

Surface Mining Technology
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Indian Institute of Technology, Kharagpur
Lecture No. 44
Excavation with Bucket Wheel Excavator - 3

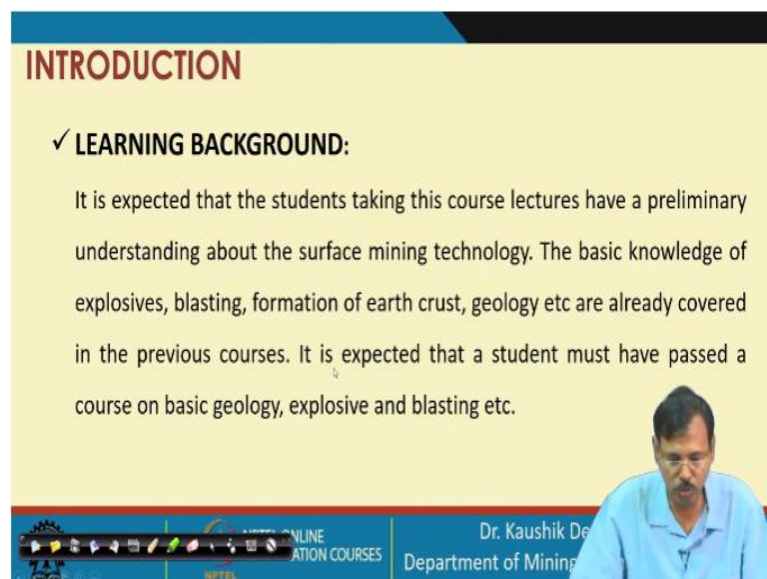
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The slide features the IIT Kharagpur logo on the left and the NPTEL logo on the right. The main title is "SURFACE MINING TECHNOLOGY" in bold black letters. Below it, the lecture title is "Lecture No: 44 – EXCAVATION WITH BUCKET WHEEL EXCAVATOR - III" in red, followed by "PERFORMANCE OF BUCKET WHEEL EXCAVATOR" in blue. The presenter's name and affiliation are listed as "KAUSHIK DEY, DEPARTMENT OF MINING ENGINEERING, IIT KHARAGPUR". A small video inset in the bottom right corner shows Professor Kaushik Dey speaking. A navigation bar with various icons is visible at the bottom left of the slide.

Let me welcome you to the forty fourth lecture of NPTEL Online Certification Course - Surface Mining Technology. We are continuing with Excavation with Bucket Wheel Excavator. This is the third and final lecture of this excavation with Bucket Wheel Excavator. In this class, we will calculate the performance of bucket wheel excavator.

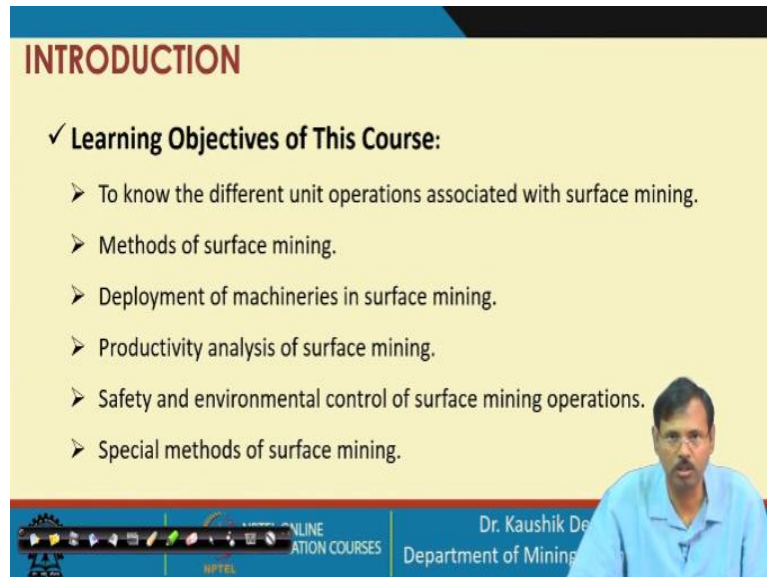
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The slide is titled "INTRODUCTION" in bold red letters. Below the title, there is a section "✓ LEARNING BACKGROUND:" followed by a paragraph of text: "It is expected that the students taking this course lectures have a preliminary understanding about the surface mining technology. The basic knowledge of explosives, blasting, formation of earth crust, geology etc are already covered in the previous courses. It is expected that a student must have passed a course on basic geology, explosive and blasting etc." A small video inset in the bottom right corner shows Professor Kaushik Dey speaking. The bottom of the slide contains the NPTEL logo and the text "Dr. Kaushik Dey, Department of Mining". A navigation bar with various icons is visible at the bottom left of the slide.

But as we do in every class, let us look once again the learning background required for surface mining technology course.

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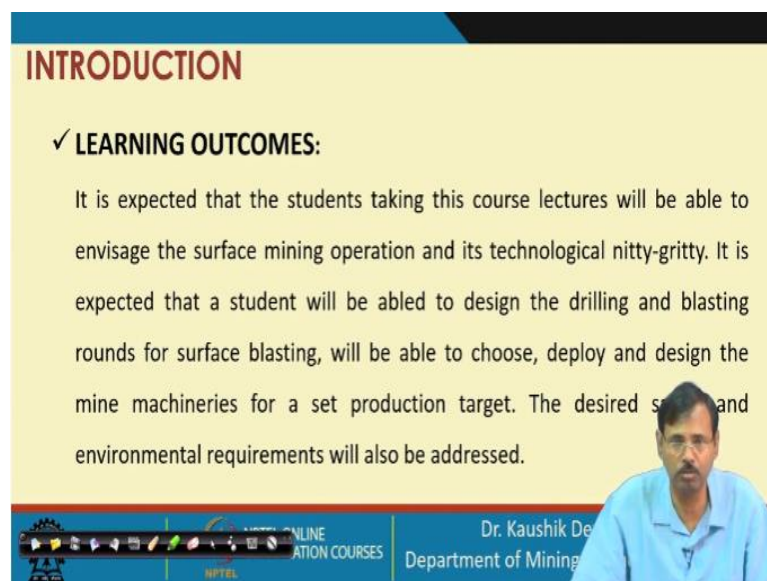


INTRODUCTION

✓ **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

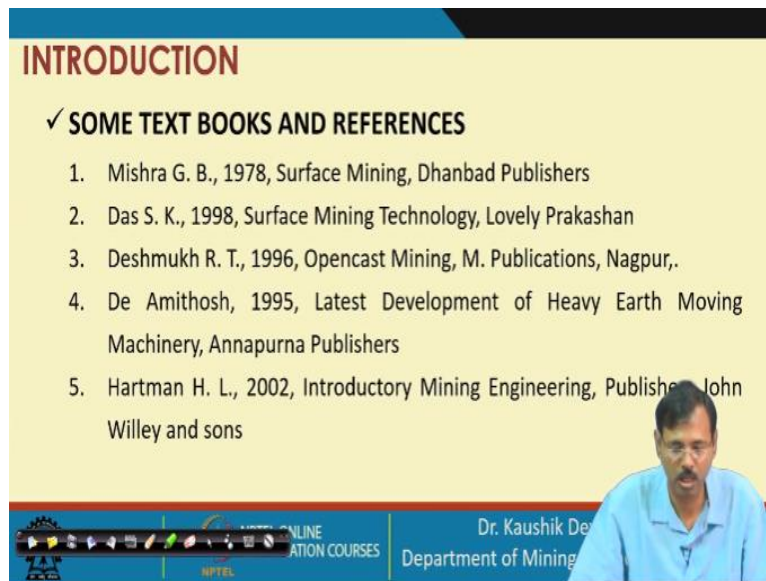
✓ **LEARNING OUTCOMES:**

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 able 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 safety and environmental requirements will also be addressed.

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The set objectives of surface mining Technology course in this NPTEL Online Certification Course. These are the expected learning outcomes from the participant of this surface mining technology course.

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INTRODUCTION

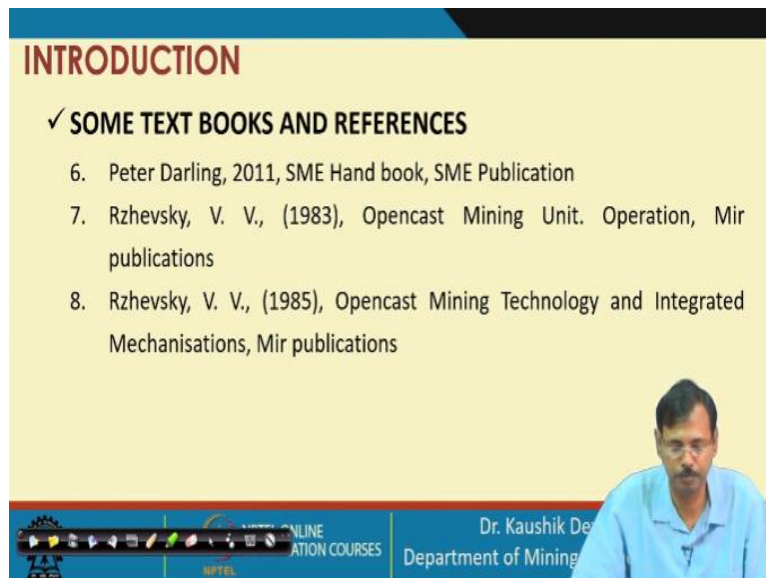
✓ **SOME TEXT BOOKS AND REFERENCES**

1. Mishra G. B., 1978, Surface Mining, Dhanbad Publishers
2. Das S. K., 1998, Surface Mining Technology, Lovely Prakashan
3. Deshmukh R. T., 1996, Opencast Mining, M. Publications, Nagpur,.
4. De Amithosh, 1995, Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers
5. Hartman H. L., 2002, Introductory Mining Engineering, Publisher John Willey and sons

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INTRODUCTION

✓ **SOME TEXT BOOKS AND REFERENCES**

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

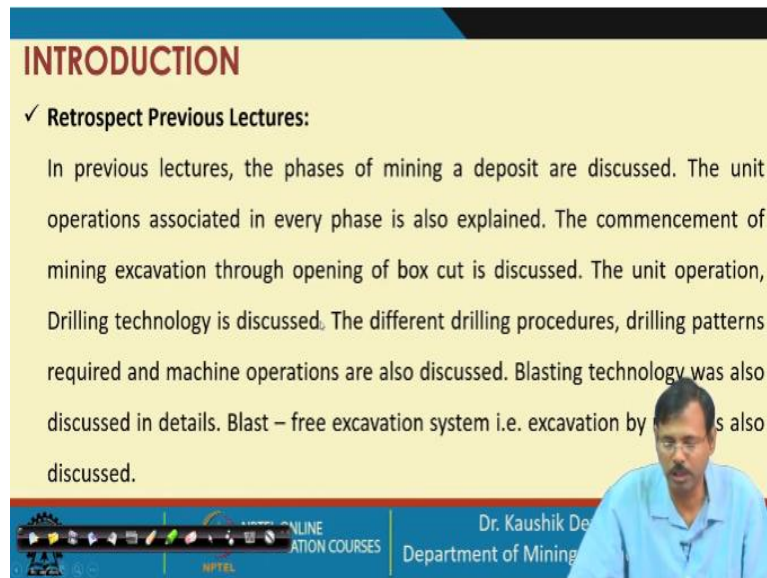
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And these are some of the text and reference.

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INTRODUCTION

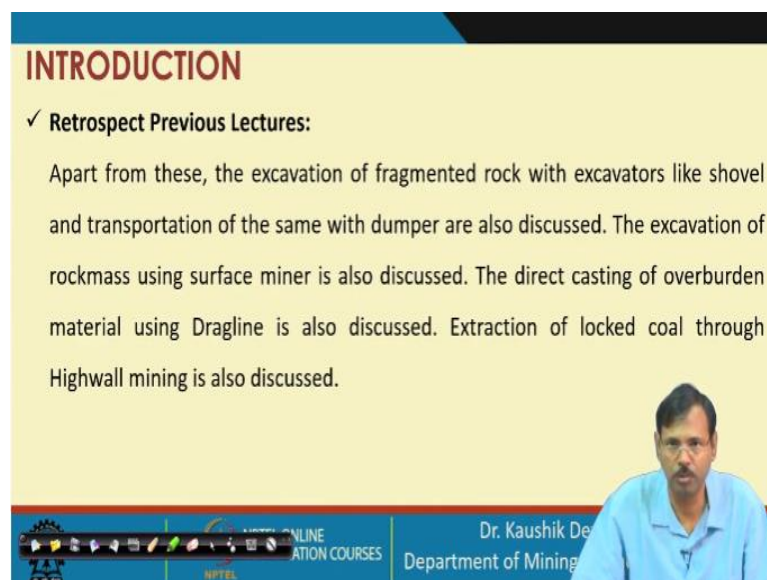
✓ **Retrospect Previous Lectures:**

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 ripper is also discussed.

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And as we retrospect whatever we have covered so far, here we have covered so far the phases of mining a deposit we have covered opening of surface mining through box cut, we have covered the drilling technology, we have covered blasting technology, we have covered plus three excavation of rock using ripper, we have covered the handling of fragmented rock mass by shovel and transporting the same with the dumper and other transportation system.

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INTRODUCTION

✓ **Retrospect Previous Lectures:**

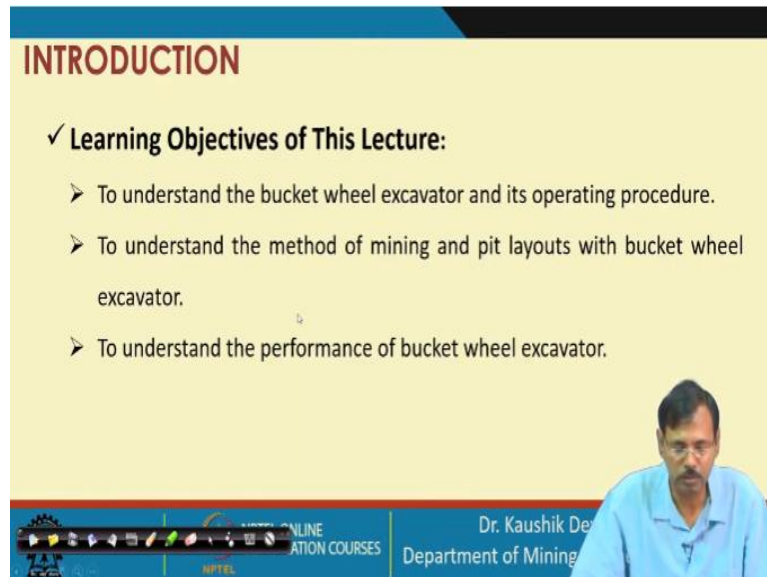
Apart from these, the excavation of fragmented rock with excavators like shovel and transportation of the same with dumper are also discussed. The excavation of rockmass using surface miner is also discussed. The direct casting of overburden material using Dragline is also discussed. Extraction of locked coal through Highwall mining is also discussed.

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We have covered the excavation of rock mass using surface miner, we have covered the direct crusting of the overburden rock material by drug line. We have covered a high wall mining operations in which the locked coal under the high wall is excavated and we have already covered two lectures related to bucket wheel excavator in which we are introduced

with the bucket field excavation system and we have seen the different types of excavation possible with the bucket feel excavator, how that drop cut and terrace cutter made, how the full block method and hub block method are carried the types of bucket Feel excavator crowded type, crowd less type. These are already discussed in the previous two lectures.

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INTRODUCTION

✓ **Learning Objectives of This Lecture:**

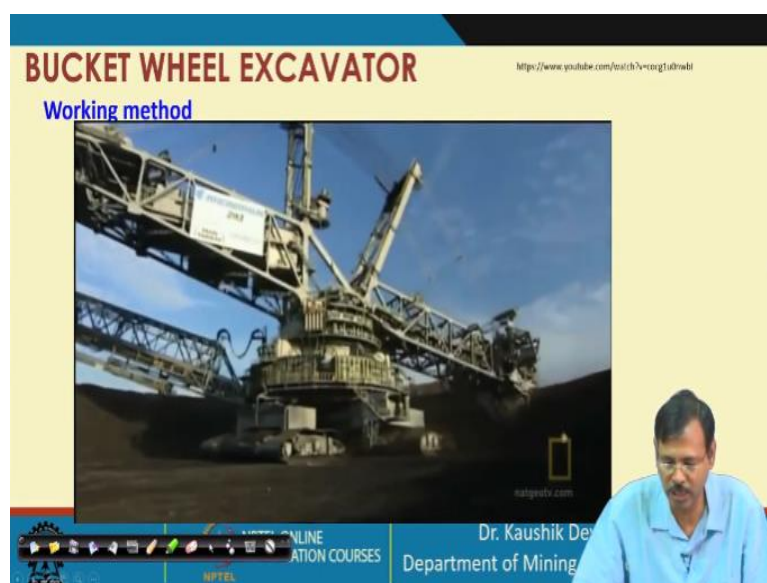
- To understand the bucket wheel excavator and its operating procedure.
- To understand the method of mining and pit layouts with bucket wheel excavator.
- To understand the performance of bucket wheel excavator.

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And these are the objectives of these three lectures. We have already understood the bucket wheel excavator and its operating procedure. We have covered and understood the method of mining and pit layouts with bucket wheel excavator and the performance of bucket wheel excavator.


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BUCKET WHEEL EXCAVATOR

<https://www.youtube.com/watch?v=cvg1dhrabI>

Working method



natgeo.tv.com

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So, in this class we will calculate the performance of bucket wheel excavator, but before that let us look once again how the bucket wheel excavator works. Then it is easier for us, you can see the bucket wheel excavator is having a number of buckets fitted with these buckets are cutting the material and as it is cutting it is allowing the material to come to the conveyor of the cutting boom.

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This conveyor is taking the material and allowing that material to come to the discharge boom and discharge boom is discharging the material to a shiftable belt conveyor and the shiftable belt conveyor is transferring that material.

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So this is in a nutshell, the bucket wheel excavator is working and as the bucket is trucking with the face wall, as the bucket is trucking with the phase wall, the rock is basically coming into the or ill being filled disclosed and filled the bucket of the bucket wheel excavator and after entering the material into the bucket wheel excavator, the material is discharged to the conveyor of the discharge cutting boom.

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PERFORMANCE

Performance of a bucket wheel excavator is estimated using the following formula.

$$P = \frac{N \times B_c \times F_f \times rpm}{S_f}$$

Where,
P = Production (m³/min)
N = No. of bucket in the wheel
B_c = Bucket capacity (m³)
F_f = Fill factor
rpm = rotation of wheel per minute
S_f = Swell factor

So, this is in a nutshell the excavator is bucket excavator is working. Now let us look how we can expect the performance of the bucket excavator as the bucket wheel excavator is fitted with a number of bucket, the performance can be estimated like this, if the number of buckets N is the number of buckets in the well, P is the performance production meter cube per

minute, B_c is the capacity of the each bucket. F_f is the fill factor of the bucket, rpm is the rotation per minute of the bucket and S_f is the Swell factor.

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PERFORMANCE

Performance of a bucket wheel excavator is estimated using the following formula.

$$P = \frac{N \times B_c \times F_f \times rpm}{S_f}$$

Where,

- P = Production (m^3/min)
- N = No. of bucket in the wheel
- B_c = Bucket capacity (m^3)
- F_f = Fill factor
- rpm = rotation of wheel per minute
- S_f = Swell factor

Excavation or per bite

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Now if the bucket is not, say, cell less type or semi cell less type, then bucket capacity calculation is difficult. So basically, we can consider this part, this B_c into F_f into is basically the excavation of power bite. So, this is the excavation, when a bucket is trucking the face is trucking the face the material dislodged and coming into this the quantity of that material is basically this one.

So, this material if we do not have that B_c also, then also this bucket bite excavation material is basically considered here as the excavated material coming out per bite. So, the production is basically the P, now N is basically the number of bucket means the number of bit and rpm is the rotation of the wheel per minute. That is basically giving us the performance of the machine.

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Tutorial -I

Determine the production capacity of a BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite.

Also determine the cost of production, considering –

- Price of BWE = 1000000000 Rs.
- Life = 50000 hr
- Rated power = 4375 kW
- Electricity price = 25 Rs/kWh

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So, now let us go for solving some problem related to this. So, our first problem is that determine the production capacity of a bucket wheel excavator of Neyveli Lignite Mine fitted with a 14 number of buckets as the capacity of each bucket is 1.4 meter cube and it is having the rpm of 5, while cutting the lignite. Rest part we are not considering at this, currently we have to find out the production capacity.

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Tutorial -I

Determine the production capacity of a BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite.

Handwritten calculation:

$$\begin{aligned}
 \text{Yearly Production (tonne)} &= 3000 \times 0.6 \times P \\
 &= 14 \text{ Mton} \\
 P &= \frac{N \times B_c \times f_f \times \text{rpm}}{f_s \times 60} \\
 &= \frac{14 \times 1.4 \times 0.6 \times 5}{1.2 \times 60} \\
 &= 49 \text{ m}^3/\text{min} \\
 &= 78 \text{ tonne}/\text{min}
 \end{aligned}$$

GIVEN and ASSUMPTION	
Bucket capacity (m ³) = B_c	1.4
No of buckets in the wheel = N	14
Wheel rpm = rpm	5
Available hours in year = \Rightarrow	3000
Bucket fill factor = f_f	0.6
Swelling factor = f_s	1.2
Density of Lignite (tonne/m ³) =	1.6

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So, for this let us find out we are already given the bucket capacity is given. So, B_c is given number of when buckets in the wheel is given, so N is given, rpm is given, 5. We have assumed this is the available hours in the year. Bucket fill factor is given. Swelling factor is given and we have assumed the density of the lignite is 1.6 per meter cube. So, the production

capacity P is the meter cube per minute is equal to 14 is equal to N into B_c in to F_f into rpm by S_f. So, N is 14, B_c is 1.4, F_f is 0.6, rpm is 5, S_f is 1.2. So if this is given so this is coming 2 and this is coming 7. So, this is understood this is 49 meters.

Now if we are multiplying it with 1.6, this is coming to tonne. So it is coming something around I think 78 ton or something like that that can be precisely carried out on multiplication. So, this is the production per minute, we have seen the available hours for cutting because the in bucket wheel excavator the downtime that is non-productive times are significant as occasionally the shiftable conveyor has to move that time.

The bucket wheel excavator has to stand alone. These are carried out very frequently and moving acceptable conveyor means it is almost for one shift time is required for shifting the shiftable conveyor. Sometimes the main conveyor has to be extended so as the benches are moving.

So, the down times are non-productive times, are also significant. But we are expecting that 3000 hours are available for bucket wheel excavator to cut continuously. And in considerations with that our production, yearly production in tonne will be 3000 into 60 into this whatever is coming that P, so this is ours 3000 hours. So, we have carried out and it can be seen. It is 14 million tonnes found as the production from this case. So, let us look into this in the detail calculation.

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Tutorial -I

Determine the production capacity of a BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite.

GIVEN and ASSUMPTION	
Bucket capacity (m ³) =	1.4
No of buckets in the wheel =	14
Wheel rpm =	5
Available hours in year =	3000
Bucket fill factor	0.6
Swelling factor =	1.2
Density of Lignite (tonne/m ³) =	1.6

CALCULATION	
Production (m ³)/min =	49
Yearly Production (tonne)/year =	78.4
Production (tonne)/min =	14112000

X 3000 x 60
*14 * 1.4 * 0.6 * 5*

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So, the production 49 meters cube per minute. So, on multiplying this with 1.6 we have found this is 78.4 tonne, this is not here, this is per minute. Actually, there is a problem, so this is

here, this is here. So, this is production in tonne per minute. So, yearly production, you have to multiply this with 3000 and 60. So, it is coming 14 million tonne, 14,000,001 lakh. 1 crore 41 lakh 12 thousand tonne. So, that is the production or you can say this is 14.112 million tonnes can be produced by this bucket wheel excavator. So, this is the first problem from where you can see this is the huge production you can achieve from one bucket wheel excavator.

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Tutorial -II

Determine the production capacity of a BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite.

Also determine the cost of production, considering – (Rs/tonne)

Price of BWE = 1000000000 Rs.
Life = 50000 hr ✓
Rated power = 4375 kW ✓
Electricity price = 25 Rs/kWh ✓

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So, let us continue for the second problem, so second problem is the same. If you are considering this excavator the price of discuss excavator is 100 crore rupees. Then the expected life is 50,000 hours. The power required for this bucket wheel excavator is 4375 kilowatt and the electricity price is 25 rupees per kilowatt hour. Then the cost of production, we need to find out cost of production of lignite in terms of rupees per tonne. If we are considering this, then we have to assume some more data also.

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Tutorial -II

Determine the production capacity of a BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite. Also determine the cost of production, considering – Rated power = 4375 kW Price of BWE = 1000000000 Rs. Life = 50000 hr Electricity price = 25 Rs/kWh

P = 78.4 km/hour
= 78.4 x 1000 / 60 = 1306.67 rpm

- ① Owning Cost = $\frac{100 \times 10^7}{50 \times 10^3} = 20000$
- ② Interest = 2000
- ③ Maint = 4000
- ④ Power = 4375 x 25 = 109375
- ⑤ Lip Cost = 2 x 2000 = 4000
- ⑥ Man = $\frac{4000 \times 4}{5} = 3200$

⑦ O/h = 0.1 x ① = 2000
⑧ Other = 0.1 x ① = 2000

Total = sum(① to ⑧) = 100000

Bucket capacity (m ³) = <i>Bc</i>	✓ 1.4
No of buckets in the wheel = <i>N</i>	14
Wheel rpm = <i>rpm</i>	5
Available hours in year = <i>Assumed</i>	3000
Bucket fill factor = <i>Ff</i>	0.6
Swelling factor = <i>Sf</i>	1.2
Density of Lignite (tonne/m ³) = <i>Assumed</i>	1.6
Price of BWE(Rs) = <i>given</i>	1000000000
Life of BWE (hr) = <i>given</i>	50000
Interest @ 10% of capital = <i>assumed</i>	0.1
Maintenance cost @ 20% of capital = <i>assumed</i>	0.2
Bucket lip consumption /hr = <i>assumed</i>	2
Lip price (Rs) = <i>assumed</i>	2000
Rated power (kW) = <i>given</i>	4375
Electricity price (Rs/kWh) = <i>given</i>	25
EMS (Rs) = <i>assumed</i>	4000
No. of person = <i>assumed</i>	4
Effective hour/shift = <i>assumed</i>	5
Overhead cost @10% of total = <i>assumed</i>	0.1
Other cost @10% of total = <i>assumed</i>	0.1

Now let us look into the assume data. So, in this case you can see the bucket wheel excavator capacity is given this is busy. The number of buckets is given 14 rpm here. Available hours assumed. This is assumed bucket fill factor given selling factor. Given density assumed price of the bucket, given life, we assume 10 percent capital interest, maintenance assumed 20 percent of the capital, bucket lip consumption we have also considered here bucket tip.

So, this is assumed lip price is also assumed that is 2000 rupees rated power. Actually, this is kilowatt hour, this is given kilowatt power, given this is electricity price given this is EMS assumed, we always assume it is 4000 rupees number of persons required is 4, that is also we have assumed and effective hour perceived is also assumed as the 5 hour overhead cost assumed 10 percent and other cost also assumed 10 percent in this case.

So, with this assumption and given data, we have to find out the cost of a person. So, let us consider it, first we have to calculate the owning cost. So, this is price by life, so price is 100 crores, 100 into 10 to the power 7 and life is 50 into 10 to the power 3. So, that means it is 2, then 10 to the power 4, so 1111. So, 20,000 rupees is the owning cost. Now let us consider the interest, interest is 10 percent of the owning cost. So, it is 2000 rupees. Then we have considered the maintenance cost is 20 percent. So, that is 2000 into 2. So, this is 4000.

Now next our power cost, so power cost is rated capacity 4375 and power price is 25 rupees per kilowatt hour. So, whatever is coming this is the electric power cost and then the lip is consumed. Two lips are consumed every hour, so the lip price is 2 into 2000. And so that is 4000 rupees. And then EMS manpower man power. EMS is 4000 rupees, we are deploying 4 person, so this is the cost in one shift. So, our lip cost is this much. So, this is coming 3200.

And after that we are considering if we are making it 1, 2, 3, 4, 5 and 6, then our overhead cost. 0.1 into 1 to 6 and other cost 0.1 into 1 to 7. So, these are the cost and if we are calculating this one we will get the cost, total cost is the sum of 1 to 8. And this is expressed in terms of rupees per hour. So, this is the cost of bucket wheel excavator is capital in per hour when it is under operation.

Now we have to see what is the hourly production. So, if you are considering the hourly production, we have seen the production per minute is 78.4 tonne per minute. So, hourly production is 78.4 into 60 tonne per hour. And if now whatever we are obtaining at this position, then to convert it into rupees per tonne, we have to make it 78.4 into 60, we have to divide whatever value we are getting here, we have to divide that value with this value. Then we will get the price in rupees per tonne.

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Tutorial - II		Bucket capacity (m ³) =	
Determine the production capacity of a BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m ³ capacity, and operates at 5 rpm for cutting lignite. Also determine the cost of production, considering - Rated power = 4375 kW Price of BWE = 1000000000 Rs. Life = 50000 hr Electricity price = 25 Rs/kWh		1.4	
Production (m ³)/min =	49	No of buckets in the wheel =	14
Yearly Production (tonne)/year =	78.4	Wheel rpm =	5
Production (tonne)/min =	14112000	Available hours in year =	3000
Owning cost (Rs/hr) =	20000	Bucket fill factor =	0.6
Interest cost (Rs/hr) =	2000	Swelling factor =	1.2
Maintenance cost (Rs/hr) =	4000	Density of Lignite (tonne/m ³) =	1.6
Pick cost cost (Rs/hr) =	4000	Price of BWE(Rs) =	1000000000
Diesel cost (Rs/hr) =	4375 × 95 = 109375	Life of BWE (hr) =	50000
Man power cost (Rs/hr) =	3200	Interest @ 10% of capital =	0.1
Overhead cost (Rs/hr) =	14257.5	Maintenance cost @ 20% of capital =	0.2
Other cost (Rs/hr) =	172515.75	Bucket lip consumption /hr =	2
TOTAL COST (Rs/hr) =	172515.75	Lip price (Rs) =	2000
TOTAL COST (Rs/tonne) =	36.67	Rated power (lit/hr) =	4375
		Electricity price (Rs/kWh) =	25
		EMS (Rs) =	4000
		No of person =	4
		effective hour/shift =	5
		Overhead cost @10% of total =	0.1
		Other cost @10% of total =	0.1

So, now let us look into the calculation part. Now this is the calculated values, production 49 meters cube. Then it is again reverse, so this is here and this is here. So, owning cost we have found 20000 rupees per hour, so interest cost is 10 percent of that one 2000 rupees maintenance cost 4000 rupees, 20 percent of this one. Then the pick cost 4000 rupees is two into 2000.

Now this is the power cost, power cost is 4375 into 25. So, this is coming this much, so this is something 109375, man power cost is 3200 overhead cost 10 percent of all this is coming 14000 rupees other cost is 10 percent of all these will 15,000 rupees. So, altogether production per total cost is 172,515 is the rupees per hour and whenever we are dividing it, so

this is 172515.75 divided by 78.4 into 60. So, this is coming 36 rupees 67 paise that is rupees per tonne.

So, the total if you are considering the bucket wheel excavator excavating lignite, so that excavation cost using bucket field excavator for lignite is coming 36 rupees only per tonne of lignite. So, this is the cost of excavation for lignite and then this is considered with a highly high considerations of that the price is 100 crores. And we have also considered the rated capacities of the power is fully taken with the price of 25 rupees per unit.

So, with this consideration, it is found that the price is coming in and around 36 rupees for per tonne of excavation of so this is just estimation. We need to consider the other components depreciation, etcetera. All these components are also there, so those are not considered in this case, but this is a similar type. All these options and the realistic some values can be taken for having some cost calculation for this purpose.

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Tutorial - III

BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite and 3 rpm for cutting overburden. If the target production of the mine is 12 million tonne with a stripping ratio of 5 m³ of OB per tonne of lignite, determine the number of BWE required for OB and Lignite.

(100 x 10³) x 5

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Now let us look into the third topic, that is, what is the capital requirement for opening a mine? Suppose we are operating or we try to open a mine like Neyveli Lignite mine and we would like to have the same model of bucket wheel excavator, which is having a 14 buckets, 1.4 meter bucket capacity, 5 rpm cutting in the lignite.

Now we want to know how many number of machines are required because this machine price is 100 crore rupees. This is the machine price. If we have to procure 5 machines, then we have the capital requirement of this one, so that is why what is the capital requirement?

We want to know that one. For this, we have to find out how many number of bucket wheel excavator are to procure.

Now, for calculating this, we are trying to identify what is our requirement and it is found that our production target is 12 million tonne, We want to produce 12 million tonne of lignite every year and the lignite is situating at depth and that is giving us a overburden handling of 5 meter cube of over burden for per tonne of Lignite has to be considered. So, with this consideration, we have to find out how many number of bucket wheel excavator are required for overburden and how many for the line.

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Tutorial -III

BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite and 3 rpm for cutting overburden. If the target production of the mine is 12 million tonne with a stripping ratio of 5 m³ of OB per tonne of lignite, determine the number of BWE required for OB and Lignite.

Bucket capacity (m ³) = given Bc	1.4
No of buckets in the wheel = given N	14
Wheel rpm in lignite = given	5
Available hours in year = assumed	3000
Bucket fill factor F _f = given	0.6
Swelling factor = S _f = given	1.2
Density of Lignite (tonne/m ³) = assumed	1.6
Wheel rpm in OB given	3
Lignite production (tonne/year) = 12 Mtonne	12000000
Stripping ratio = given	5

$Bc \times N \times F_f \times rpm$
 $\frac{S_f}{= 49 m^3 (OB)}$
 $= 78.4 m^3 (lignite)$

$lignite = 78.4 \times 60 \times 3000$
 $= 14.11 Mtonne$
 $(12 Mtonne)$
BWE = 1 No.

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Tutorial -III

BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite and 3 rpm for cutting overburden. If the target production of the mine is 12 million tonne with a stripping ratio of 5 m³ of OB per tonne of lignite, determine the number of BWE required for OB and Lignite.

Bucket capacity (m ³) = given Bc	1.4
No of buckets in the wheel = given N	14
Wheel rpm in lignite = given	5
Available hours in year = assumed	3000
Bucket fill factor F _f = given	0.6
Swelling factor = S _f = given	1.2
Density of Lignite (tonne/m ³) = assumed	1.6
Wheel rpm in OB given	3
Lignite production (tonne/year) = 12 Mtonne	12000000
Stripping ratio = given	5

$5 \times 12 \times 10^6$
 $\frac{5 \times 12 \times 10^6}{29.4 \times 60 \times 3000}$
 $Bc \times N \times F_f \times rpm$
 $\frac{S_f}{= 49 m^3 (OB)}$
 $= 78.4 m^3 (lignite)$

$OB = \frac{Bc \times N \times F_f \times rpm}{S_f}$
 $= \frac{14 \times 14 \times 0.6 \times 5}{1.2}$
 $= 29.4 m^3$
 $= 29.4 \times 60 \times 3000$

$lignite = 78.4 \times 60 \times 3000$
 $= 14.11 Mtonne$
 $(12 Mtonne)$
BWE = 1 No.

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So, this calculation has to be made and to calculate this, we have to assume some of the data so it is given to us that bucket capacity it is given, number of bucket given for lignite is given

for overburden is also given. So, for overburden is 3 and for lignite it is 5. We have assumed the available hours in the year bucket field factor is swelling factor is also given. Density of lignite is assumed. We need not to assume the density of overburden because we can consider it directly the volume it is tonne conversion is not required. Stripping ratio is also given which is 5 meter cube per tonne of lignite. So, we have to calculate the number first.

In first phase we are considering the capacity of the bucket and you know using the formula B_c into N into F_f into rpm by S_f . So using this formula we have already calculated our bucket capacity is 49 meters cube, that is the N_c meter cube. So, we will consider this for overburden and we will multiply it with the density for the lignite and it is found that it is 78.4 for lignite. Now we check what would be its yearly production capacity.

So, for lignite whenever we are considering we are multiplied this 78.4 with our available to make it our we multiplied it 60 and our available hour is 3000. So, this is the total capacity and we have seen it has found 14.11 million tonnes. So, that is the production found from one bucket wheel excavator. So, this indicates our production target is 12 million tonne, this is nothing but 12 million tonne.

So, that means you have to produce 12 million tonne, we have to produce 12 million tonne. So, 14 million tonne is produced by one machine. So, 12 million ton is less than that. So, obviously our number of bucket wheel excavator required for lignite excavation is one number and that is satisfied to produce this 12 million tonne. So, this is for the lignite.

Now let us look how many number of bucket wheel excavator is required for OB, as in OB this rpm is reduced to 3. So, for OB the production requirement is B_c into N into F_f into rpm by S_f , so it is coming 1.4 into 14 into 0.6 into rpm is 3 and S_f is 1.2. So, this is 2, this is 7. So, this is 21 into 1.4, so that is coming. So, this is coming around 29.4 meters cube. So, we need not to change it to the tonne. This is the insitu centimetre cube. This much OB is handled in 1 minute, so you need to multiply with 63 hundred. You will get 29.4 into 60 into 3000. This is the meter cube per year can be handled by the bucket, one bucket wheel excavator.

So, what is the requirement? Our requirement of excavation of overburden is 5 into 12 into 10 power 6, this is the meter cube of material to be handled by the mine every year. So the number of excavator required, 5 into 12 into 10 power 6 divided by 29.4 into 60 into 3000. So, if we are doing this, so whatever is coming, this is that is the number is required. So, I think this is coming around 10 or something like that. So, let us look into the detailed calculation in the next slide which is provided.

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Tutorial -III
 BWE of Neyveli Lignite Mine having 14 buckets, each of 1.4 m³ capacity, and operates at 5 rpm for cutting lignite and 3 rpm for cutting overburden. If the target production of the mine is 12 million tonne with a stripping ratio of 5 m³ of OB per tonne of lignite, determine the number of BWE required for OB and Lignite.

Bucket capacity (m ³) =	1.4
No of buckets in the wheel =	14
Wheel rpm in lignite =	5
Available hours in year =	3000
Bucket fill factor =	0.6
Swelling factor =	1.2
Density of Lignite (tonne/m ³) =	1.6
Wheel rpm in OB =	3
Lignite production (tonne/year) =	12000000
Stripping ratio =	5

Production lignite (m ³)/min =	49
Production lignite (tonne)/min =	78.4
Yearly lignite Production (tonne)/year =	14112000
No of BWE for lignite =	1
Production OB (m ³)/min =	29.4
Production OB (m ³)/year =	5292000
No of BWE for lignite =	12

Capital require = Price x [Lignite + OB]
60 x 10⁶ m³

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So, you can see the production for lignite is 49 meters cube, which is coming 78.4 tonne. So, this is the production achieved from one bucket wheel excavator, which gives the number of bucket wheel excavator required for lignite is 1, production requirement in OB production we are obtaining from OB is in meter cube, 29.4 meters cube per minute. OB required to be handled 5 into 12, so that is coming around, I think there is some problem with this.

So, 5 into 12 it is coming around, say 660 into 10 to the power 6 meter cube and if we are dividing it with this, so whatever value is coming, I think this value is a little bit wrong here. So, whatever value is coming, that will be the number of bucket wheel excavator required for overburden handling. So, that is why you have to find out the capital requirement: is the price of each bucket wheel excavator multiplication required. The number for lignite plus OB is the capital requirement.

So, this is the in a nut cell, this is more or less about the production performance, determination of the number of machines and determination of the number of machines, determination of capital requirement and production target cost of excavation. These are calculated in this case and these are more or less all about the excavation with bucket wheel excavator. We will continue with the next topic in the next class. Thank you.