Surface Mining Technology
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Lecture No. 43
Excavation with Bucket Wheel Excavator – 3

Let me welcome you to the lecture number 43 of NPTEL Online Certification Course: Surface Mining Technology. This is the second lecture of excavation with bucket wheel excavator and in this lecture, we will discuss the operation of bucket wheel excavator, its method and pit layout.

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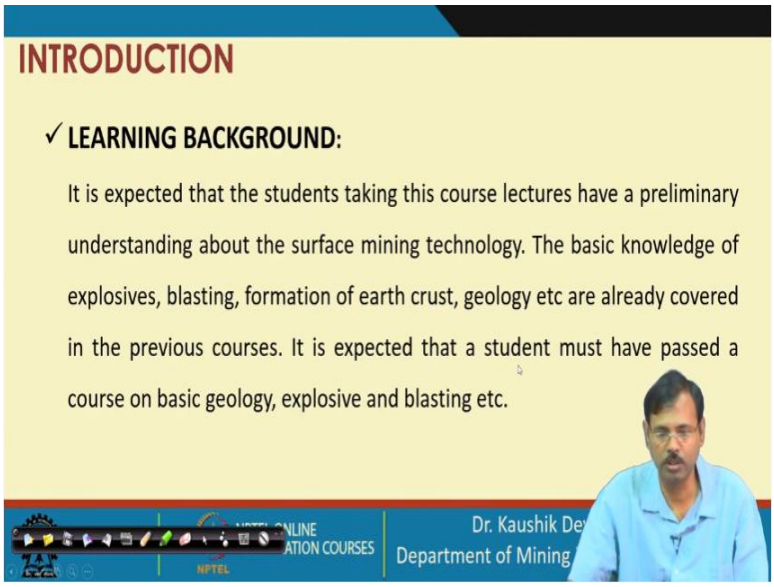

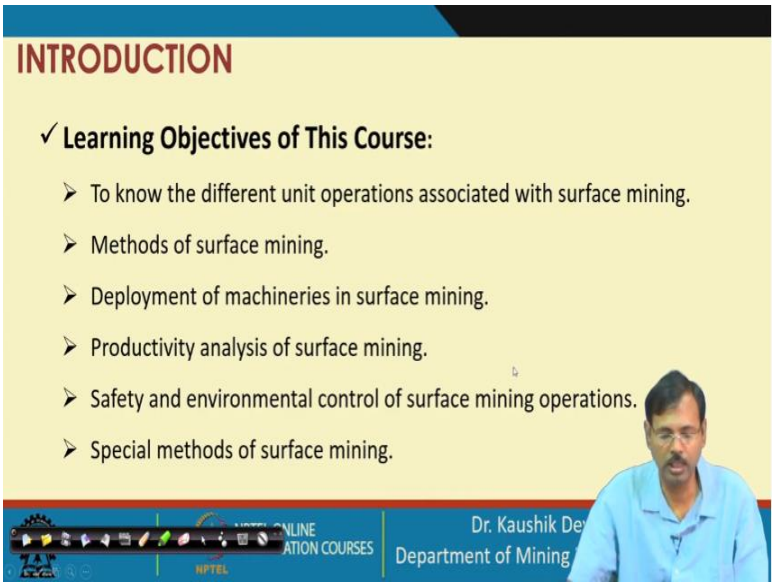

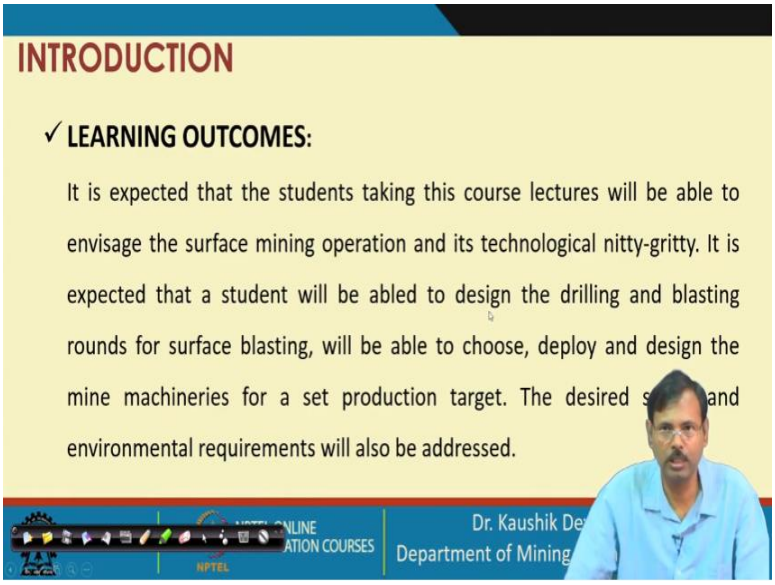

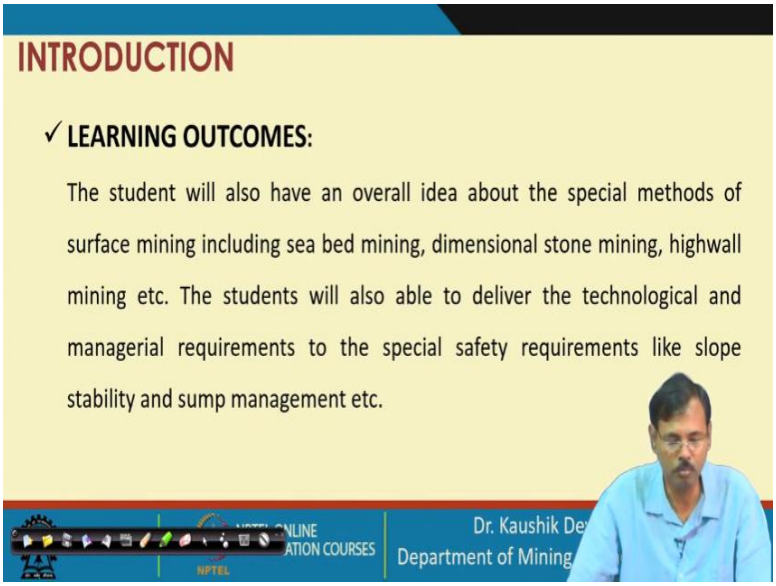

So, as we do in every lecture, let us look once into the learning background required for the participant of surface mining technology course and the set learning objectives of the surface mining technology course. Expected learning outcomes from the participant of surface mining technology course.

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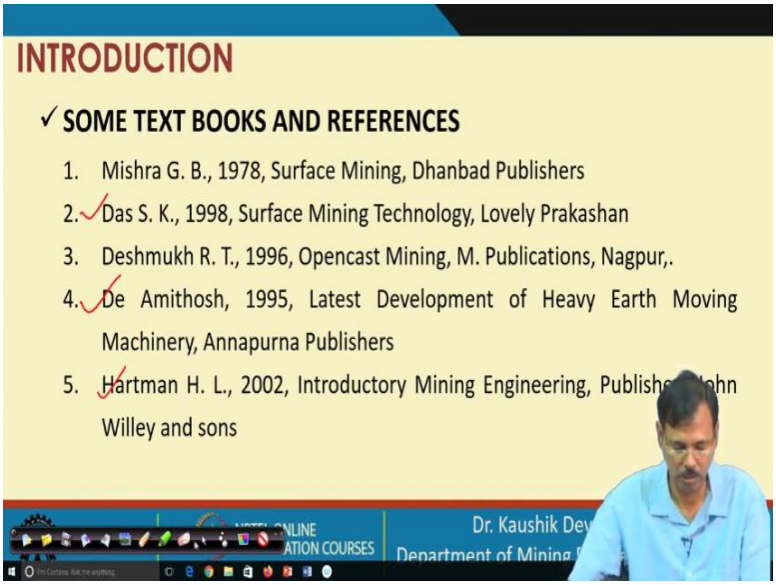

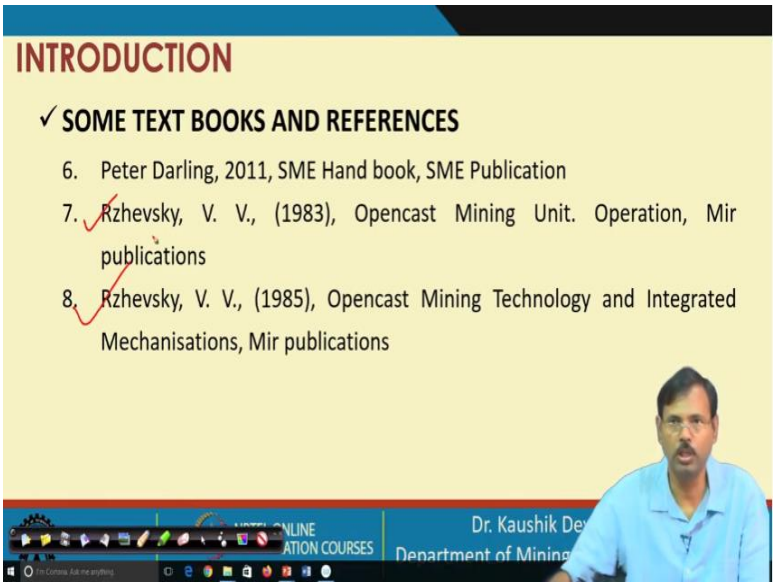

And these are some of the text books and references. It is expected that the participants will follow specially these books, and these books also particularly for this excavation of the bucket wheel excavator but in last class we have seen bucket wheel excavator is a very highly productive machine.

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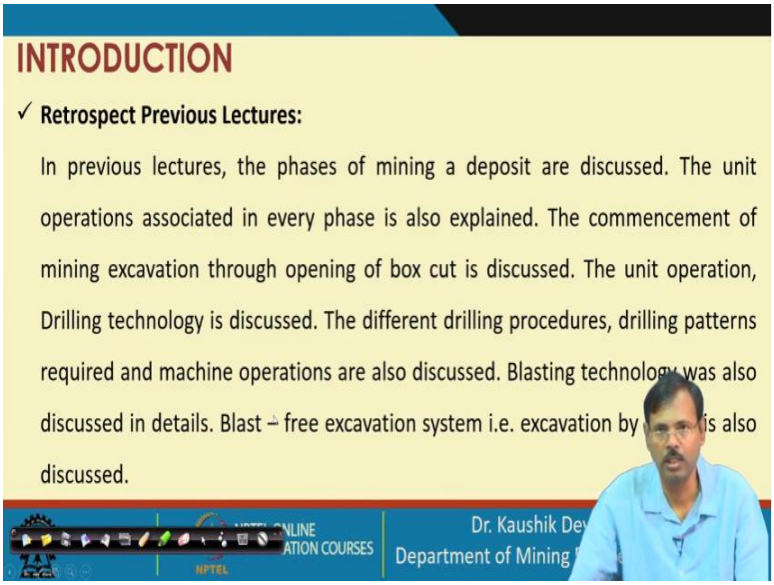

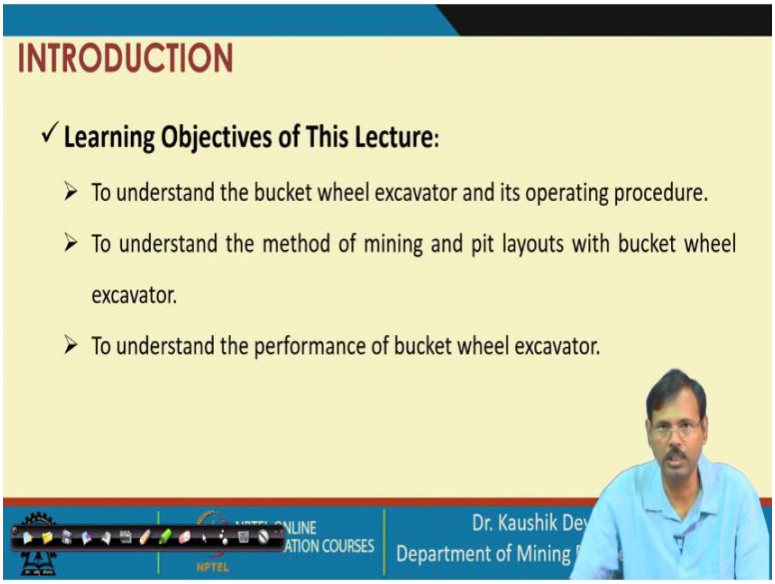

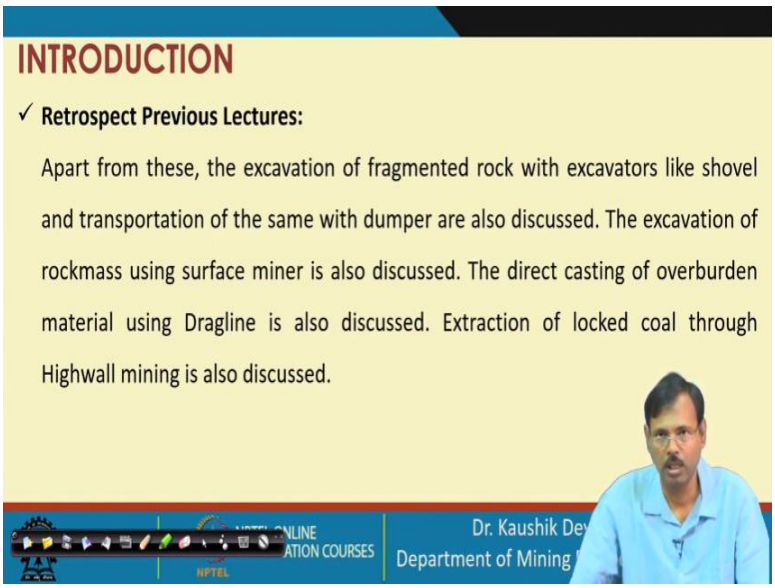

Before discussing this bucket wheel excavator, we have already covered the current status of surface mining, we have covered the phases of mining a deposit, we have covered the opening of surface mining through the box cut and we have covered the technology unit Operations like drilling, blasting, excavation by ripper, excavation by surface miner, fragmented material handling by excavators, with and transporting them with the transport system with special emphasize to the shovel dumper operations and we have covered the direct casting of the material using the drug line.

As well as we have covered the high wall mining system for mining of the locked coal under the high wall slope. We have said the learning objectives for the three lectures on the bucket wheel excavator are to understand the bucket wheel excavator and its operating procedure to understand the method of mining and pit layouts with bucket wheel excavator: this will be covered in this class, and to understand the performance of bucket will excavator, will be covered in the next class.

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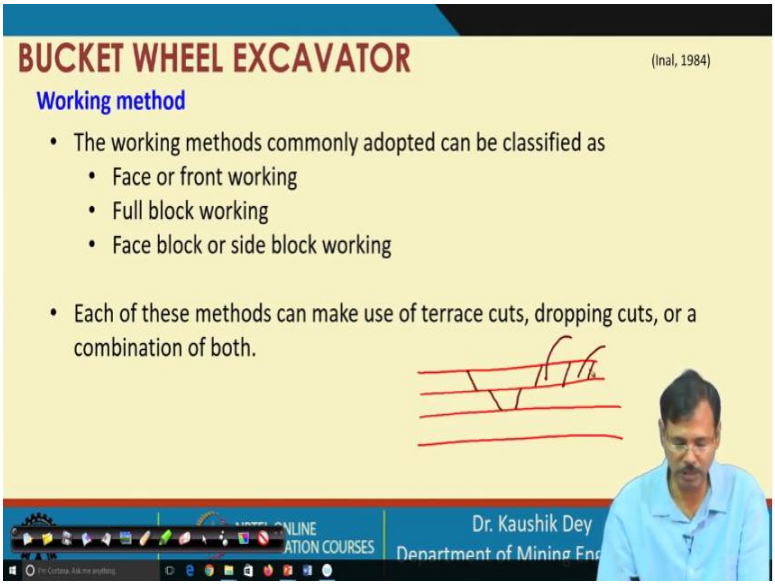

So, let us look into the working methods. Basically, we are having different types of working method as the excavation is carried out generally, we have discussed surface mining is nothing but the excavation with horizontal slices and whenever we are taking this is already discussed to you, so surface mining is basically taking the horizontal slices. How we take this horizontal slices? For taking this horizontal slices, we cut the material like this.

So, first we excavate like this then we take another slice like this so, then gradually it takes slices like this, so these are gradually removed, so this is basically horizontal slicing but whenever we are carrying out horizontal slicing.

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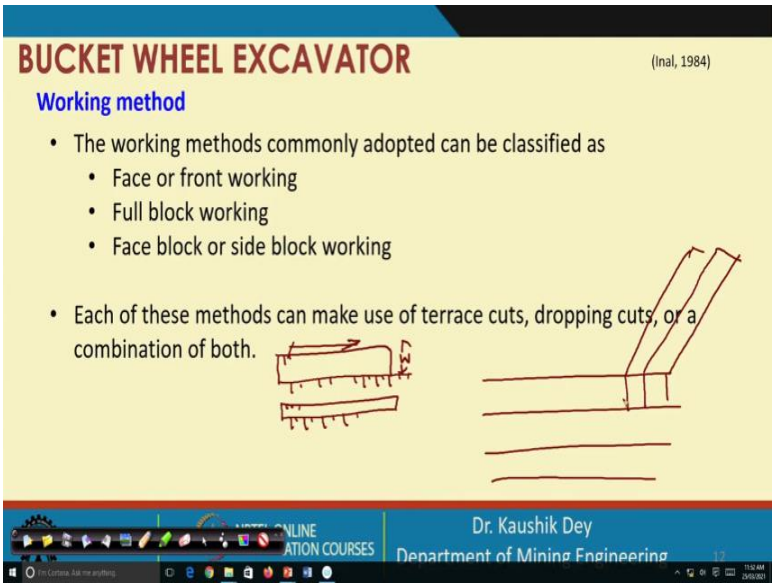

Along with that if this horizontal slicing we are thinking about in plan view, we are basically designing this along with this so where these are operating. So, these are basically the plan view so, we are taking this material as one block, so gradually as it is moving the new face is coming at this position, so we are also shifting this one, the new face is coming at this position.

So, this is the block width and these are the length of the block, so this is the block mining each slices, if we are considering this is another dimension, then this is the one block we are cutting, this is the next block we are cutting so gradually these blocks are taken out and this block mining is carried out. So, if the mining is carried out in blocks that is called full block working, sometimes side block workings are also carried out, sometimes front working is also carried out.

So, these are the different types of working procedure of the bucket wheel excavator and we can take out using the terrace cut and drop cut, terrace cut is basically cutting in the front direction, drop cut is basically cutting in the bottom direction. So, these are the two another type of working method possible with the Bucket Wheel Excavator.

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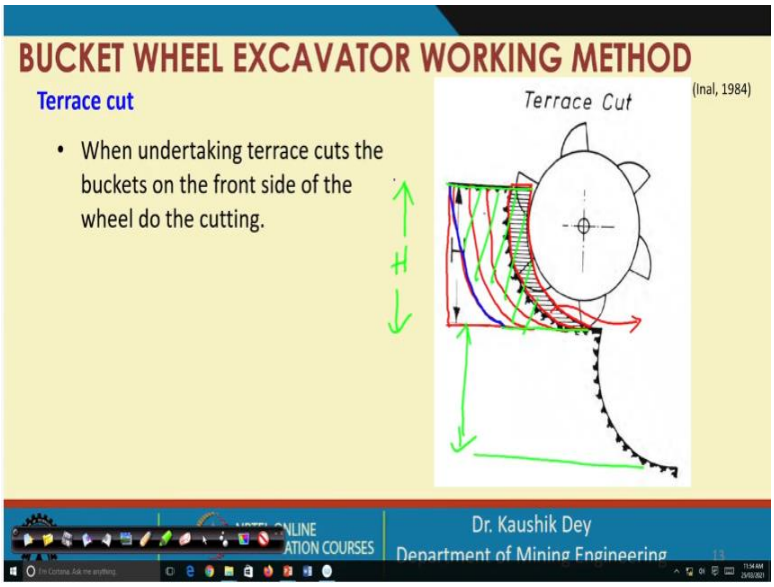

So, let us look into them one by one, the terrace cut is basically cutting in the front direction, so a one bite one bite can be considered like this and the following bites will be like this and gradually the excavation is carried out in this form and this is the each bite: is basically excavated by the; once the complete rotation of the excavation is carried out.

So, by this way up to H height, this much width is excavated and the new phase will generate at this position, so that this portion excavation from here to here is basically taken by the excavator. So, terrace cut is basically carried out with a particular bite height and the excavation is carried out in the front direction like this, so this is called terrace cut. So, one H is complete here the second H is taken here.

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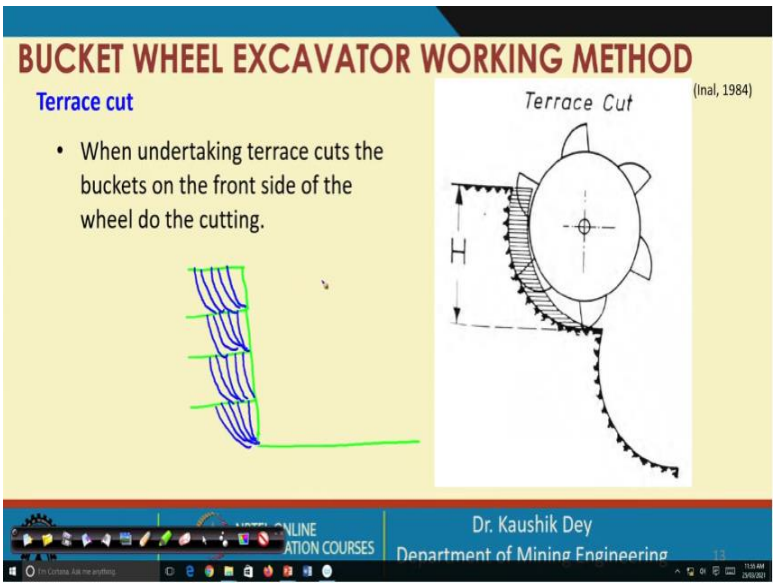

So, if there is a complete face, this complete face may be excavated with a number of slices like this, so this is called Terrace cut.

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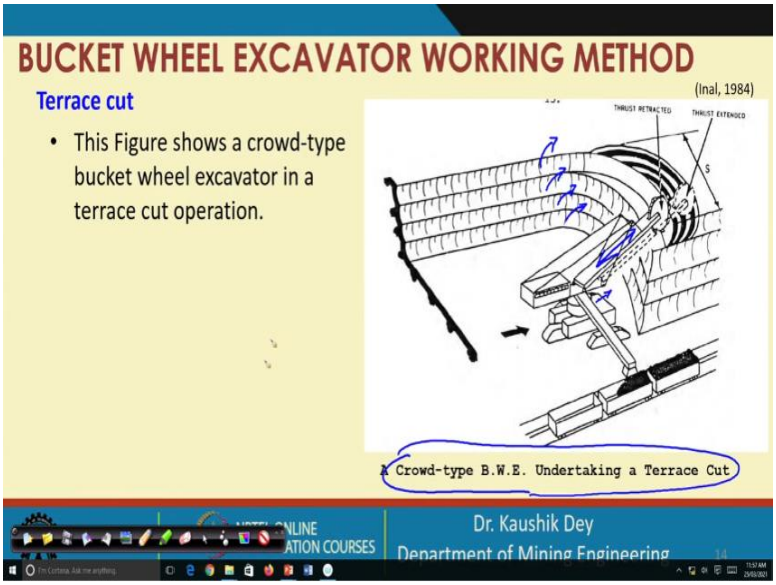

So, this is one figure of terrace cut you can see this is one terrace, second, third, fourth, the complete bench height is basically taken in four slice slices, with each slice a terrace cut height it is taken. So, this is called terrace cut and this is the front thrust provided, so the machine boom, the cutting boom is allowed to be forced in the front direction and it is often very beneficial if we are having a telescopic boom.

If the telescopic boom is not available then the machine has to move in front direction to give the thrust to cut in the front direction of the particular block. So, this is a crowd type bucket wheel excavator which is allowed to take the Terrace cut in the mine.

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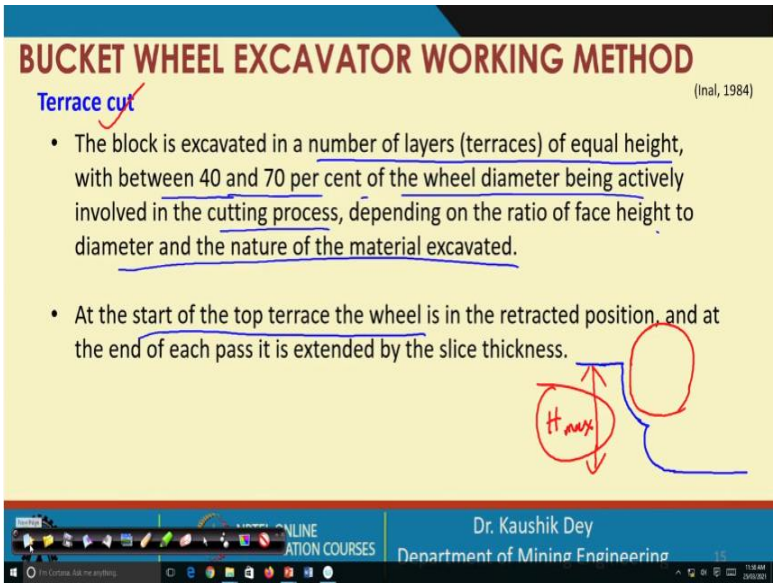

So, terrace cut is basically excavated in a number of layers of equal height in general between 40 to 70 percent of the wheel diameter actively involved in the cutting process and depending on the ratio of the phase side to the diameter and the nature of the material excavated. Terrace cut is preferred to start from the top, the benefit is that you can see the maximum bench height is utilized in the, if this is the machine and if we are having a machine which is having the maximum boom position at this, then we can have a terrace cut at this position.

And that is why the maximum bench height, this H, can be maximum if we are using this terrace cut method of excavation. So, that is the benefit of this one and in the top slices terrace cut is the best utilization of the boom height.

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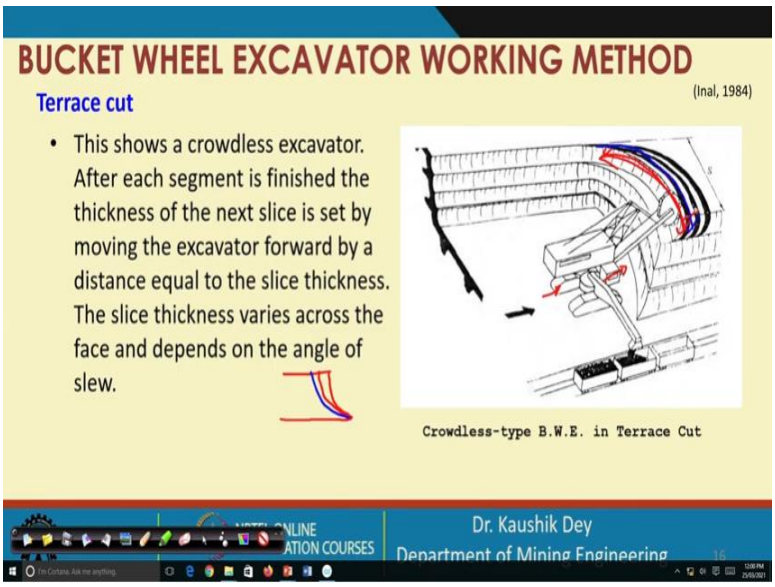

So, earlier we have seen the crowded type bucket wheel excavator is having the facility to move its boom in the front direction because it is a telescopic type but if the bucket will excavator is crowdless, then it cannot move its bucket in this direction, instead it can rotate the bucket like this and by this way it can go for terracing the block and the machine has to move forward to take the front slice in the front direction.

So, that means in crowdless bucket wheel excavator this first width is taken this first slice is taken all along these, this first slice is taken then the machine move to the a little bit forward direction and the second slice will take at this position in the next turn. So, this is carried out specially for where we are having the crowdless type of bucket system in that case, this is the practice in general carried out using a crowdless bucket wheel excavator.

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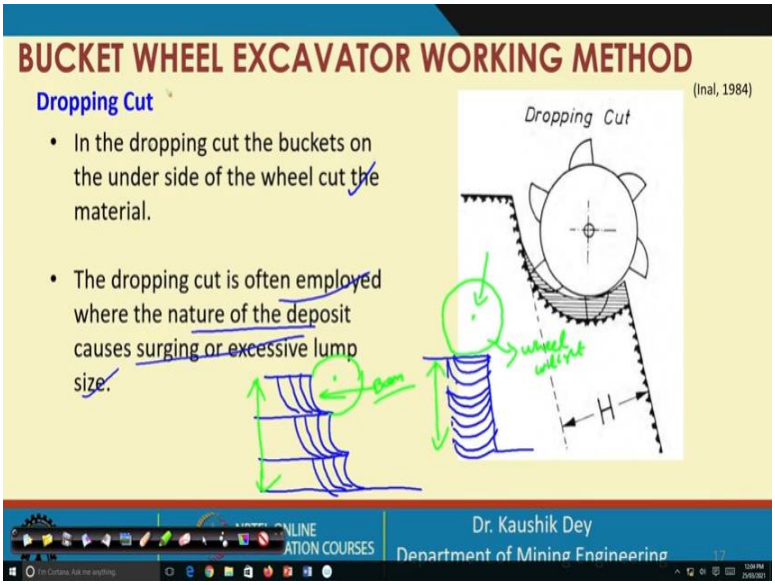

Now next is drop cut, in drop cut the machine is allowed to cut in the bottom direction and that is why it is cutting a slice like this at this place so if we are comparing now two blocks side by side terrace and say this is three, so that means it will take each slice like this. The same one, when we are taking it using the drop cut, will be, so drop cut the buckets on the underside of the wheel, allow to cut the material, this is employed when the nature of the deposit causes the surge of exercise lump size.

So, in drop cut we are initially are positioning our bucket like this, whereas here we are positioning our bucket wheel like this, this is beneficial as the bucket wheel weight is providing a normal force, so that is the additional force we are obtaining and this is allowing the more normal force than the terrace cut.

The Terrace cut, the force thrust, is given by crowding the boom or by movement of the crawler in this case, that movement is not required, or only dropping the bucket wheel on to the material is good enough to excavate this one, but here we are maximum utilizing the bench height here if this is the maximum height we can provide, then it is utilized here properly but here we have to have this bench height much lesser than the terrace cut involvement.

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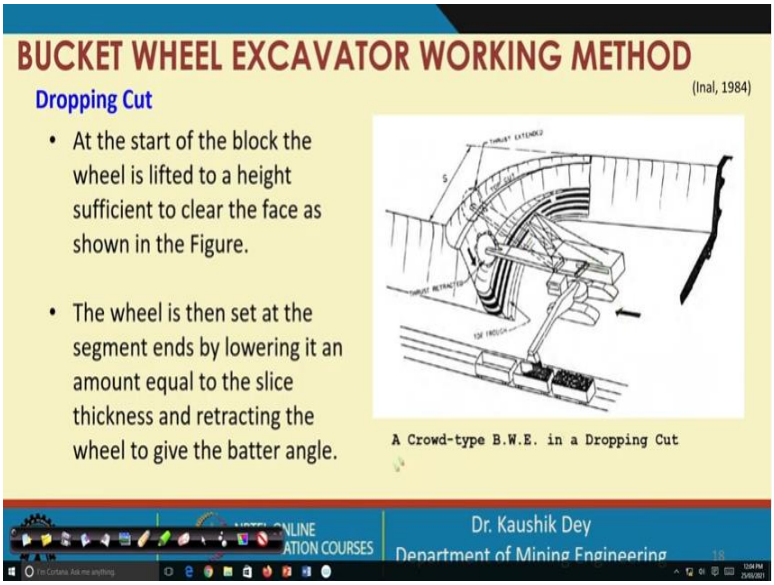

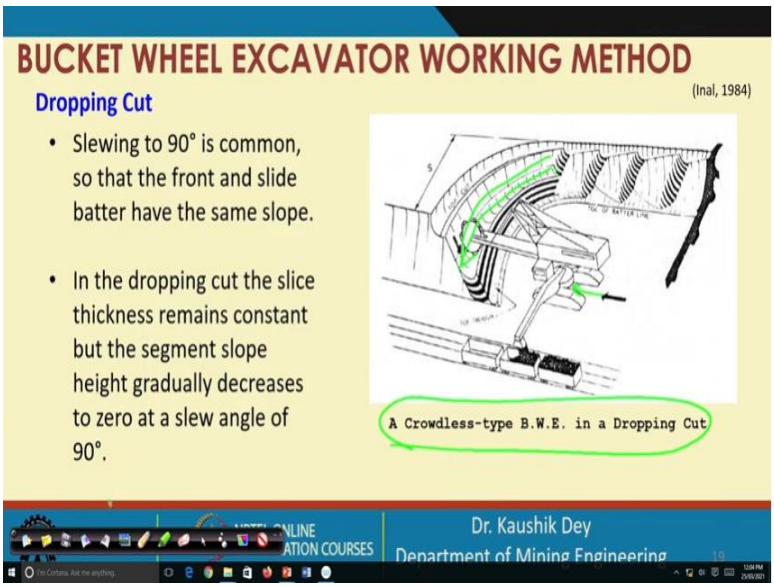

So, this is the drop cut figure with a crowd type bucket, so drop cut can be carried out, this is the possible layout possible layout with a crowd type bucket, excavator practicing drop cut, and this is for the crowdless type bucket will excavator practicing a drop cut only slewing

from this direction to this direction then it is moving and taking the next one. So, like that way it can operate using a drop cut in the practicing condition.

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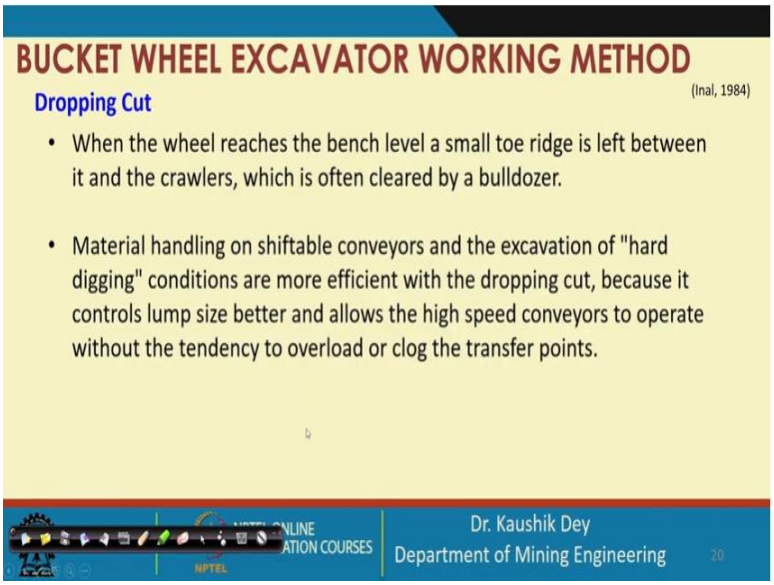

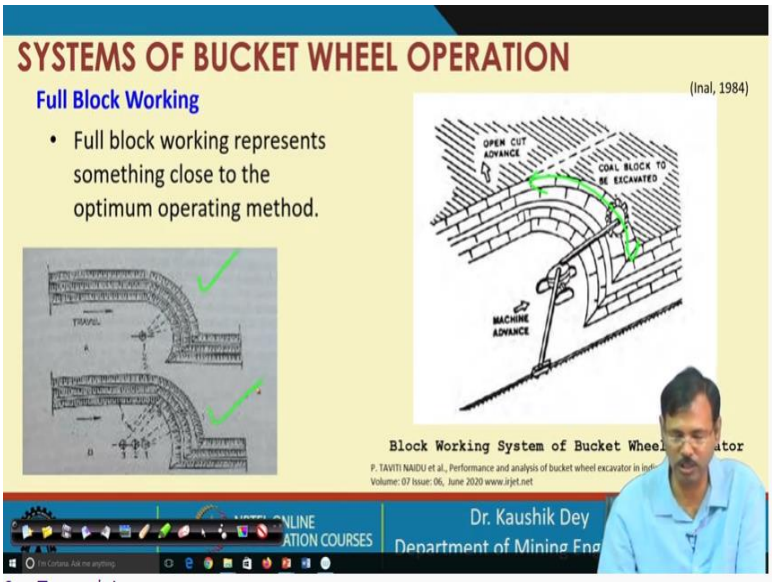

So, this is the more or less theory of the drop cut, if now we are looking at the other side when the full block method is practiced you can understand this is the block size, this is the layout of that one full block working system with bucket wheel excavator. If this is the block size, we are considering, this is the height of the block, a bucket fill is deployed like this, in that case the bucket will have to take the complete block width and this complete block width is taken by this bucket and that is why it is called full block method.

So, in full block method it can be carried out with, this is with the crowded type bucket wheel excavator, this is crowdless type bucket wheel excavator, these are the possible layouts with these systems and that can be practiced here.

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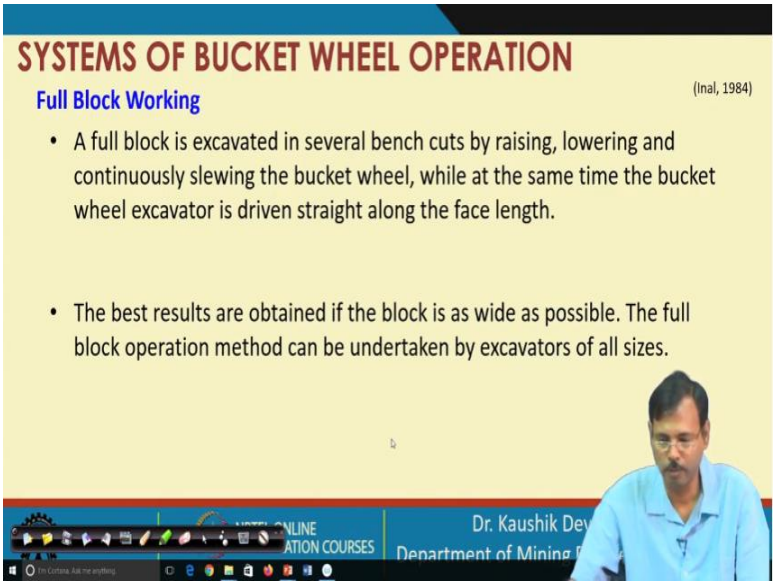

So, this is the full block method, if we look into the details of this, a full block method is excavated in several benches cut by raising, lowering and continuously slewing the bucket while at the same time, the bucket wheel excavator is driven straight along the face length. So, if the block is kept as wide as possible then the better operation is possible in this case and this is also beneficial to use occasionally, when the shiftable belt conveyor has to move if we are using the larger block width the shifting of the shiftable belt conveyor can be reduced, a lot of the frequency of shifting can be reduced a lot with the more block width.

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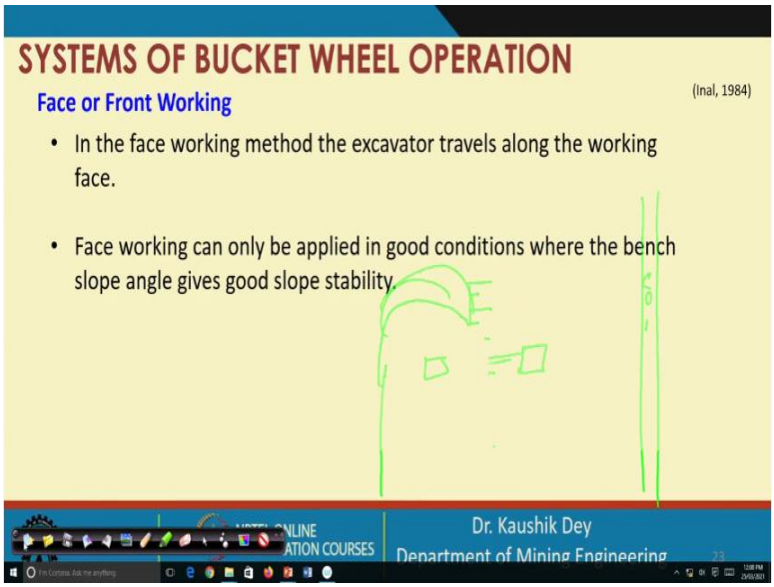

And in that case, it is expected that sometimes we can use a mobile transport conveyor or so for this. Bucket fill excavator can work from the front direction also that means, if we are drawing the layout like this and if we are having, this is our shift table conveyor, a bucket wheel excavator can initially operate to cut this portion and after cutting this this is creating an opening and in that case this is allowing a bench formation like this and it can move at this position to gradually cut the next slices like this position.

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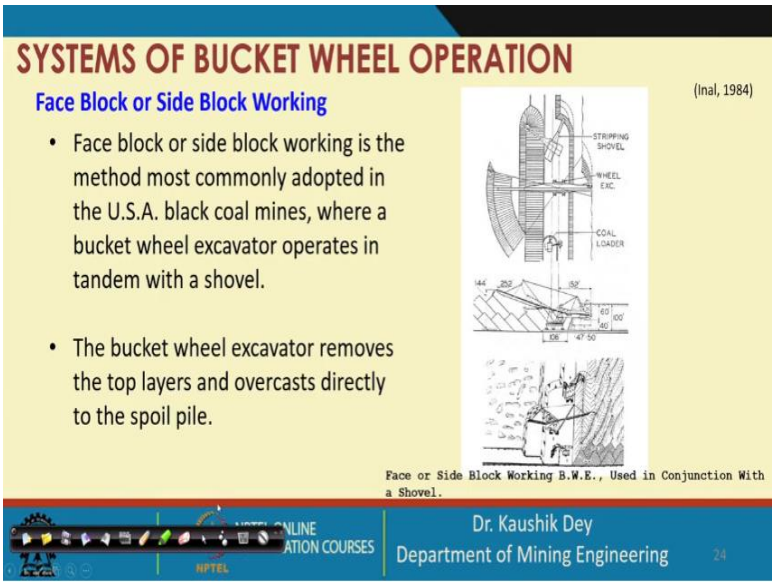

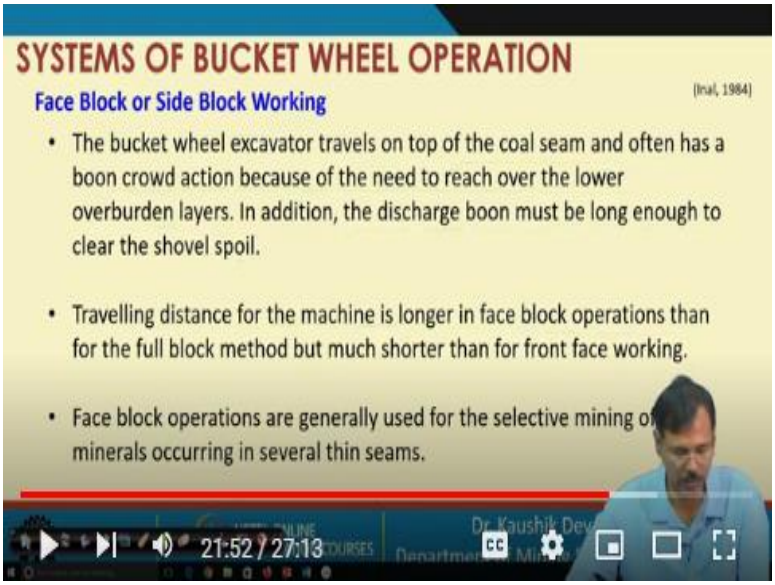

This is side block working layout. In side block working excavator travel on the top of the coal seam and often has a crowd action because it needs to reach over the lower overburden layer and in addition discharge boom must be long enough to clear the shovel spoil, travelling distance for the machine is longer in phase block operation than the full block operation.

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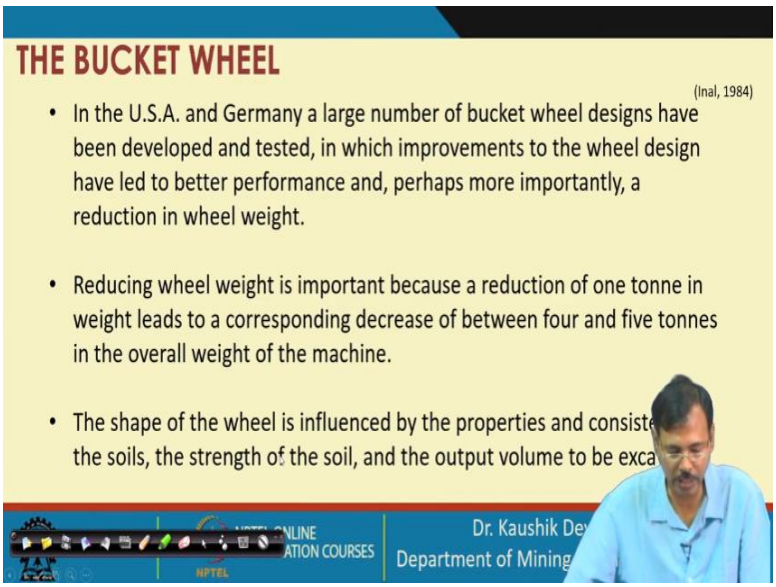

So, this is one another method where the hub block or that type of operation is carried out where two weights are mentioned maintained in the bucket.

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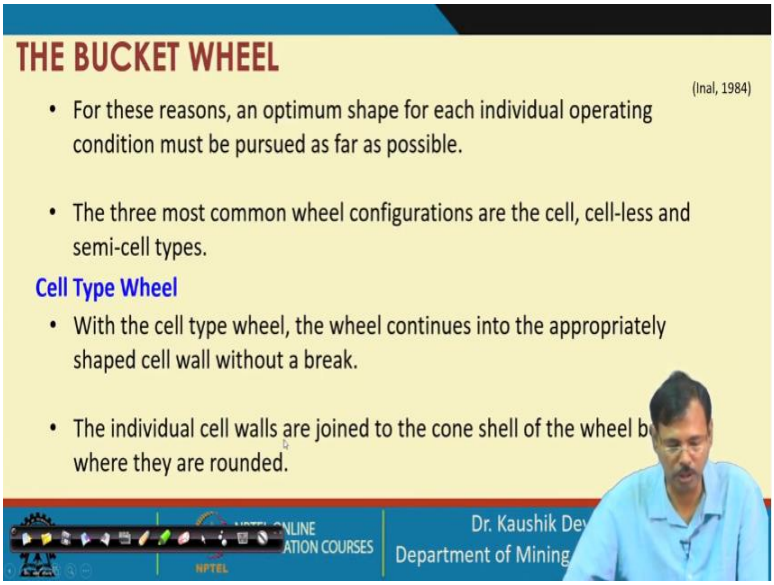

Now let us look into what are the possible different types of buckets available, we are having cell type bucket where each bucket is having a different cell and it can withstand the material little bit so the safe cell is a wall available without a break and this self-cell can contain some of the material around it.

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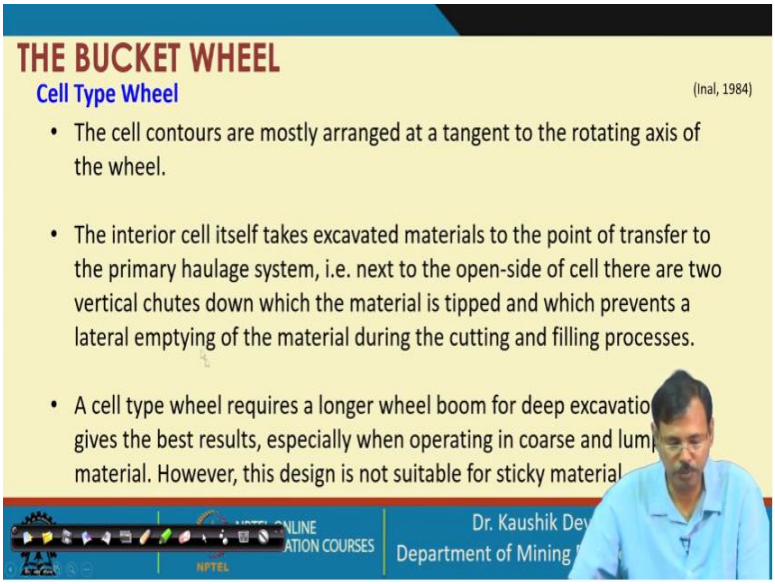
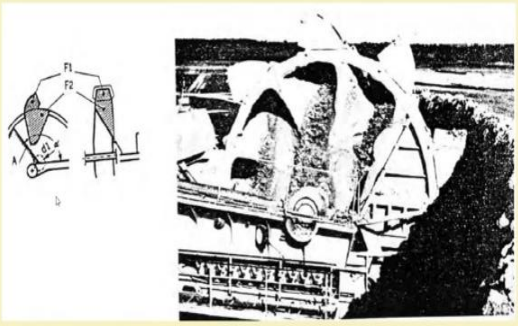


THE BUCKET WHEEL

Cell Type Wheel

(Inal, 1984)



THE BUCKET WHEEL

Cell-less Type Wheel

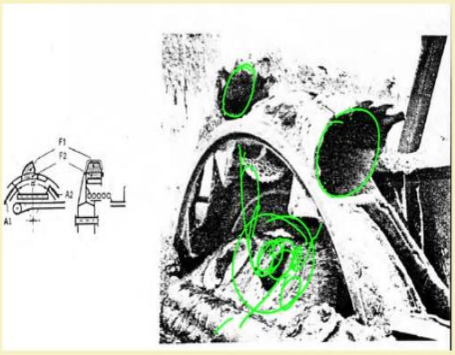
(Inal, 1984)

- In the cell-less type bucket wheel, there is only a short continuation of each bucket into the wheel body, and this increases the capacity of the buckets.
- The advantage of the cell-less wheel, compared to the cell type, is the very short distance covered by material in the buckets before it leaves the rotating ring space, and the almost free discharge.
- Thus a higher wheel speed and a consequently higher output can b achieved.

THE BUCKET WHEEL

Cell-less Type Wheel

(Inal, 1984)



Cellless-type Bucket Wheel

In cell type, this is a photograph of the cell type bucket and you can see the material can be taken in this if this is the cell type bucket, this is the bucket cell. So, this each cell contained its material and allowing that material to discharge into the conveyor like this ok, so this is another cell which is also allowing the material to coming here.

There are second one available which is a cell less bucket, so cell less bucket is only having the bucket teeth or bucket lips are there, so that is cutting the material, then the material is left inside the wheel and that is allowing its discharge automatically. If you see this is the cell less bucket you can see this cell less bucket basically cutting the material and after cutting this there is no cell, the material is transferred to the man inside the wheel and the from inside the wheel the material is then transferred to the conveyor.

So, all these buckets are basically sending this material in a cell less type inside the wheel and from there the material is transferred to the conveyor system. So, this is cell less type and as obviously we are having a cell type and cell less type.

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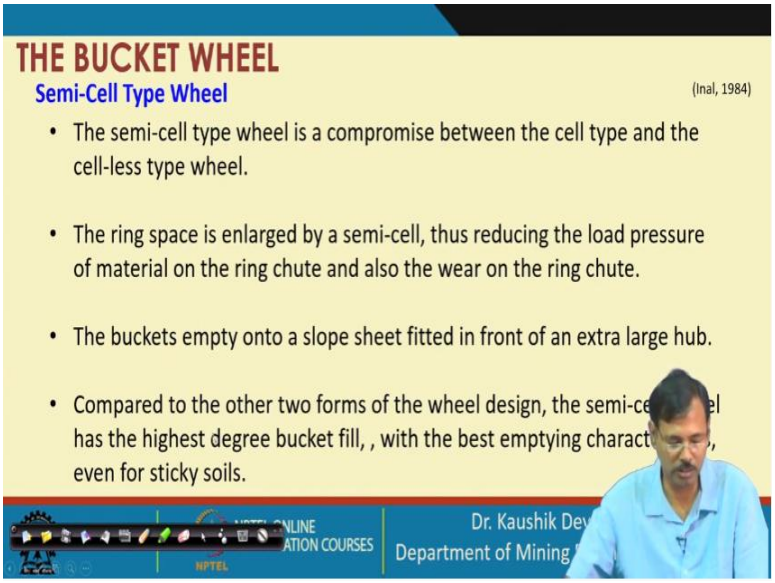

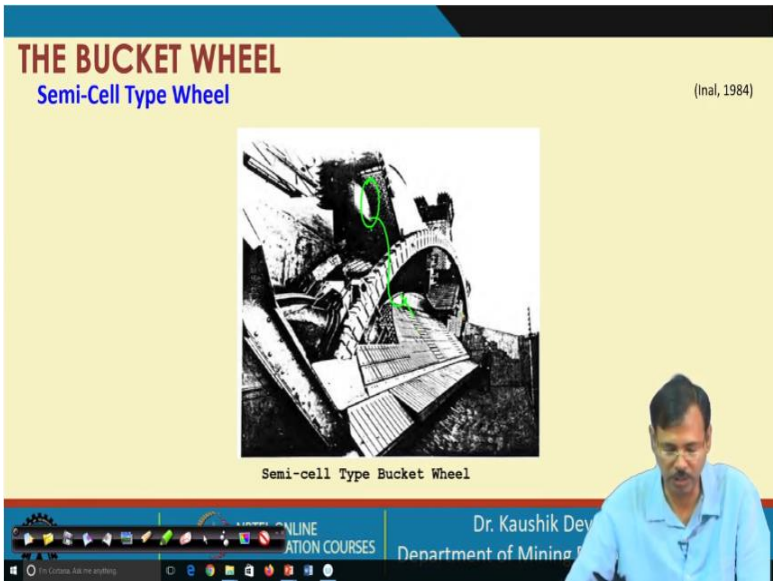

There is an intermediate system which is called a half cell or semicell type wheel so there is a little bit cell wall is provided to guide the material so that it will not jump into the lower side of the wheel there will not be spillage from that side to avoid that one semi-cell type is provided in semi-cell type.

If we are looking into the figure in semi-cell type, the material is guided little bit and then after excavating there is a little bit guidance is provided at this position and from there, we are allowing the material to coming into the discharge and coming into the primary conveyor.

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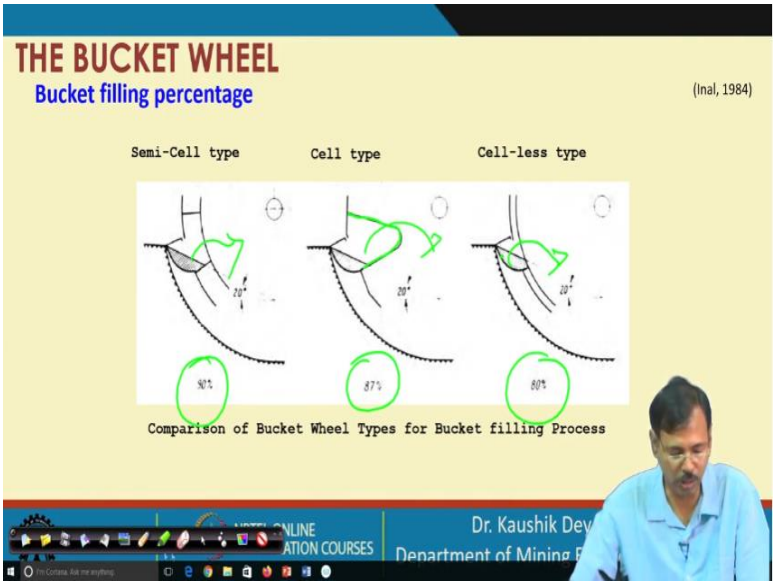

Now, if we are looking in this way you can see this is the semi-cell type, a particular cell is provided here the full cell is provided and there is no cell provided at this so the material taken means, it is directly transferring into the wheel part here, it is retaining and then it is

transferred. And here it is guided only a little bit. So, in semicell type this is our filling percentage, this is in cell type and in cell less type our filling percentage is relatively very poor. So, that is why we have opted for either cell type or semicell type because that is having the better percentage of filling.

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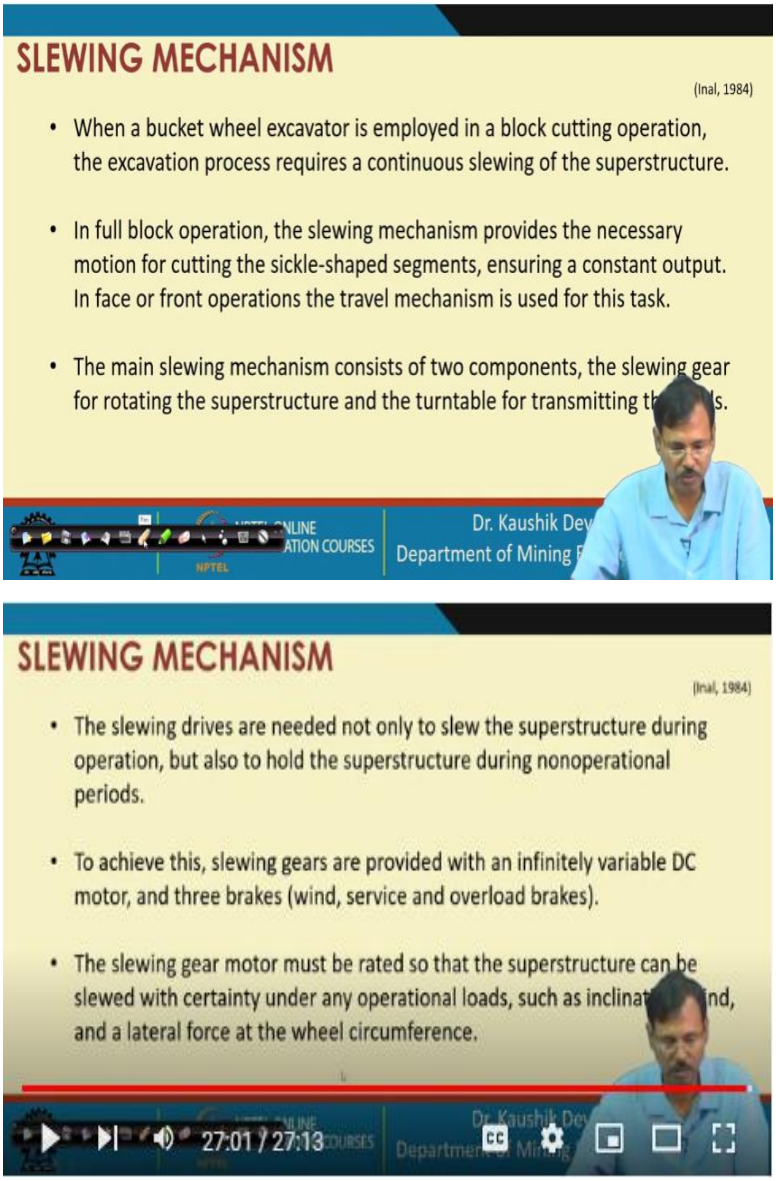

Slewing mechanism is very important because it is providing the crowding action and that is why bucket will excavator for the block mining should have a suitable boom and that slewable mechanism provides the necessary motion for cutting the sickle shaped segments ensuring a constant output and the main slimming mechanism consist of two components: the slewing gear and the turntable, also transmitting the load and these are the details about the slewing systems.

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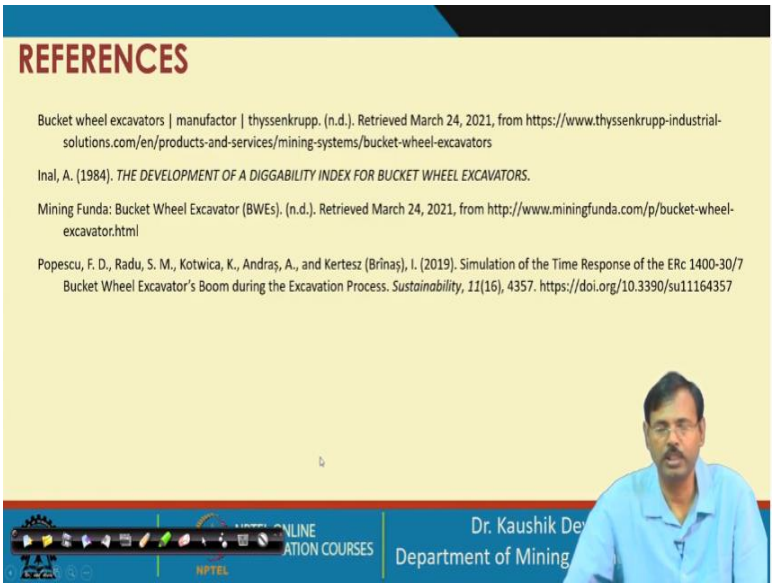

And let us stop at this position we will continue with the performance of the bucket wheel excavator in the next class.