Surface Mining Technology
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Lecture 38
Excavation with Dragline - 3

Let me welcome you to the 38th lecture of Surface Mining Technology NPTEL Online Certification Course. This is the third lecture on excavation with the dragline and also the final lecture. In this lecture we will discuss about the performance and tutorials related to excavation with dragline.

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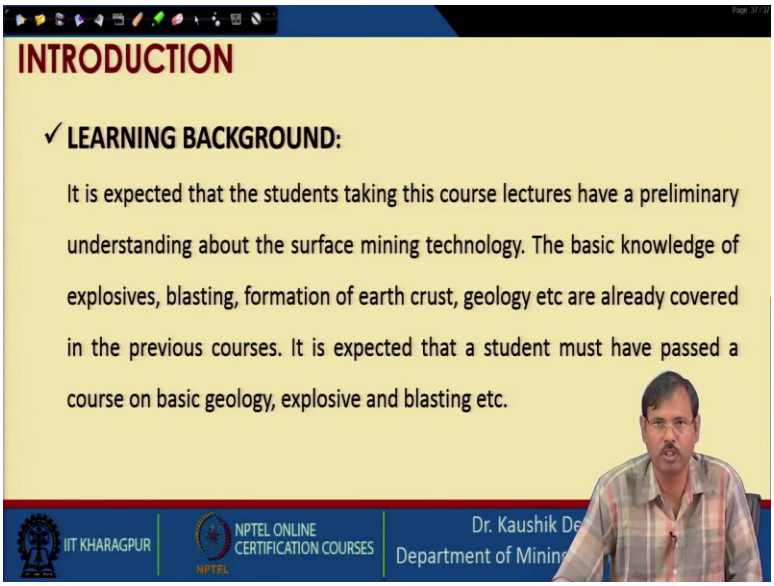

INTRODUCTION

✓ **Learning Objectives of This Course:**

- To know the different unit operations associated with surface mining.
- Methods of surface mining.
- Deployment of machineries in surface mining.
- Productivity analysis of surface mining.
- Safety and environmental control of surface mining operations.
- Special methods of surface mining.

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INTRODUCTION

✓ **LEARNING OUTCOMES:**

It is expected that the students taking this course lectures will be able to envisage the surface mining operation and its technological nitty-gritty. It is expected that a student will be abled to design the drilling and blasting rounds for surface blasting, will be able to choose, deploy and design the mine machineries for a set production target. The desired and environmental requirements will also be addressed.

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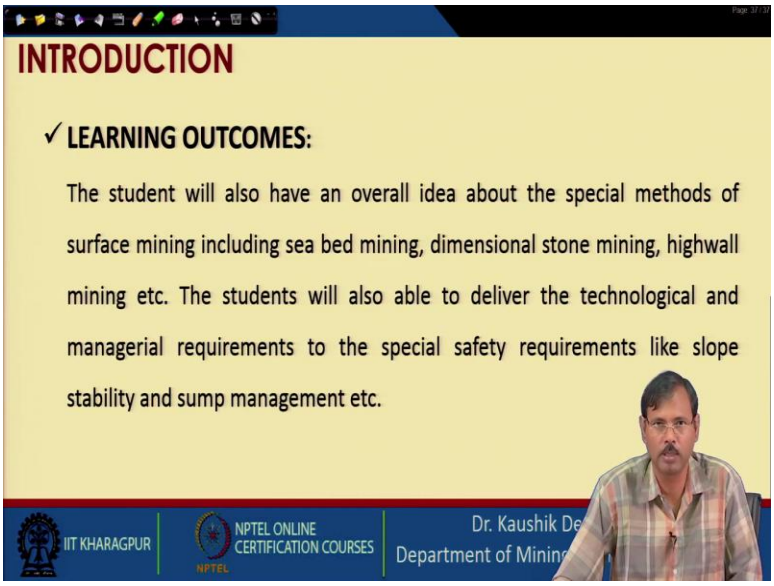

As we do every class, let us have some look into the learning background required for Surface Mining Technology Course. And these are the learning objectives of the Surface Mining Technology Course. And these are the expected learning outcomes from the participant of Surface Mining Technology Course.

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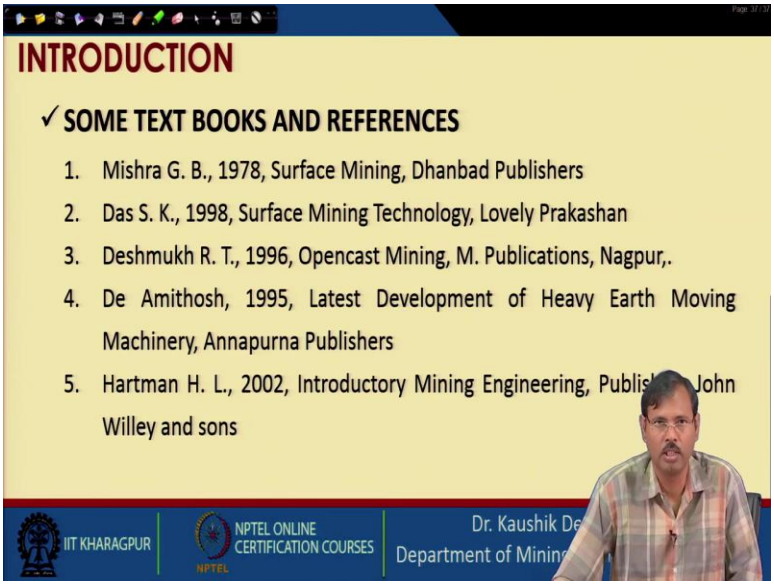


INTRODUCTION

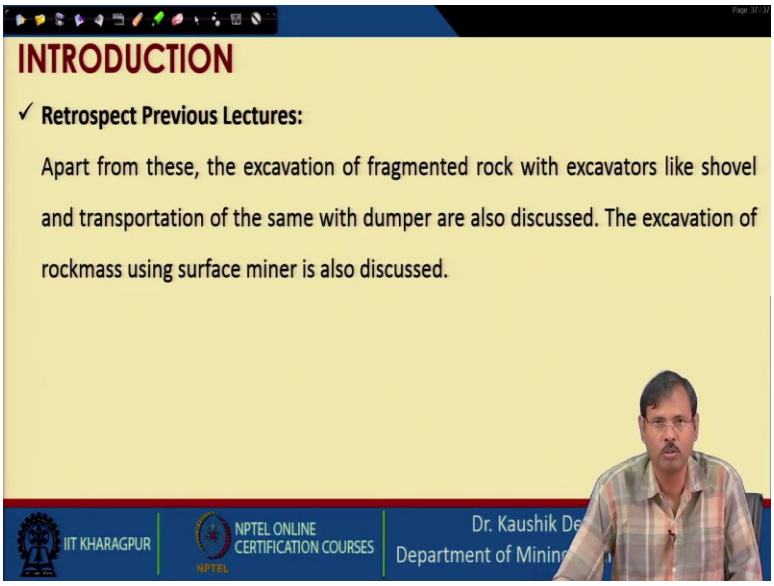
✓ SOME TEXT BOOKS AND REFERENCES

6. Peter Darling, 2011, SME Hand book, SME Publication
7. Rzhevsky, V. V., (1983), Opencast Mining Unit. Operation, Mir publications
8. Rzhevsky, V. V., (1985), Opencast Mining Technology and Integrated Mechanisations, Mir publications

INTRODUCTION

✓ **Retrospect Previous Lectures:**

In previous lectures, the phases of mining a deposit are discussed. The unit operations associated in every phase is also explained. The commencement of mining excavation through opening of box cut is discussed. The unit operation, Drilling technology is discussed. The different drilling procedures, drilling patterns required and machine operations are also discussed. Blasting technology was also discussed in details. Blast – free excavation system i.e. excavation by [illegible] is also discussed.



And these are some of the textbooks and references. And before this lecture- pertaining to the excavation with dragline, we have covered the phases of mining a deposit, we have also covered the commencement of surface mining through opening up box cut, we have covered the drilling technology, and we have also covered the drilling pattern required for blasting, we have also covered the blasting technology and designing details of a blast.

We have also discussed the blast free excavation technique using the ripper. We have also covered the handling of the excavated fragmented rock mass by excavator like shovel and transportation of the seam using the dumper. And we have also covered the excavation of rock mass using surface miner. And in the previous two lectures related to excavation with dragline.

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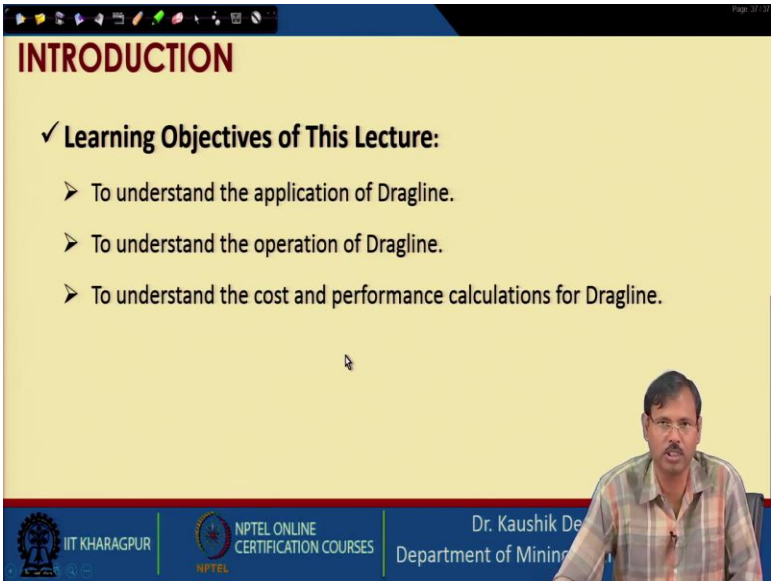

We have covered the dragline operations and also we have found how the dragline is operating along with the different layouts of the dragline. In general, we have seen the dragline is mostly adopted for the simple casting, side casting or direct casting, but in some special cases where the dump is not within the reach of the dragline, we can go for extended bench method or we can go for tandem method where the two draglines are used: horizontal tandem method or vertical tandem method.

In vertical tandem method, we are having the advantage with the extended bench height. So, that is the advantage of the vertical tandem method and those are discussed in the last two classes. In this class we will solve some tutorials pertaining to the performance of the dragline. But let us look once again the learning objective of this lectures to understand the application of dragline, to understand the operation of dragline, these are covered and we will go for under estimating the cost and performance calculation for the dragline operation in this class.

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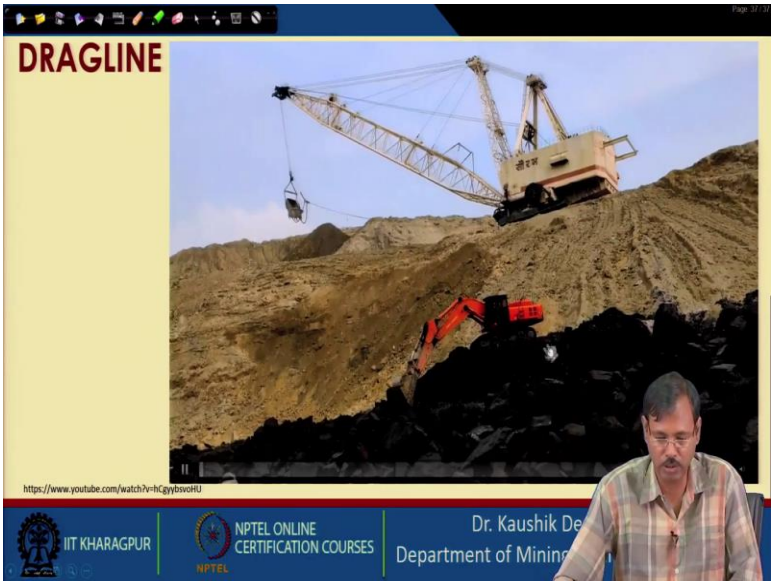

So, once again let us look into this photograph how the dragline is working that is a simple side casting. So, we can understand that this dragline is working and you can see this dragline is in general having a large cycle time. So, two to three minutes, four minutes are taken by the dragline for its one cycle of operation. And we understand that dragline is a walking type of dragline. So, its movement is also very difficult.

So that is why the utilized hours in general with a dragline is significantly low. You can see this is the bucket fill factor also very poor, you can see the bucket is being dragged towards the machine to fill it. And you can see the bucket filling is not significant high though this is the way

the blasting is carried out and this is very good blasting. So this is the position how it is filled and now the material is moved towards this dump.

And now the material will be discharged at the dump as the hoisting rope is being hoisted. Now, this is allowing the discharge of the dump. So, this is the way you can see the second bucket is being taken here with the same machine. So, the cycle time is significantly higher you can see it already takes more than two minutes for the first cycle whereas the shovel etcetera, they take around 30 to 40 seconds or one minute for filling the bucket for one cycle of a operation. And continuum of bucket is also a very difficult task. So, this is another dragline. So, now, the hoisting rope is lifting the bucket. And taking the material towards the hoisting dump.

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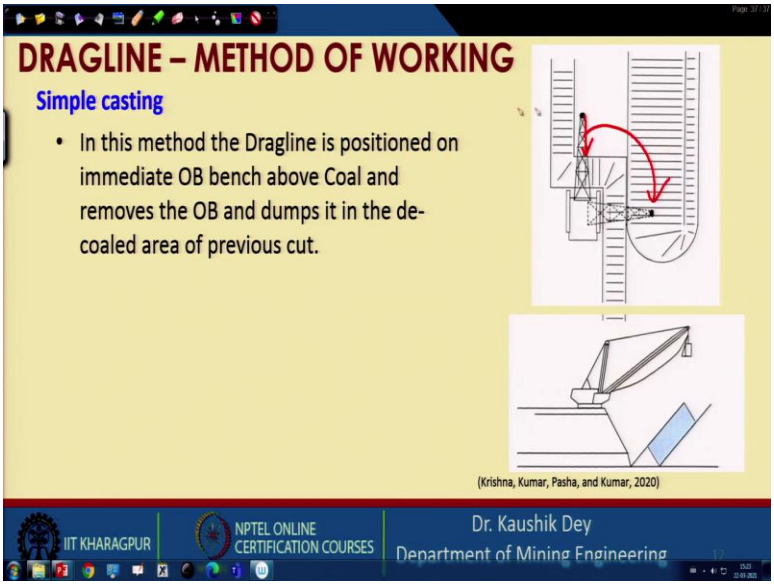

And the side casting we have seen the material is moved, taken from this site and after that the material is taken at, bucket is filled at this position then the boom is swing and it is discharging at this position. So, the whole cycle is taking some time.

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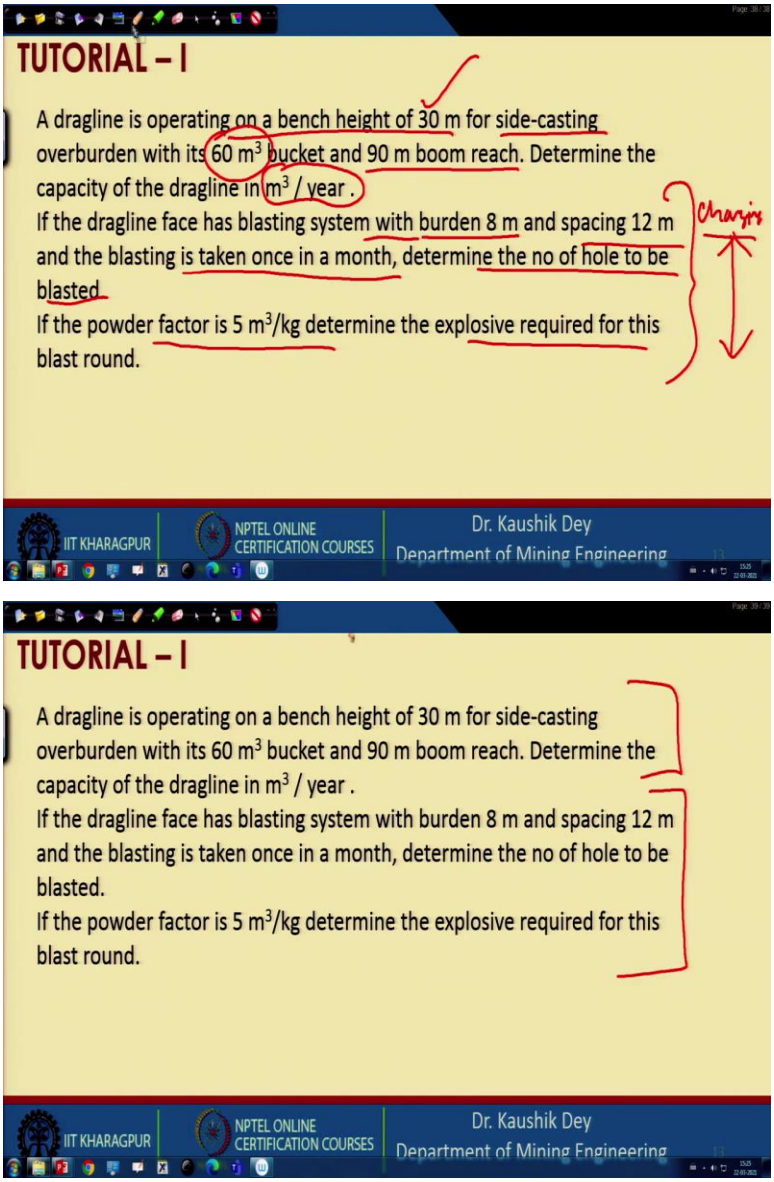

And with consideration of this let us consider the first tutorial where a dragline is operating on a bench of height 30 meter, simple side casting is being carried, bucket size is 60 meter cube boom reach is 90 meter. And we have to find out the capacity of the dragline to handle the material in 1 year. Now, if the dragline face has the blasting system with burden value of 8 meter, spacing value of 12 meter and the blasting has to be taken once in a month find out the number of holes to be blasted.

And if the powder factor is this find out the explosive required for one blast. Because dragline holes are in general large dia. hole and see 30 meter bench means it is significant deep also. And

large quantity of explosive has to be used in this case. So, the charging time is significantly high. So, generally sleeping hole technique is used where the explosive is charged and allowed to degasified and the charging is carried out for a few days after the completion of the charge only the blasting is carried out. So that is a special method, in general adopted at this position but let us solve the first part first. This part we will solve at a later stage. But this one, let us consider first.

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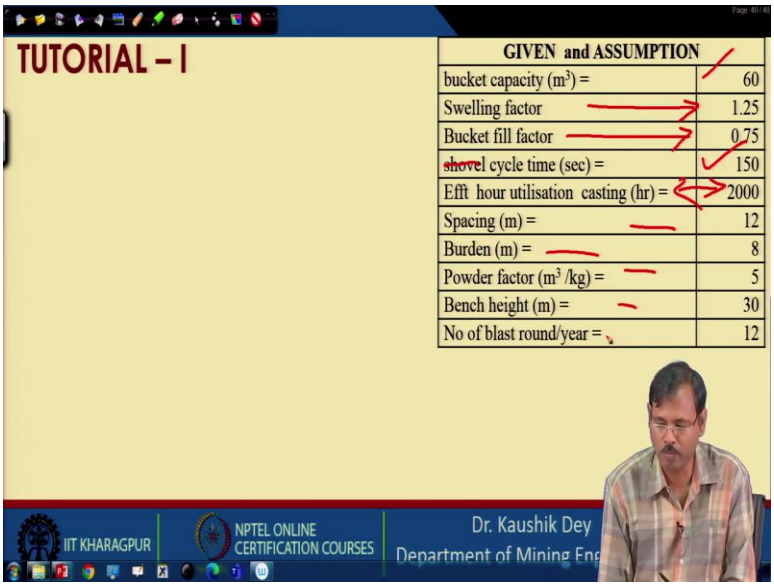

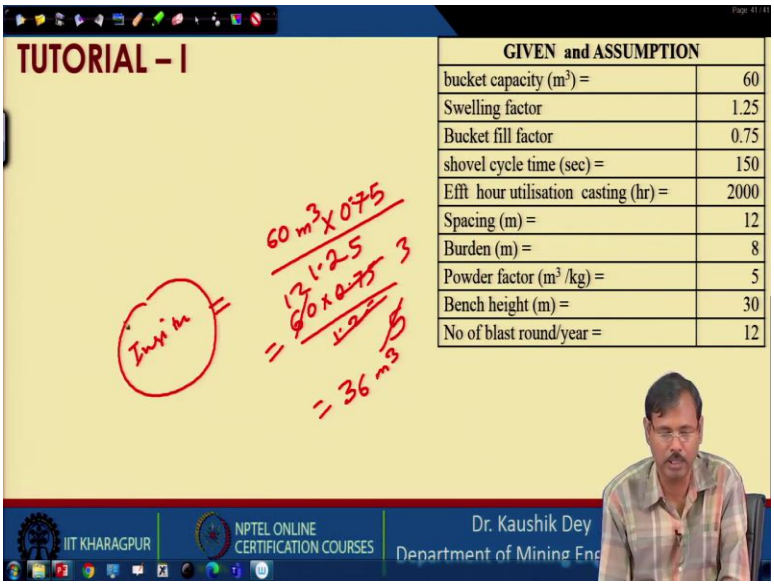

This is given and we have assumed something, our given is that our bucket capacity is 60 meter cube. We have assumed swelling factor of 1.25. Bucket fill factor of 0.75. We have assumed that

this is not shovel, this is dragline cycle time 150 second, that is two and a half minute. And effective utilized hour for casting is 2000 hour we have considered available for work, casting operation rest part is available but the movement of the dragline from one position to another position, shifting of its cable, maintenance etcetera is required.

And these are spacing, burden, powder factor, bench height, and number of blast round, it is considered that once in a month we will blast in the dragline phase. So, the number of blast round per year is 12. So, now let us start solving this problem say bucket capacity is 60 meter cube, fill factor is 0.75 and swelling factor is 1.25. So, actual meter cube in situ meter cube which is being taken by this can be calculated like this so 60 into 0.75 by 1.25. So, if I cut this with this, this 3 by 5. So, this is 12 so 36 meter cube material in situ material is basically taken out by 1 bucket.

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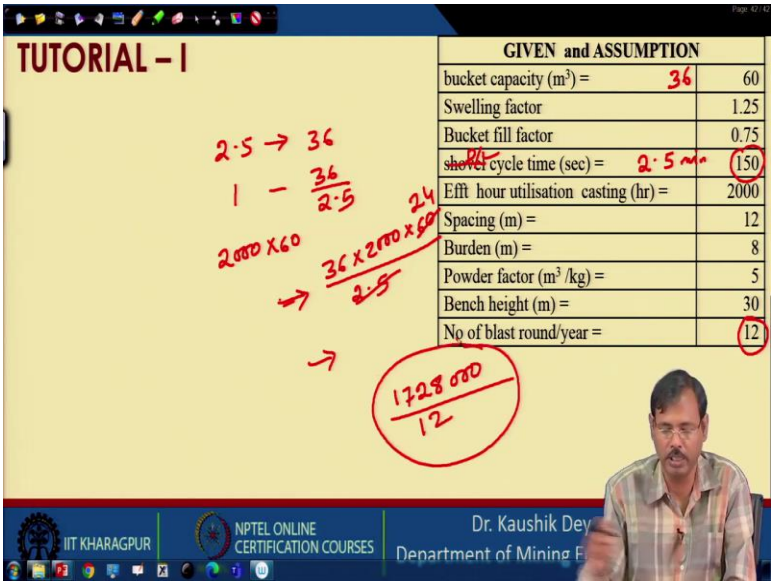

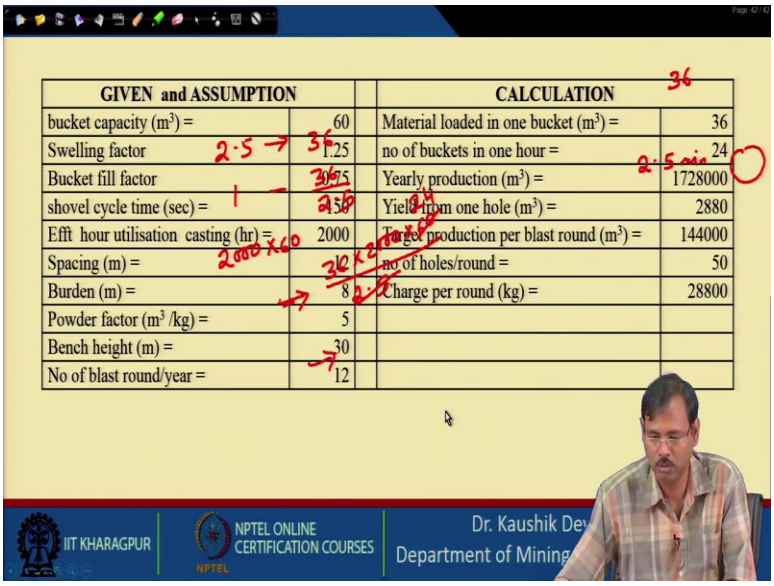

So, bucket capacity in situ is 36 meter cube. Now, this 36 meter cube material is basically 150 second. So, 150 second means 2.5 minute. So, 2.5 minute we can handle 36 cubic meter in situ cubic meter. So, in 1 minute 36 by 2.5 and hour available 2000 into 60 minute is available. So, in this we will get 36 into 2000 into 60 divided by 2.5. So, you get, this is the value. So, now, if we multiply it and we can get the value and I have already multiplied it in the next slide.

We can show it, I think this is so 172800. So, 1.7 million meter cube of material can be handled by the dragline. So, this is dragline. Now, this is the dragline, which can handle in 1 year and we are having 12 blast rounds. So 1 blast round we need to excavate this much of material. So now let us again clear this slide.

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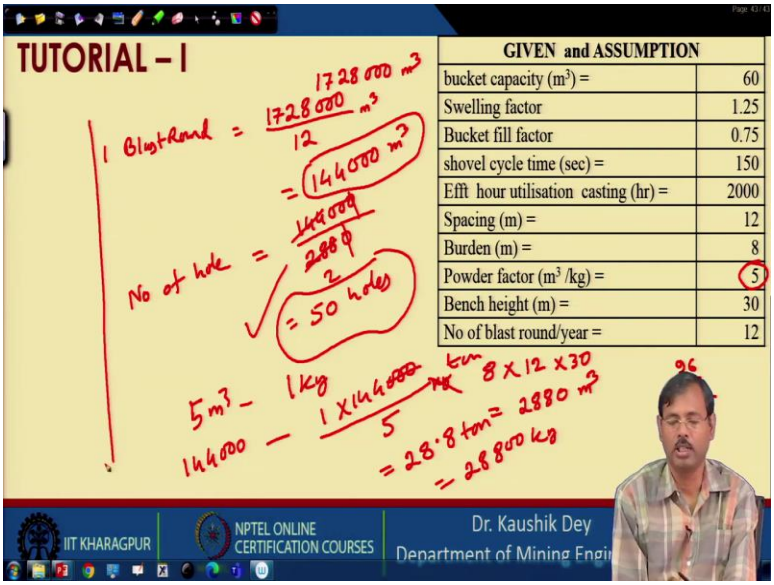

So, dragline capacity is 1728 meter cube. So in one blast round we have to handle 1728000 divided by 12 meter cube. So this is 1, so this is in 1 blast round. And we are having burden of 8 meter, spacing of 12 meter, bench height of 30 meter. So in one blast, we can take this much of material. So this is 2880 meter cube, we can get from one blast. So, the number of hole required in one blast round required in one blast round. So, this is 50 holes.

So, in one blast round we have to go for blasting of 50 holes. And if we look into the explosive requirements then our explosive requirement will be like this say in our 1 round this is the quantity to be obtained must be blasted and our powder factor is 5 meter cube per kg. So, 5 meter cube material we can get from 1 kg and our target is 144000 meter cube we can get from 1 into 144000 kg 0 divided by 5 kg.

So, now convert this kg or to turn, this will be removed. So, this one is 28.8 ton or in other case 28800 kg. So, 28,800 kg of explosive is required for blasting 50 holes of 1 round. So, that is the requirement of blasting in a dragline phase if we are practicing blasting in 1 month only.

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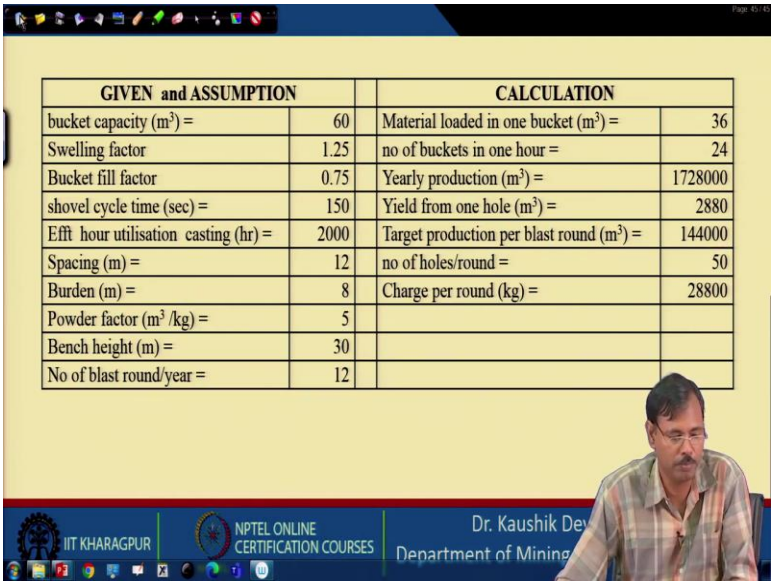

So, now let us look into all the values. Now, we have found the yearly production requirement is 1728000, yield from one hole is this one. Number of holes to be blasted per round is this one and charge required for blasting is this one 28,800 kg or 28.8 ton of explosives are required. So, this is the solution for the first problem.

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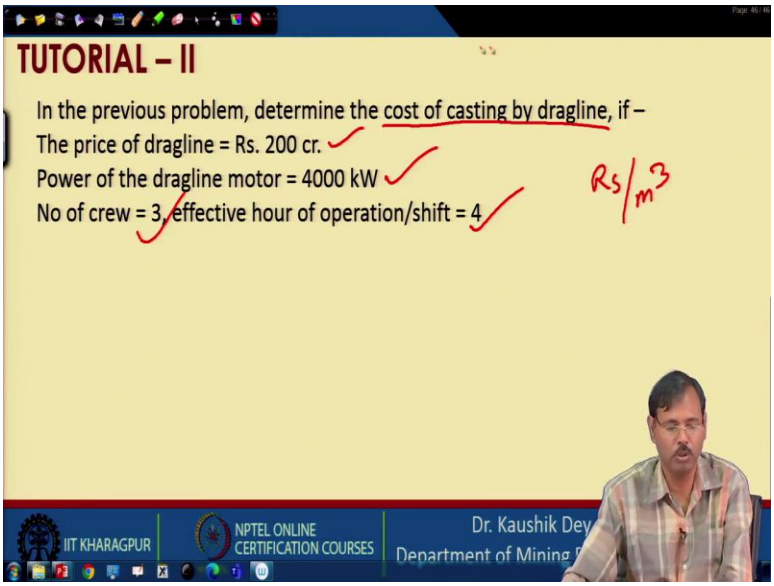

Now, let us look into the second problem. In the first problem itself, we are using that one and we have to determine the casting cost by the dragline. If the price of the dragline is given, power of the dragline is given 4000 kilowatt, number of crew required to operate the dragline is 3,

effective hour operation of per shift is 4. And rest values we need to assume in that case, what will be the cost of casting in terms of rupees per meter cube. So, we have carried out similar costing calculation previously for other equipment but we need to assume something.

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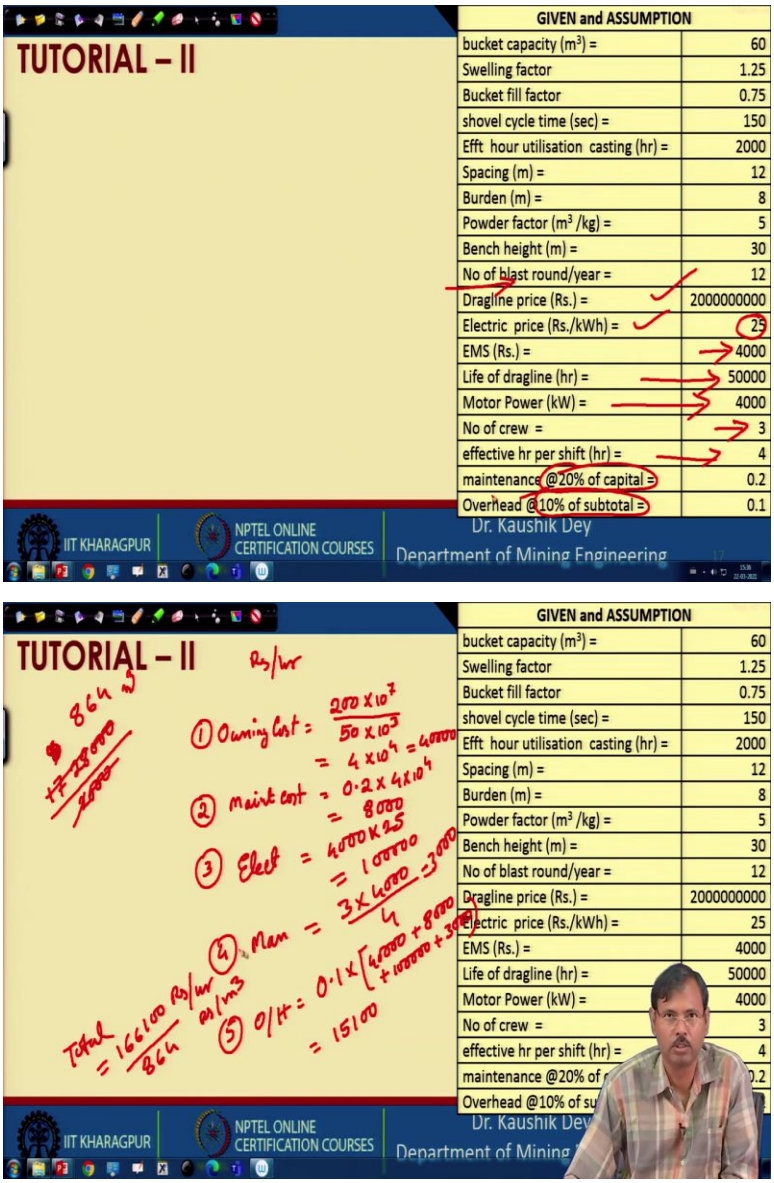

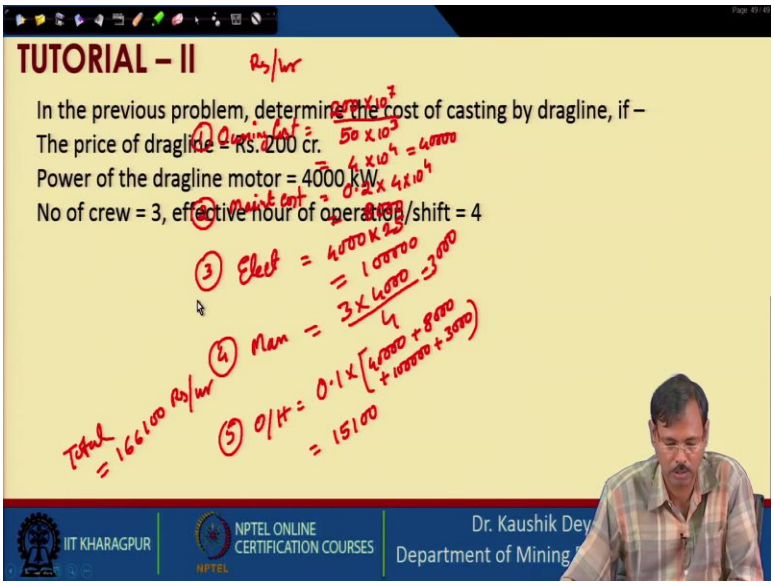

So, these are the assumptions, up to this is already carried out in the previous one, now it is given this is the price 200 crores: the price of the dragline, we have considered the electric price that is the 4000 kilowatt motor working is rupees 25 per kilowatt hour. EMS we have considered earning per month shift rupees 4000, life of dragline is considered 50,000 hour, motor size is considered 4000 kilowatt, number of crew is given, effective power is given and we have considered maintenance as the 20 percent of the capital.

Overhead cost is the 10 percent of the sum of the all other operating costs. So let us calculate it. The first hour is owning cost. So, this is the price buy life. So, 200 crore life is 50,000. So, owning cost is this much of rupees 40,000 rupees. Then the maintenance cost we have considered 20 percent of capital cost. So, that is 0.2 into 4 into 10 to the power 4. So, it is 8000 rupees then we are having a running cost.

So, the electrical consumption cost is you are having, these are all expressed in rupees per hour. So, electrical consumption cost is 4000 kilowatt into 25 rupees. So, this is coming one lakh rupees per hour. And 4th is manpower cost. So, 3 to 4000 is the EMS for 3 person. So, 4000 to into 3 that is per shift their salary and effective hour per shift is this much. So, it is coming 3000 rupees, 3000 rupees per hour and the overhead cost is 0.1 into 40,000 plus 8000 plus 1 lakh plus 3000.

So, altogether it is coming one lakh 40,000 1 lakh 51,000. So, 1 lakh 51,000, 10 percent of that is 15,100. So, the total is now coming 1 lakh 51,000 plus 15 1 lakh 66,100 rupees per hour. So, this

we have obtained and we have seen the performance of the machine in the previous, So, this is production per year given and performance you have seen the bucket capacity is 60 or you can directly take it 17,020; 1728,000.

So, you can directly get it from here 1728,000 divided by 2000. So, this is coming 864. So, 864 meter cube is the hourly handling. So, if it is rupees per meter cube is considered. So, this is divided by 8064. So, then it is becoming rupees per meter cube and so, it is coming close to say 200 close to 200 rupees, maybe 190 rupees or something it is coming.

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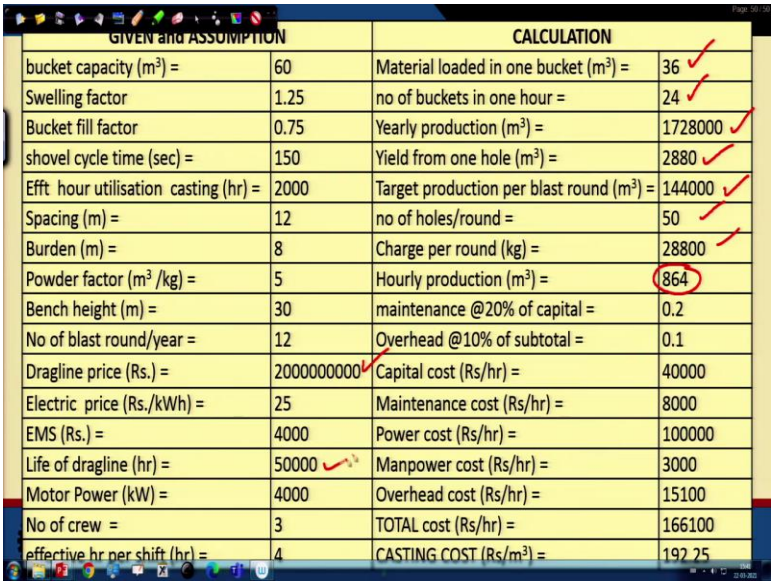
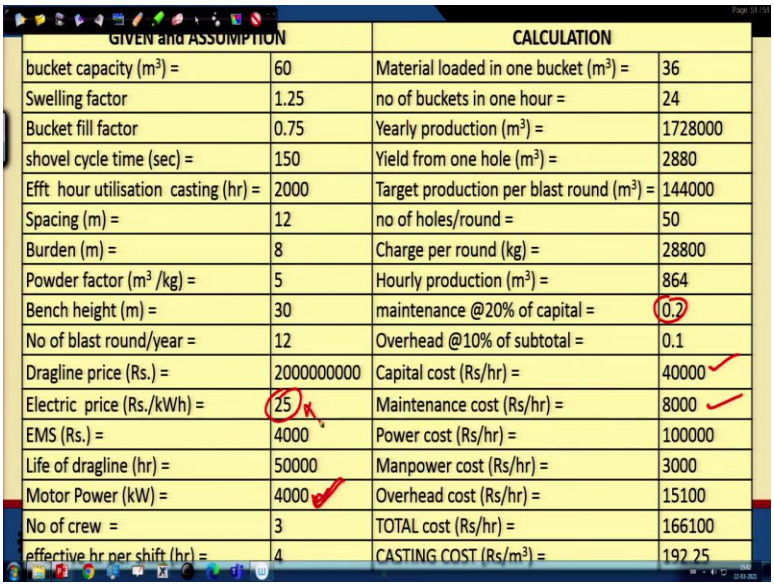


GIVEN and ASSUMPTION		CALCULATION	
bucket capacity (m^3) =	60	Material loaded in one bucket (m^3) =	36
Swelling factor	1.25	no of buckets in one hour =	24
Bucket fill factor	0.75	Yearly production (m^3) =	1728000
shovel cycle time (sec) =	150	Yield from one hole (m^3) =	2880
Efft hour utilisation casting (hr) =	2000	Target production per blast round (m^3) =	144000
Spacing (m) =	12	no of holes/round =	50
Burden (m) =	8	Charge per round (kg) =	28800
Powder factor (m^3 /kg) =	5	Hourly production (m^3) =	864
Bench height (m) =	30	maintenance @20% of capital =	0.2
No of blast round/year =	12	Overhead @10% of subtotal =	0.1
Dragline price (Rs.) =	2000000000	Capital cost (Rs/hr) =	40000
Electric price (Rs./kWh) =	25	Maintenance cost (Rs/hr) =	8000
EMS (Rs.) =	4000	Power cost (Rs/hr) =	100000
Life of dragline (hr) =	50000	Manpower cost (Rs/hr) =	3000
Motor Power (kW) =	4000	Overhead cost (Rs/hr) =	15100
No of crew =	3	TOTAL cost (Rs/hr) =	166100
effective hr per shift (hr) =	4	CASTING COST (Rs/m^3) =	192.25



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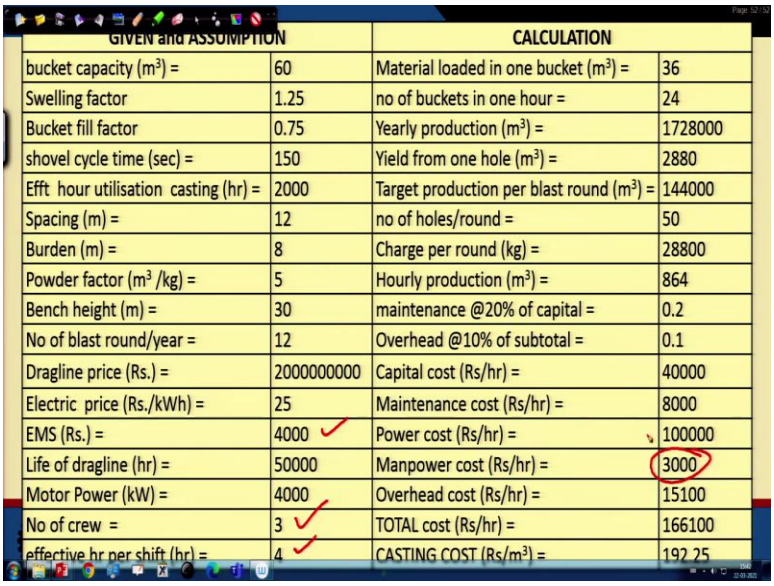

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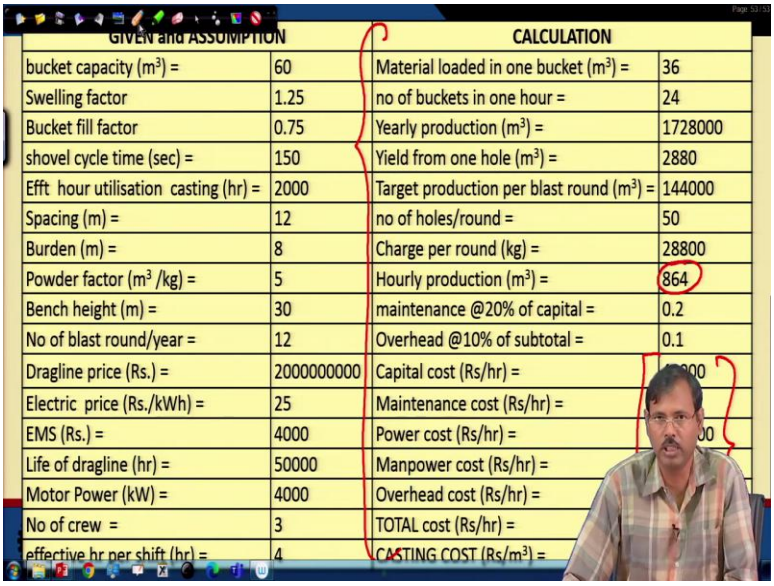

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effective hr per shift (hr) =	4	CASTING COST (Rs/m^3) =	

So, now, let us look into the details of the calculated values in the next slide. So, you can see the material loaded in 1 bucket is 36 meter cube, we have already calculated, number of buckets per hour is 24. So, from there we have got this one. So, per hour we can calculate, the hourly production is 864 into 36 into 24 into 864 meter cube is the hourly production. So, we have already got this one in the previous tutorial. This value also, we have got this one.

Now, we are considering the maintenance cost, it is given by a 20 percent overhead cost, it is given 10 percent. So, capital cost is in rupees per hour that is this one divided by this one we have got this one 40,000 rupees, maintenance cost is the 20 percent of this one 8000 rupees

power cost is 25 into motor power. So, this is the power cost, manpower cost is EMS into number of manpower divided by the effective hour effective hour is 4.

So, this is the manpower cost then the overhead cost is summation of this one and 10 percent of that is overhead cost. So, all together summing up all this, we have got this value and the moment we have divided this one with this one we have got the casting cost in rupees per meter cube. So, this is the casting cost in rupees per meter cube, this is the final value we have obtained as the for the dragline excavation of side casting.

So, if we are thinking of the tandem method of operation or something like that then this cost will become almost double or similar to you will get for that casting cost. So, this is the cost calculation for a dragline. So, this ends the dragline excavation with dragline, and we will continue with our topic with our new topic in the next class. Thank you.