Surface Mining Technology
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Lecture 37
Excavation with Dragline - 2

Let me welcome you to the 37th lecture of the Surface Mining Technology course NPTEL Online Certification Course. This is the second lecture on excavation by dragline. And in this lecture, we will look into the excavation methods and pit layouts.

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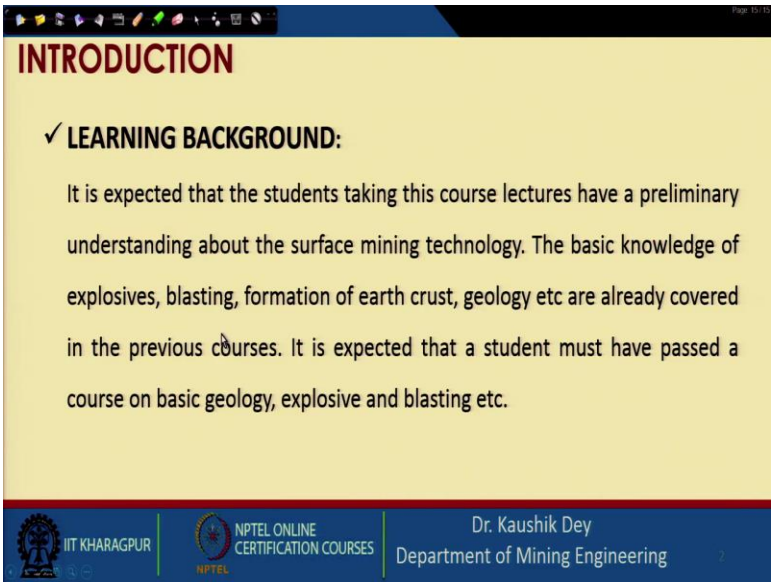

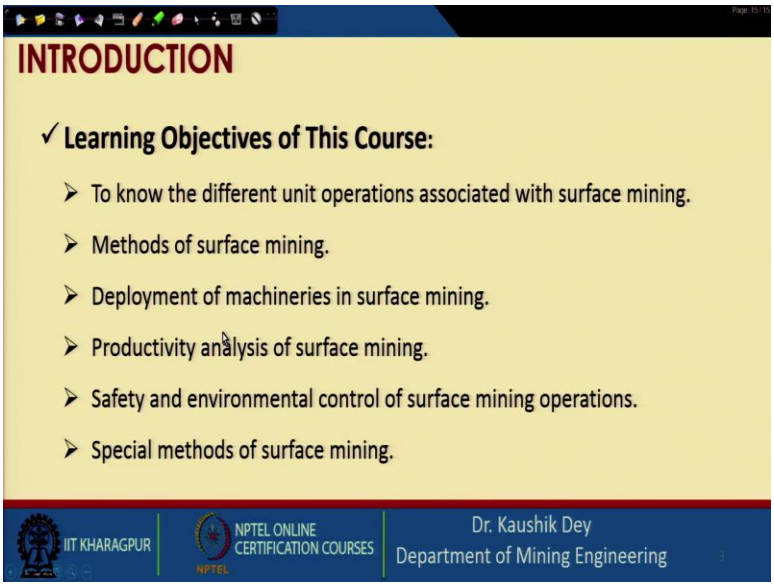

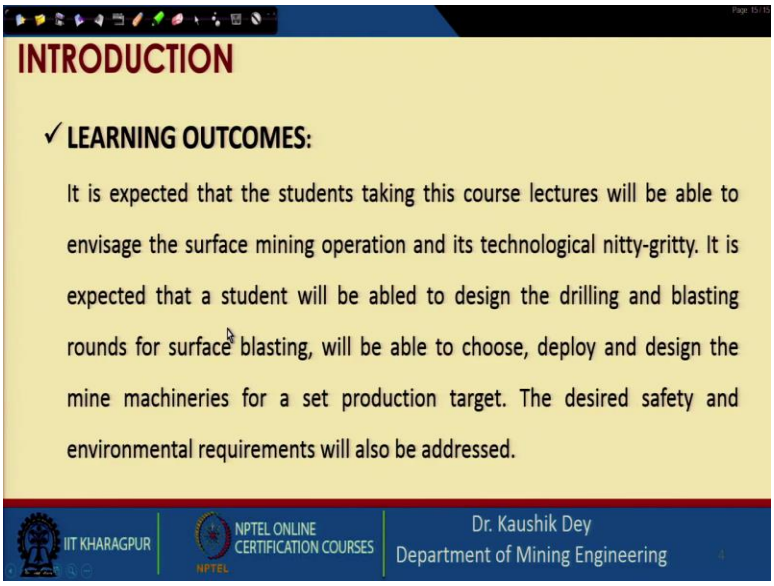

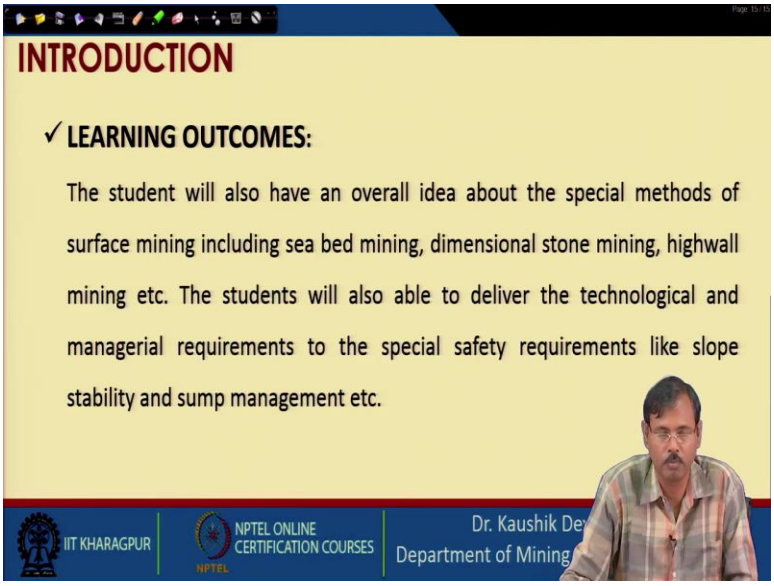

So, let us, as we do in every class, have a glimpse of the learning background for the Surface Mining Technology course. These are the learning objectives of the Surface Mining technology course. And these are the expected learning outcomes from the participants of the Surface Mining Technology course.

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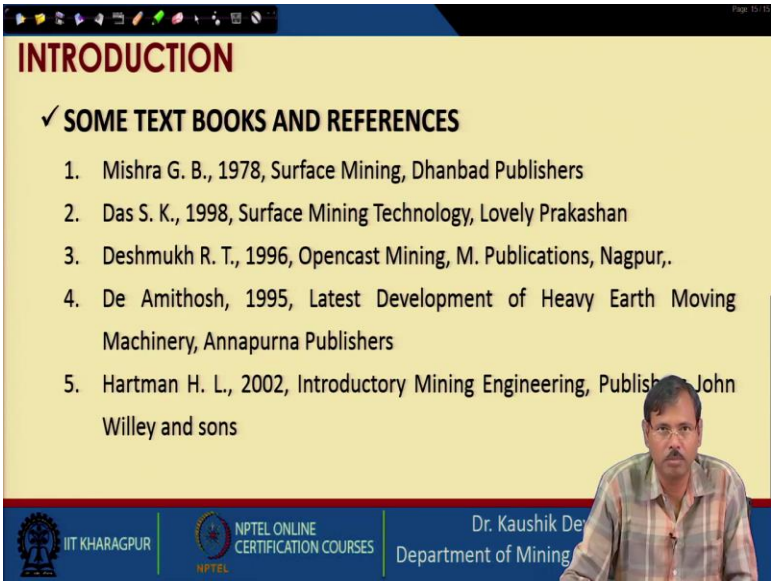

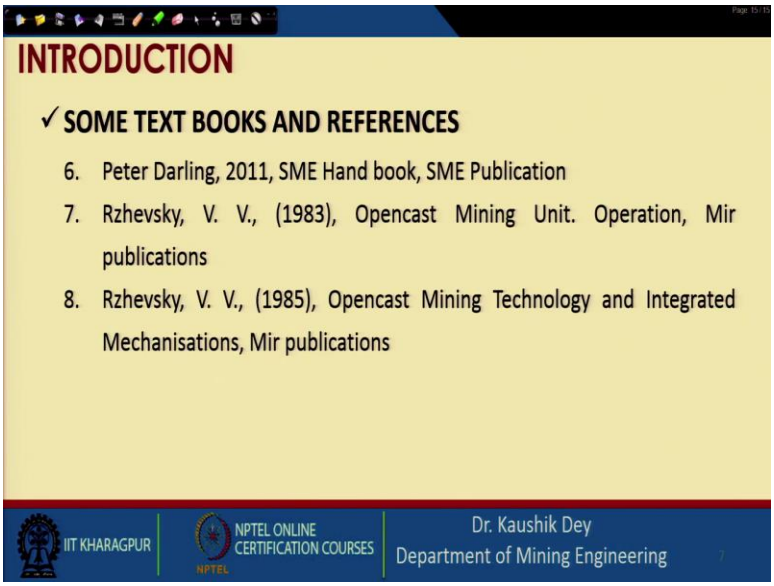

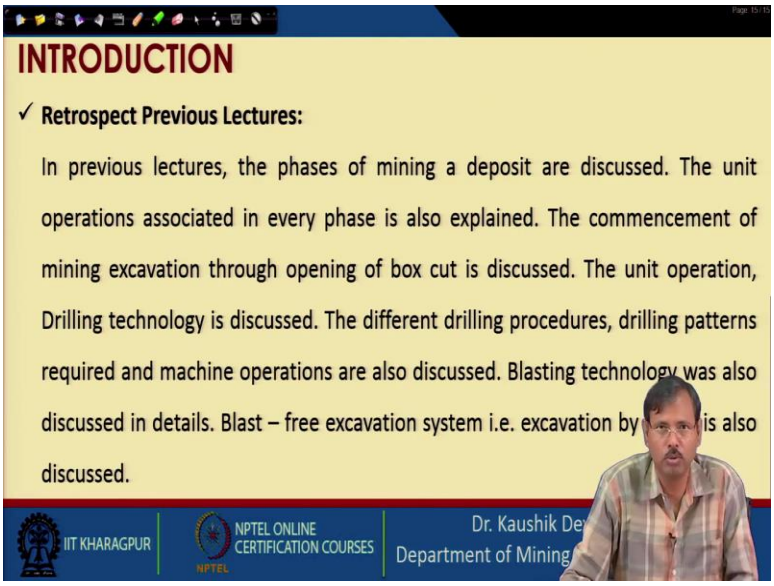

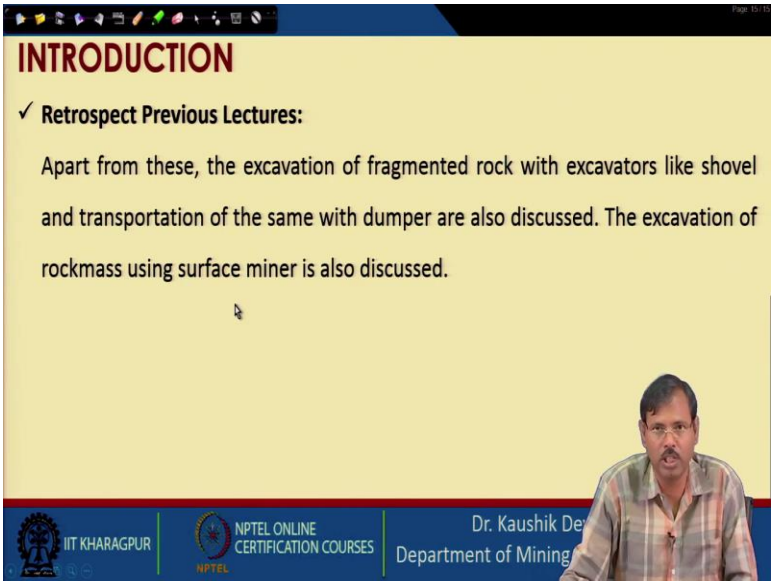

And these are some of the textbooks and references. Now, let us look into the retrospect of the previous lectures. So, far we have covered the phases of mining, we have covered the different unit operations associated with every phase, we have covered the commencement of mining through opening of box cut and we have covered the unit operations like drilling, blasting, and excavation by shovel and dumper combinations.

We have seen the blast free excavation systems using ripper and surface miner and we have covered one class on the dragline in which we have introduced the dragline, it has been found that dragline is basically an excavator, which has the bucket suspended by the rope from the

boom. So, the bucket basically suspended by two wires, one is hoisting wire, another is a drag wire, so the bucket is suspended from the boom through the hoisting wire.

And if the hoisting wire is allowed to take up the bucket in the upward direction it can lower also. And when the bucket is required to fill, the hoisting wire allowed the bucket to be positioned at the toe of the bench, then the drag wire is basically dragging the bucket towards the machine. And machine standing above the bench. So, bucket is allowed to move through rubbing the face of the bench and on that movement, the loose material rock muck pile which is there after the blasting, that material is entered into the bucket.

And by the way the bucket is filled. Then on filling the bucket, the machine is again hoisting up the bucket with the hoisting rope by the time the machine starts rotating towards the dump direction and on the dump direction, the hoisting rope and drag rope, they position themselves in such a way that the bucket is discharged from the mount itself and the material is dropped onto the dump.

So, this is in a nutshell, the dragline is working that we understood in the videos and other photographs in the last class. And in this point, one, very important that the bucket is always under the hoisting through the hoisting rope. And that is why there is no solid, no strong contact between the boom and the bucket and that is why bucket is always oscillating. And that is creating the problem: that the direct positioning of the bucket cannot be possible.

And it is essentially required dragline cannot be used to fills any trucks etcetera. So, it is basically dumping the material over an area. So, the actual control on the dumping and actual control on the or you can say not actually it is a precise control on that, dumping the material at a precise location is not possible with the dragline. Dragline is always go for the area dumping of the material but because of it is having a very high reach, long reach then the dragline is allowed to dump the material directly at a distance.

If a shovel dumper combination is allowed for that, it is taking more time. Dumper is often compared with the stripping shovel. Stripping shovel we have seen that stripping shovel is also just like dragline having a large boom. But as it is a solid boom which is having the controlling unit of the buckets also. So, that is why stripping shovel boom reach is not as much as the dragline reach.

So, that is the problem with the stripping shovel, stripping shovel has to work from the bottom of the benches towards the upward direction. But stripping shovel has the facility, it can dump the material at a precise location not like dragline. Dragline dump the material over an area but the cost of the dragline is lesser than the stripping shovel, it can operate with very high specification as the bucket is wire suspended, its digging depth is significantly high. And also, if the power requirements are lesser than the stripping shovel. So, these are the facilities of the dragline we have already found in our previous class.

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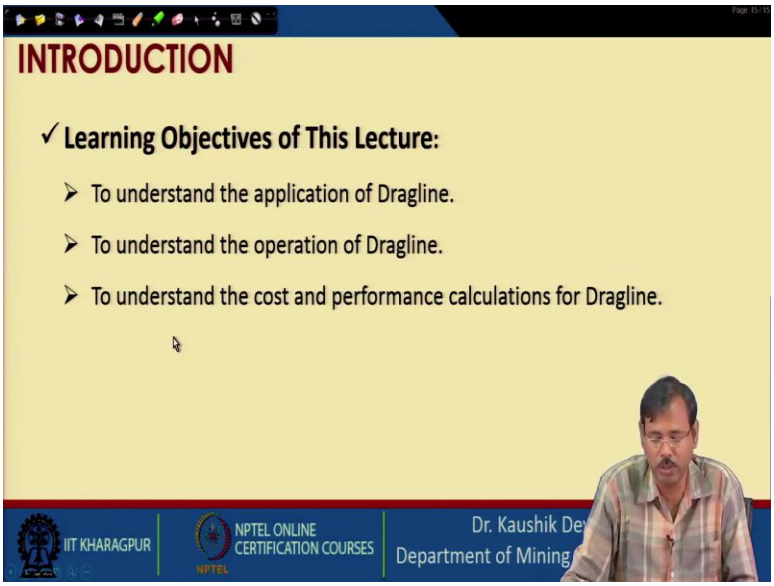

Let us look into the objective of this lecture of same lectures of the dragline to understand the application of the dragline, to understand the operation of the dragline, and to understand the cost and performance calculations of the dragline.

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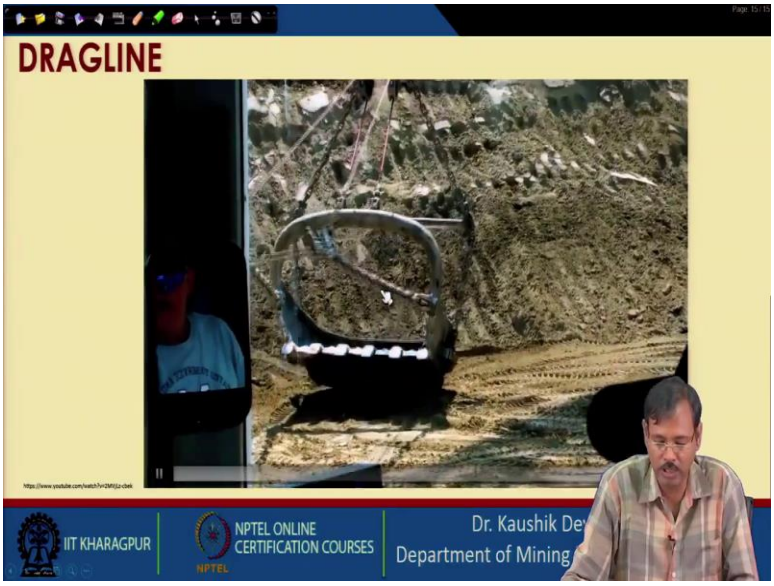

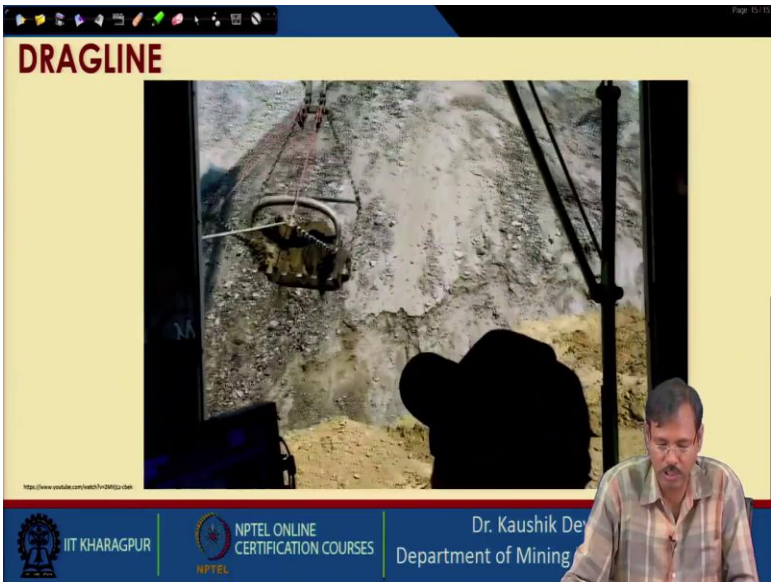

So we, in this lecture, will start basically the operations of the dragline, but I want that you should observe this video, this is a YouTube video, link is given. This video basically shows you the view of the operator, you can see this is the operator, this is the bucket you can see, the drag rope here, this is the hoisting rope and this now operator is basically working on this. And you can see the view of the operator from this.

And operator is now using the hoisting rope, lifting the bucket. So, now the bucket is lifted operator is now rotating towards the direction from which the material has to dig. So, this is rotating in the opposite direction where the bench is there. So, now we can see this is the bench from where the operator has to take the material. So, we can see the view of the operator. Now you can see how the operator can see, it is now lowering, hoisting rope is now lowering the bucket and it is now in the toe of the bench and it is now taking the material.

So, after taking this, it is now rotating. See as it is wire suspended the bucket is oscillating. It is always oscillating you can see the bucket is oscillating. Now, you see bucket has started dumping the material over this area and all this filling and dumping is basically controlled by the two wires that is hoisting wire and drag wire. Now hoisting wire is now again lowering the bucket and now the bucket is lower towards the toe. See this is the toe of the bench and now the drag wire is basically dragging the bucket for its filling.

So, buckets size: you can keep very large size bucket and this large size bucket is allowed to fill and that is why a little bit larger boulders can also be accommodated in this bucket. Now see the dumping is carried out over an area so that area dumping is very clear from this view.

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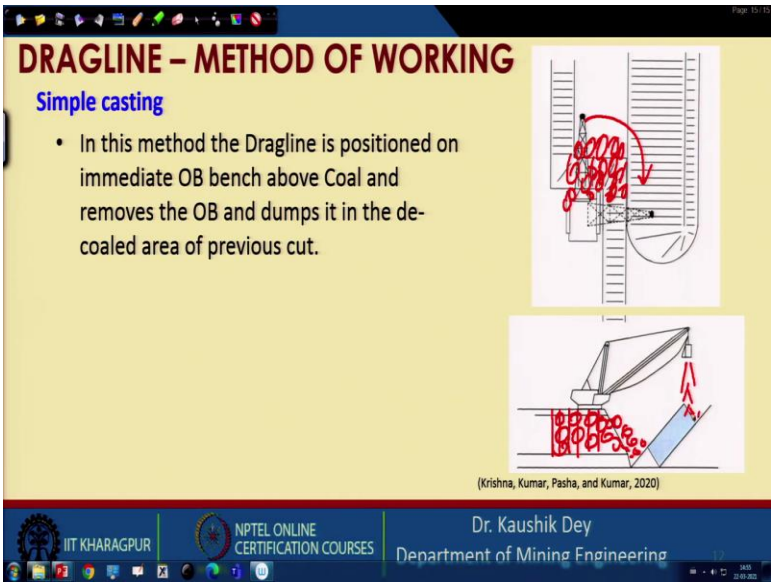

Now, let us understand how the dragline works, dragline works with basically the casting works for casting the material, casting the overburden blasted rock from its fresh to the dump yard. So basically, if you look into this figure. This is the bench before you deploy the dragline at this position you have carried out different holes, drill different holes here and then you blast this portion and allowed the material dumped like this.

Now, this is the after blasting, this is the fragmented material. Now, this material is basically taken and thrown at this dump by the dragline. So, in other way, you can consider this is the fragmented boulders, these are the fragmented boulders and these fragmented boulders are now taken by this dragline, after taking this one drag line is rotating and dumping the material at this position. So, the material is dumped at this position.

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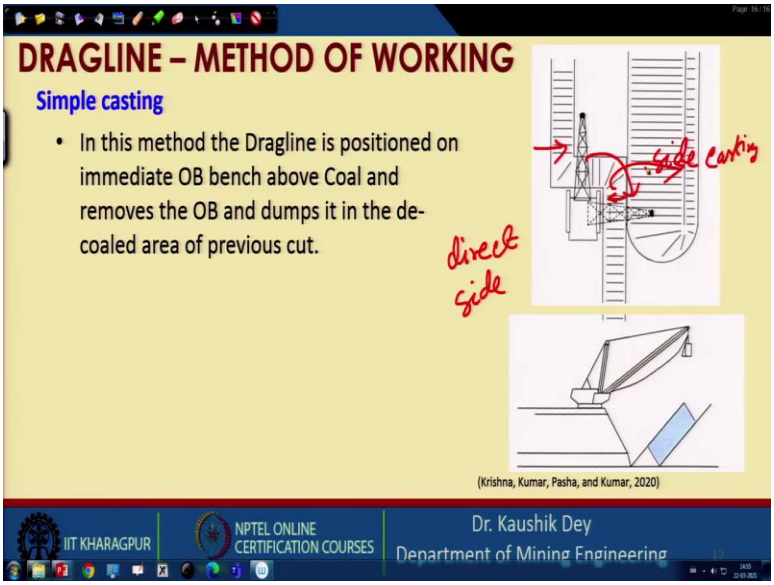

So, in a nutshell dragline is working in general like this and this method is called side casting. Generally, we are having two types of casting here, one is direct casting, another is side casting instead of having a casting like this dragline can take the material from this place and dump at this place that is called direct casting. And if the material is taken from this and dumping at this then it is called side casting. In general 90 percent cases, the dragline is allowed to go for the side casting because that is the best way a dragline can be utilized in mine.

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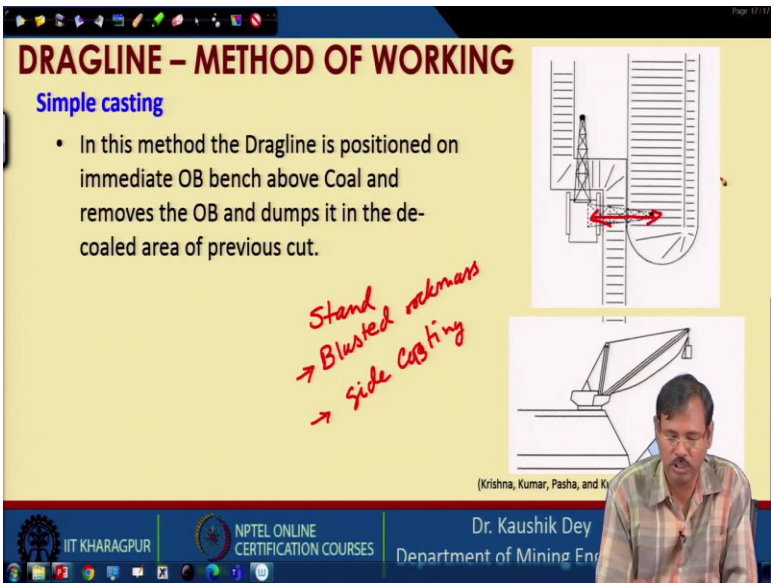

So, in a nutshell, the simple way a dragline is allowed to stand on a blasted rock mass. So, to stand on a blasted rock mass, then take the material, and go for side casting it to the overburden dump. So, in side casting, the maximum boom reach is utilized and gradually the complete material can be taken out. So, this is the simple casting or side casting in general followed for most of the bedded deposit operations like coal mining, etcetera.

These are basically commonly used in fact some phosphate mines of Morocco so they are also using dragline for casting direct casting of the material and that is why this is very well applied specially if in case of multiple seam, for the lower seam or if it is a single seam deposit the dragline can be easily used. But there are some special cases where draglines are utilized.

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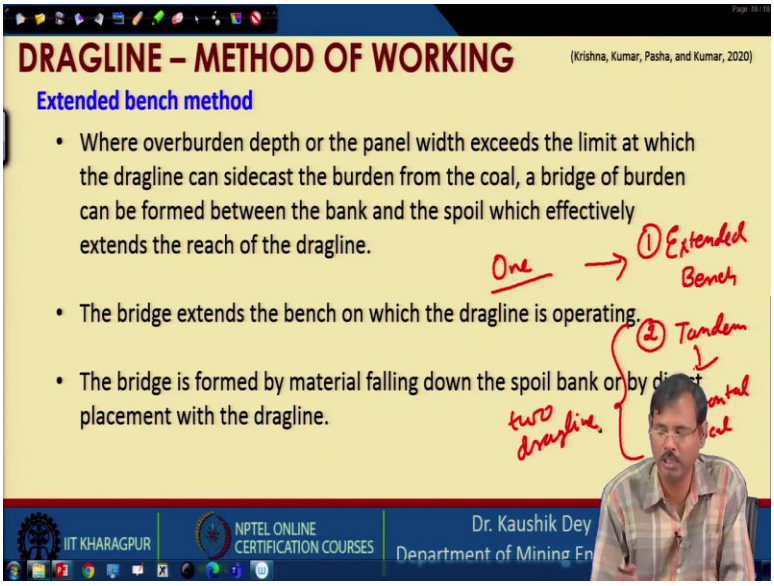

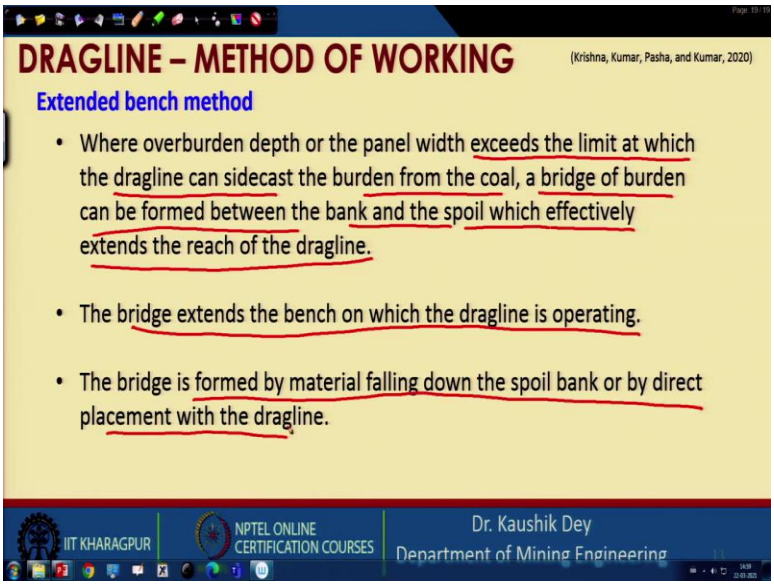

Those methods will discuss one by one, there are three special methods we will discuss here. One is extended bench method. Second one is tandem method. In this we are having two, one is horizontal tandem method and vertical tandem method. In first case in extended bench method, we use one dragline, we can use multiple dragline also. But you can use one dragline but in tandem method we need to have at least two dragline for this operation, where the second dragline works behind the first dragline.

So, this is the way we do before going into the details of the extended bench method. Let us first read out some of this point. This is where the overburden depth of panel width exceeds the limit at which the dragline can side cast the burden from coal, a bridge of burden can be formed between the bank and the spoil which effectively extends the reach of the dragline. So, basically extended bench method is allowed, while standing on the bench dragline cannot have that reach to transport the material.

So, the blasted muck pile is utilized to extend the bench and by this way we are extending the reach of the dragline. So, the bridge extend the bench on which the dragline is operating and bridge is formed by the material falling down from the spoil and direct placement with the dragline. So, the bridge itself is basically formed by the dragline.

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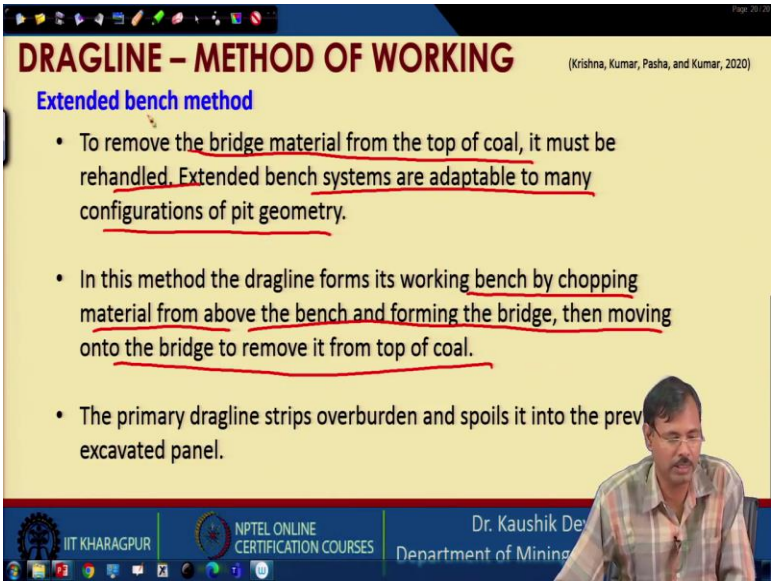

Then to remove the bridge material from the top of the coal, it must be rehandled and extended based systems are adaptable with many configurations geometries. And working bench by chopping material from above the bench, forming the bridge, then the bridge has to be removed from the top of the coal. So, the first bridge has to be formed then the material major portion of the material will be shifted from that extended bench or that is bridge whatever is called and then the bridge has to be removed from the coal top. So, this is the way the excavation is basically carried out.

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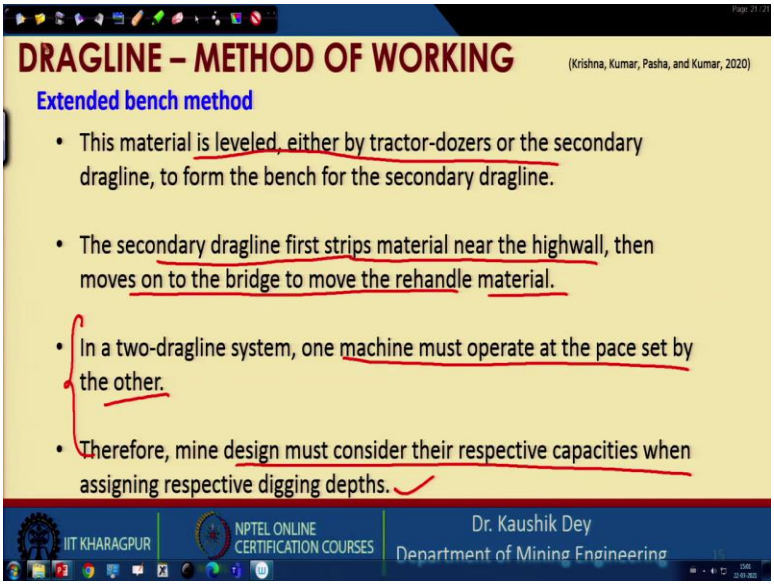

So, the steps are first the material is leveled by a dozer or tractor after the blasting. Then secondary dragline first shifts the material near the highwall then moves on to the bridge and rehandles the material. When two draglines are used in that case one machine must operate at the speed set by the second one. And mine designs must consider their respective capacities and assign their separate digging depth for the best applications.

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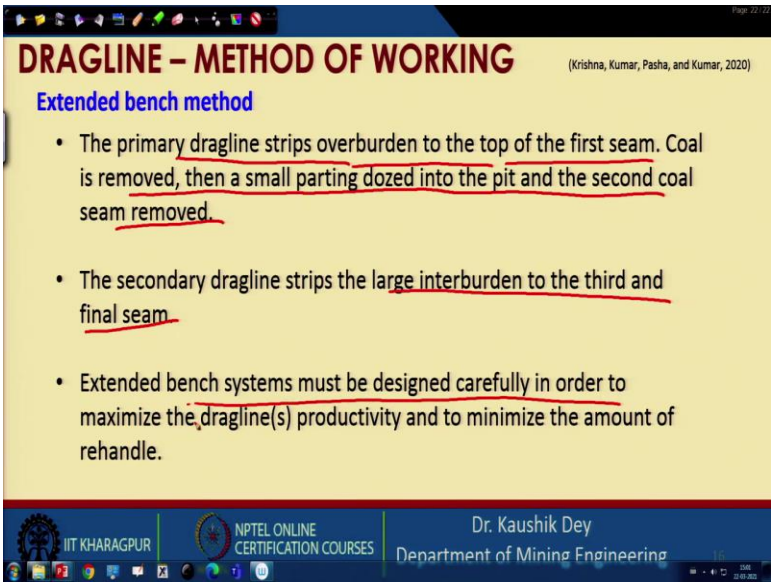

Otherwise, extended bench method is applicable for the one dragline also, if two draglines are used, first dragline strips the overburden from the top of this first seam. And coal is removed then the small portion is dozed to the pit and secondary coal seam is removed. And in secondary dragline strips large interburden to the third and final seam. And is removed and extended bench system must be designed carefully in order to maximize the dragline productivity.

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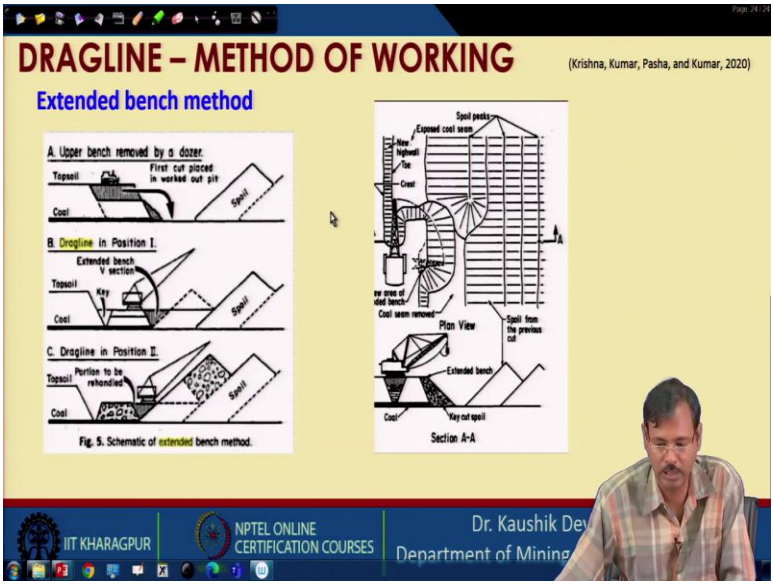

Now, let us look into the details features of this one, there is another figure sets available with this, we will go into this at a later stage. First, the blasting is carried out and the material is found like this available after this. So, first dragline is allowed and the key cut is carried out and the extended bench is made at this position. Then the dragline is positioned on this and take the material and send the material at this position. So, this bench is extended and then the bench material is shifted.

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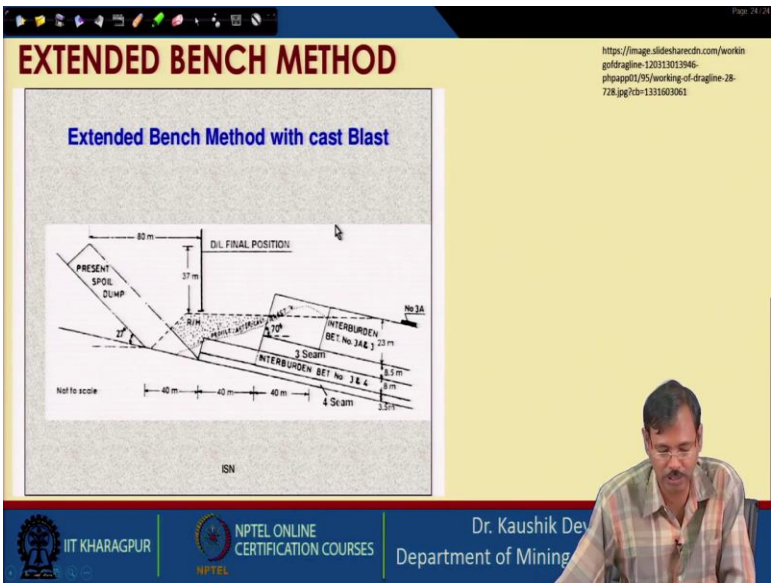

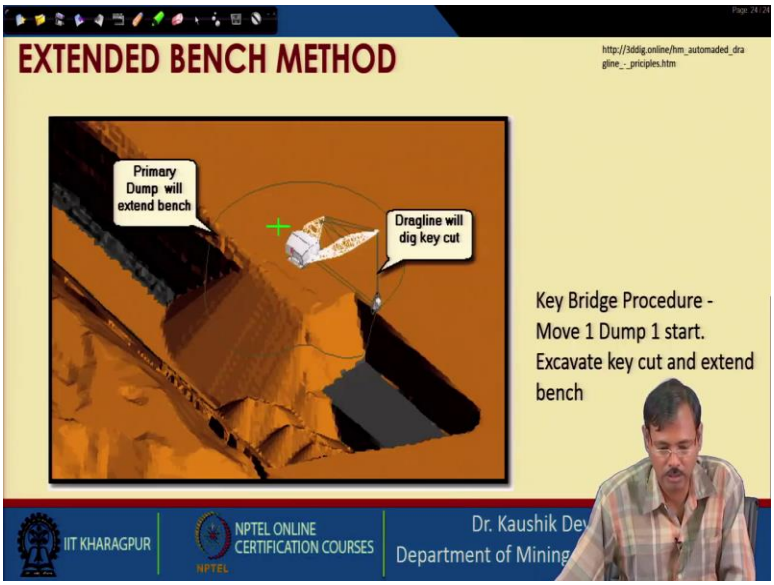

This is another figure of the seam. So now let us look into this figure you can see this is the primary dump and this primary dumped has to be first extended. So, first job is to excavate the key cut and extend the bench. So, the key cut at this position, at this position the key cut has to be made and the bench has to be extended. So that is the first requirement in the extended bench method. So now let us look how it is carried out.

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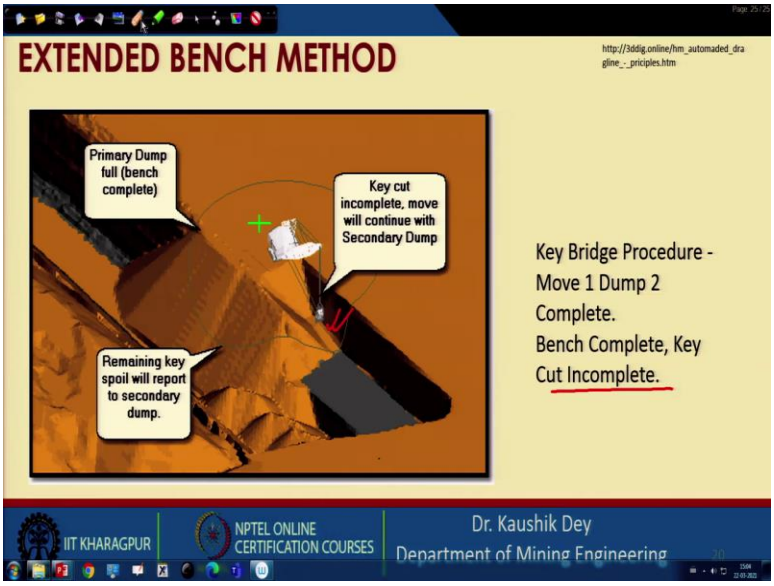

EXTENDED BENCH METHOD

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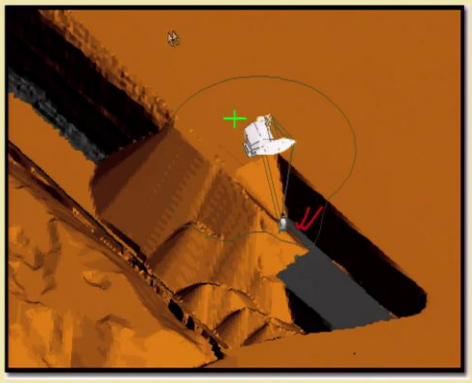

Key Bridge Procedure - Move 1 (Key cut) Complete

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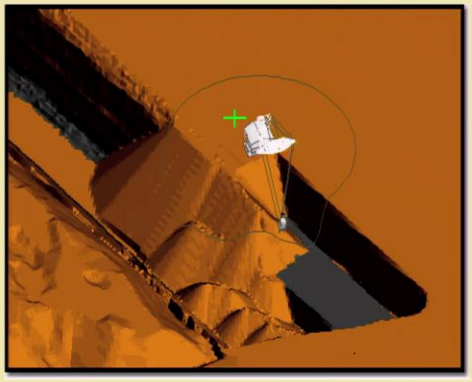

Key Bridge Procedure - Move 1 (Key cut) Complete

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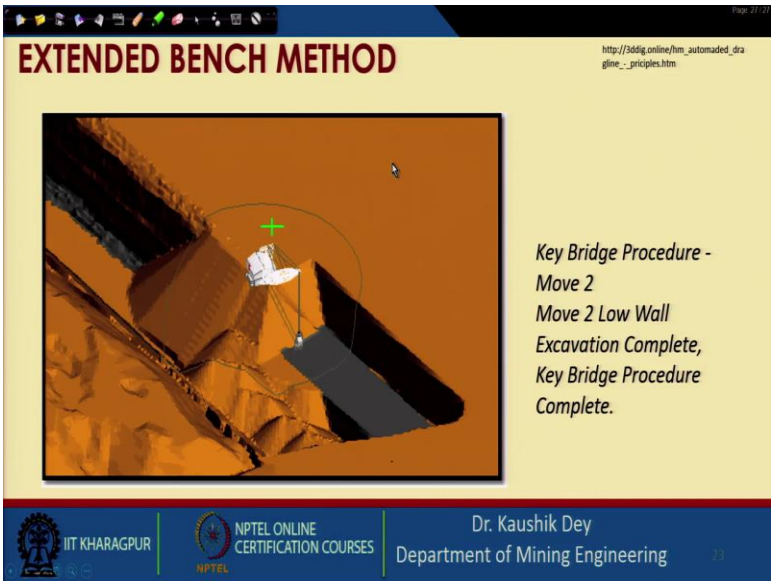

So, now you can see the key cut is on progress. So, we are carrying out key cut now. And the extended bench is made already and the secondary dumped is prepared at this position. So, dump is complete key cut, still incomplete, we are doing this key cut and we will continue this key cut until we are completing this one. So, now the key cut is complete our bench is already extended, key cut is complete at this position the bench is extended.

And now you can see our initial position of the dragline was at this position. Now, our dragline is moved to the extended bench. So, the dragline is now on the extended bench, it is started taking out the other material and dumping the spoil at a larger distance. So, the dumping is start from the extended bench and the excavation is continued from this point. Now, you can see our main dump; we have completed its excavation from this new position.

And so, in this case excavation is complete. So, the main excavation is complete and bridge has to be then handled. So, that is the next part. Now, from here the dragline will return back to its position and it can move take out the bridge part and allow the material to be a fit for the the next phase of operation.

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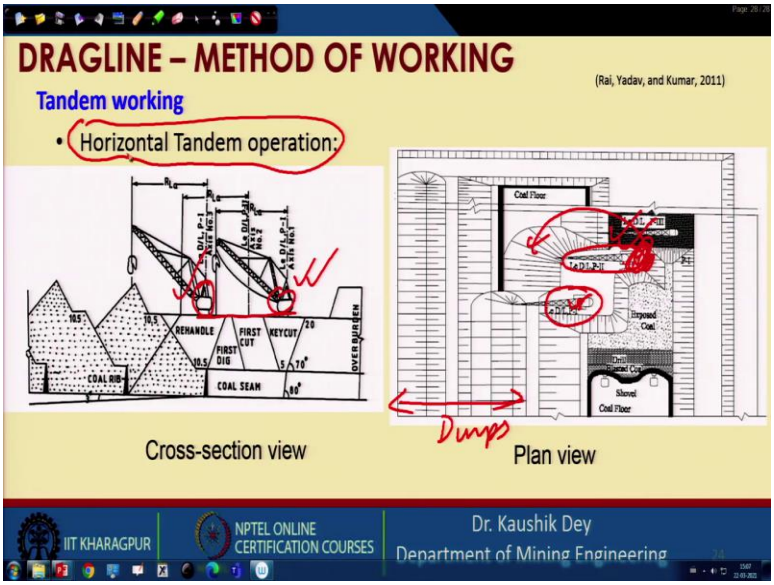

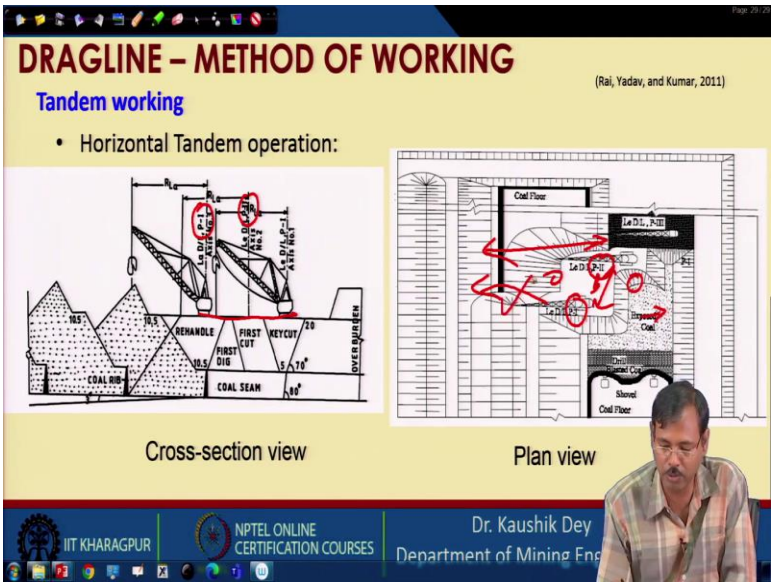

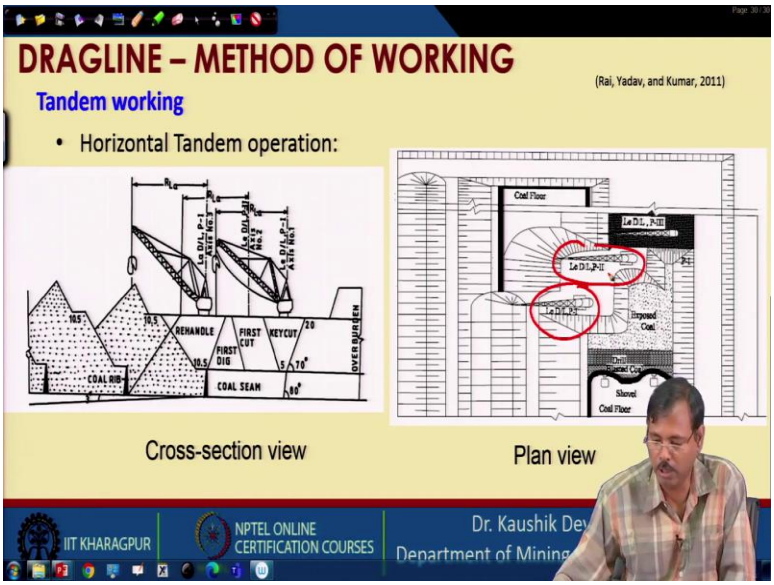

Next method is tandem method, in tandem method basically we are deploying two dragline. So, two dragline; the first dragline is basically taking the material and giving the material to the second dragline and the second dragline is finally shifting the material to the dumps pile. So, this method is two type; one is horizontal tandem operation: in horizontal tandem operation both the dragline are working on a same level.

So, they are working on same level and this is the plan view of this one, this dragline and this dragline working at the same level and these are the overburden dumps. These are the dumps and we can see the first dragline, that is this dragline which is at this position and this dragline is at this position. So, this dragline is taking the material and dumping at this position.

So, this dragline is taking the material from this place and take the dumping the material at this place and this dragline is taking the material from this place and shifting that to the next place. So, this is the way the horizontal tandem dragline is working, first dragline is taking the material for the second and second dragline is basically rehandling that one. So, this is the horizontal tandem method.

This is the horizontal tandem method using which the muck pile is basically transferred. So, in horizontal tandem method once again you look both the dragline are standing on the same bench, on the same bench both are standing here. And dragline one and dragline two, these are two dragline one and two, and this one is for two, this one is for one. So, this two is basically taking

this one material, giving that to the first one, first one is shifting that one at a further distance. So this is the exposed coal.

This coal is being exposed by these two dragline gradually and the material is being shifted at a longer distance at this case which is this reach not available with the dragline two. But this is available with the dragline one. So, this is the way the horizontal tandem method is working and that is why this dragline capacity must be matching with the capacity of the dragline of the first one. Otherwise, this will be in some trouble.

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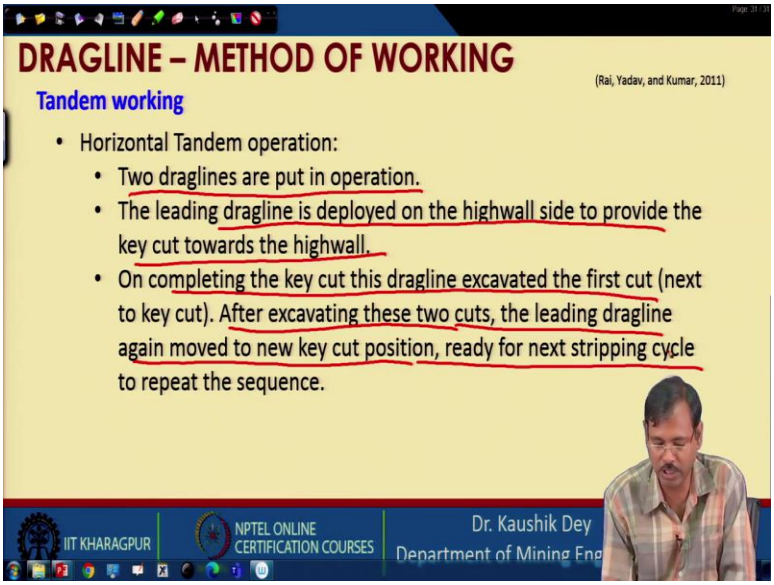

So, in horizontal tandem method, there must be two draglines the leading dragline is deployed on the highwall side to provide the key cut towards the highwall and on completing the key cut this dragline excavated the first cut and after excavating these two cut, the leading dragline again move to the new key cut position ready for the next stripping cycle to repeat the sequence.

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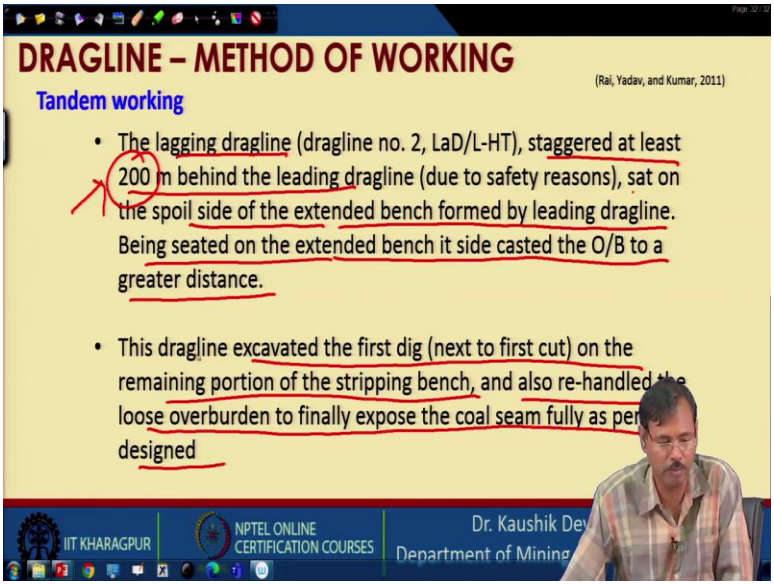

And the lagging dragline that is the dragline number two staggered at least 200 meter behind or this is depending on the reach behind the leading dragline and shut on the spoil side of the extended bench formed by the leading dragline. And then the extended bench, whatever casted overburden is there, it has to lift that and move it out at a greater distance. So, this dragline excavates first, dig on the remaining portion of the stripping bench. And also, re-handle the loose overburden finally exposed to the coal seam fully as per the design made.

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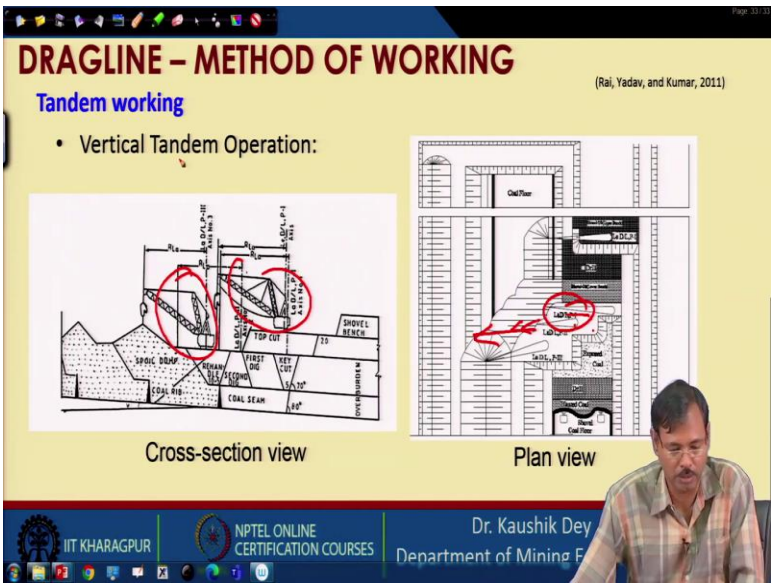

The similar operation can be carried out in two wire in vertical tandem method also. In vertical tandem method the first one is standing on a upper elevation, the second dragline is standing on a lower elevation. So, the first one which is working at this position is basically taking the material and moving it towards the second one which is at a lower elevation and basically it is dumping that material to a longer distance.

So, it is basically giving from the upper two to a lower one and this lower one is basically taking that one and it removing that to a longer distance. So basically, this is carried out for maintaining this height of this benches and that is also depending on the quantity of material that has to be shifted from this point to this point. So, these are basically some important aspects. Vertical tandem method is similar to the horizontal tandem method.

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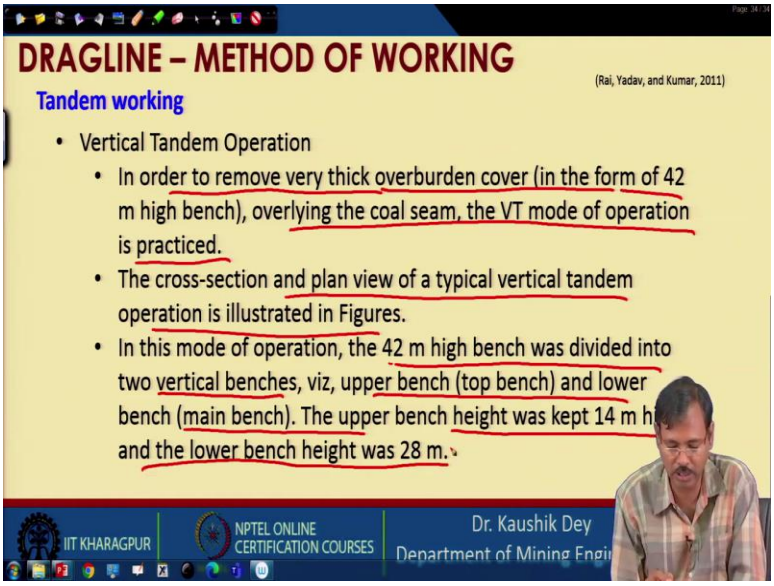

The same material is basically rehandled by the second dragline. So actually, the overall performance is basically the rehandling, additionally re-handling has to be considered in this case. So, in order to remove very thick overburden cover in the form of say 42-meter bench height or something like, that the vertical tandem method is practiced.

And this is illustrated in the figure and these high benches divided in two vertical benches. And upper bench and lower bench are basically considered here. Upper bench height is kept a little bit low and lower bench height is kept a little bit more.

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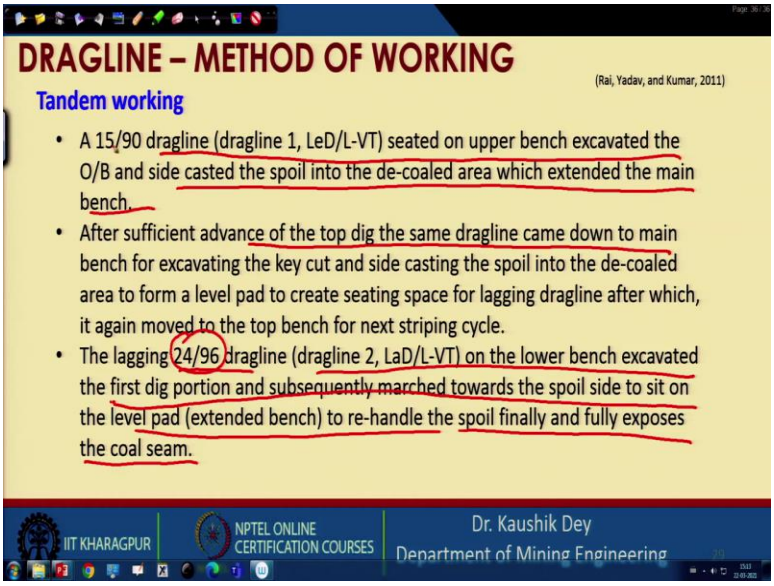

And the first dragline seated in the upper bench and cast the material in the de-coaled area which is basically by the extended bench method established and after sufficient advancement. The second dragline, which is having a little bit larger capacity, is deployed on the lower bench on the excavated site and first dig operation subsequently marched towards the spoil seat has to be carried out and finally fully expose the coal seam. So, this is the vertical tandem method which is basically allowing the dragline to work on a very high bench up to 42 meters and that is allowing the vertical tandem method of operation.

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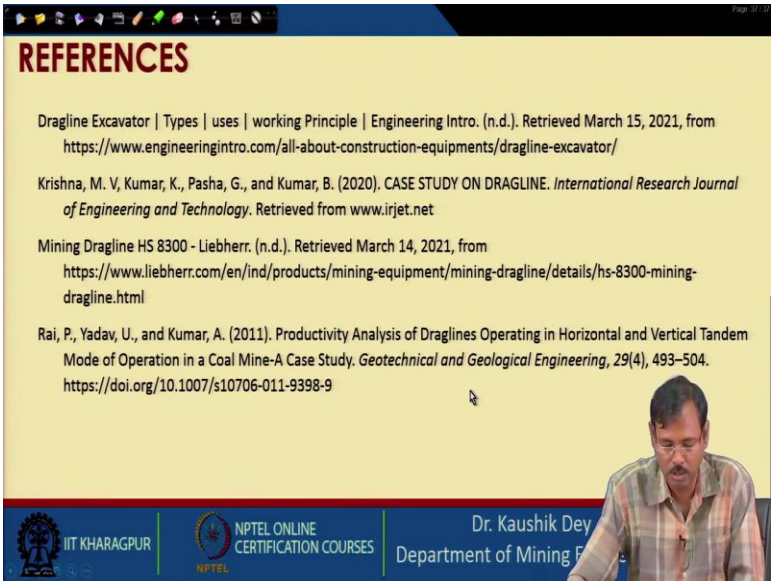

So, these are the references. Thank you.