addressing the shovel number 1, if it is instructed, next time it has to address the shovel number 2 it can go for that immediately. But that much flexibility is not available with the continuous excavation system.

So, applicability is different in continuous excavation systems, these are applicable to the small and uniforms sized distributed sizes of fragments only. Large boulders cannot be taken in the conveyer system and if the boulder's size distribution is very very scattered then also it cannot be taken in the conveyor system because that will spill out from the conveyor. And feeding systems should be a steady feeding system you cannot directly dump one bucket load onto the conveyor which is not possible.

So, the bucket has to be discharged on a feeding system that may be a front feeder that may be a belt feeder, whatever feeding system is there, the material has to be taken in the conveyor through the feeding system only and the feeding and loading discharge point are also fixed that means, the conveyor system has to take material from one point and each has to discharge the material at a particular point.

So, this type of flexibility is not available in the continuous system those which are available in the discrete system. But discrete system it is not energy-efficient, it is costly, but these systems are not that costly and it is energy efficient also. So, these are the basic advantages and disadvantages and applicability of the discrete and continuous systems of excavation.

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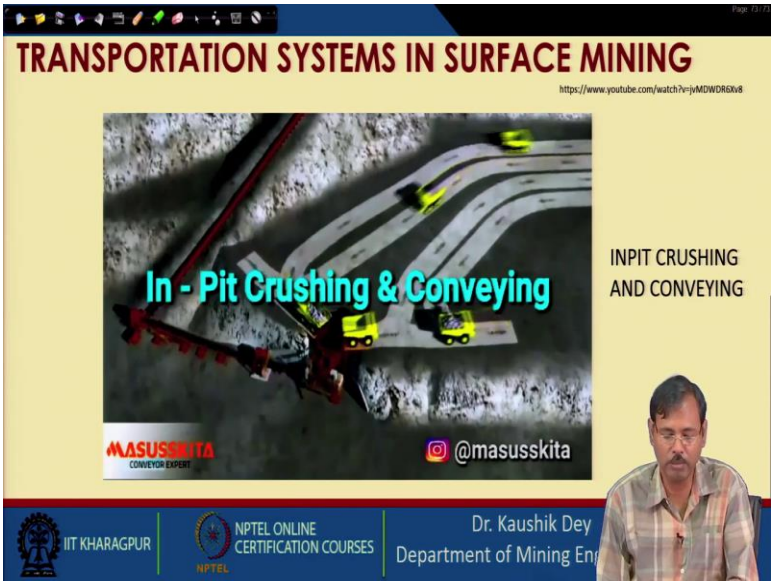

Now, let us look into some of the continuous system videos of some of the continuous system discrete systems we will discuss this is one arrangement where the blast fragmented rocks are crushed fast. So, to make it a uniform size and smaller size, so, that that can be conveyor after that. So, this is a negotiation between the discrete and continuous systems a small portion where the discrete transportation system is used, but the major portion where the continuous transportation system is used for the adjusting the cost.

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So, this is the way this is carried out where the first after the blasting the material is taken and then the material is taken into the crusher it is a reduced in the site and then that size material is conveyed. So, this is the in pit crushing and conveying system which is used for the transferring of the material. This is the discharging system of the conveyor, where the spreader is used for constructing the dumps.

So, after a particular dump formation, the conveyor can be shift once in a while. So, this is the shiftable conveyor. Now, the second row of dump can be made then again the bench floor is extended this video is available in this YouTube link. And by this way, the uniform dump can be formed using this spreader system. So, overburdened rocks are blasted then it is taken into the in-

pit crusher then the in-pit crusher makes the fragment size uniform then which is taken in the conveyor then finally discharged with the spreader.

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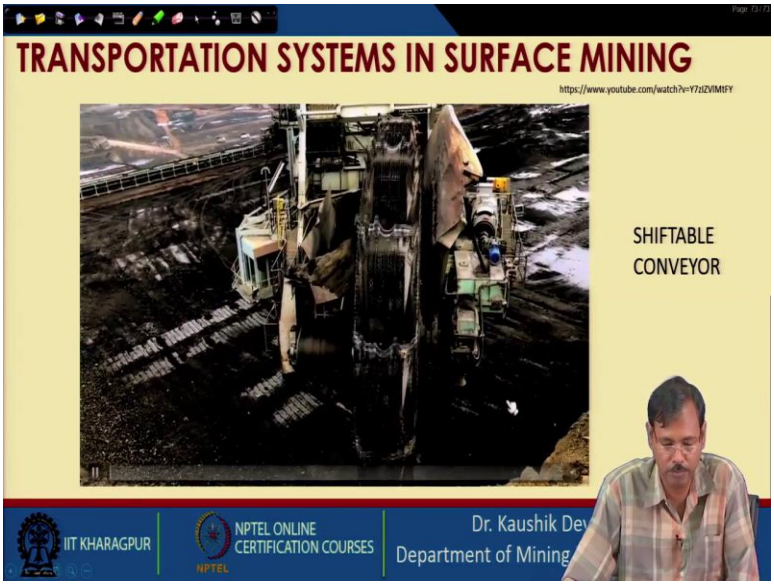

So, this is in pit crusher conveying system. This is a shiftable belt conveyor system, where the material is taken from the bucket wheel and material is discharged using a mobile transport transfer conveyor the material is discharged to a shiftable conveyor. Now, behind this, the shiftable conveyor is working.

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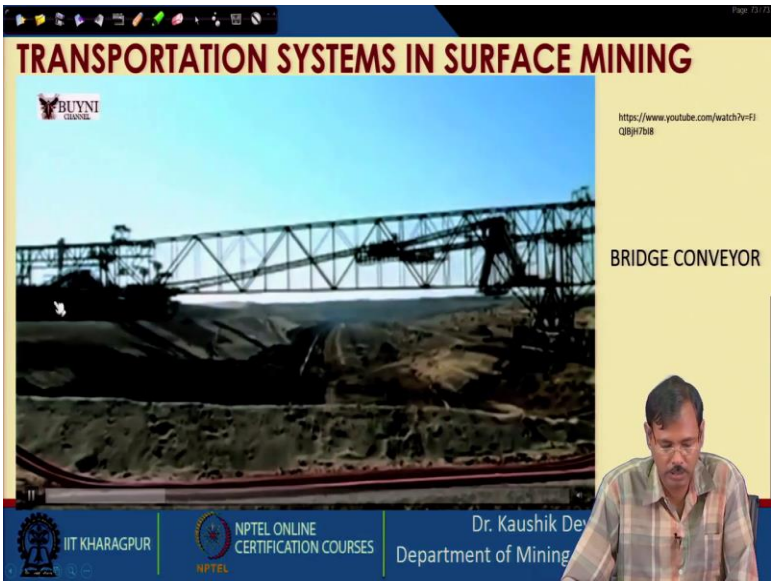

And this is a bridge conveyor where the material is discharged through this bridge conveyor and which forms the overburden dump or backfields in the backside of the mine. So, the material is excavated on this side using a bucket chain excavator. This bucket chain excavator can be seen here, then the material is transferred through this bridge conveyor and being discharged at this position.

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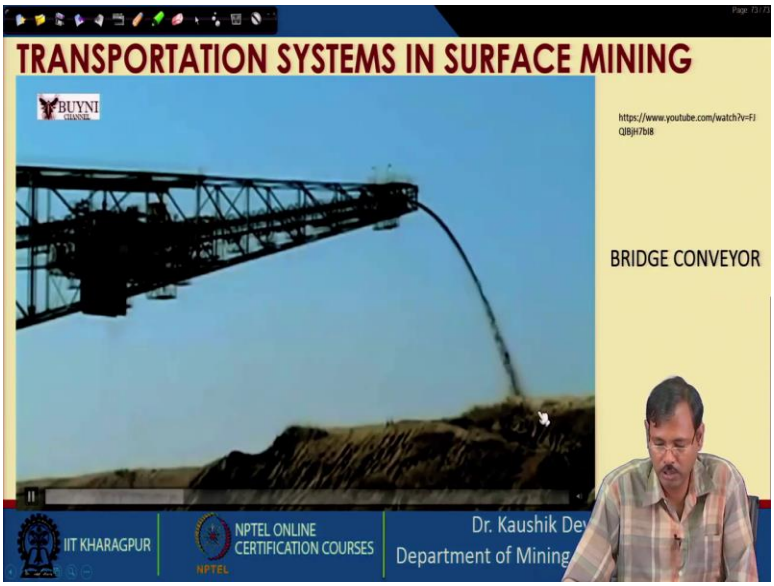

So, this is intermitted discharging system so, that the bench can be extended on this side also. So, this type of transporting system gives us the facility to go for the highly productive mines, and with the highly productive mines, you can go for deep surface mining. In fact, using this continuous excavation system only some of the German coal mines are operating at 500-meter depth also in the Surface Mining system. So, this is more or less the end of this lecture. Thank you.