

**Mining Machinery**  
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**Module - 10**  
**Lecture - 52**  
**Endless Rope Haulage**

In our last class, we have discussed about the general introduction of the Rope Haulage, and there we have talked about this Endless Rope Haulage. This which is most commonly used in our Indian coal mines.

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The slide features a blue header with the title "Endless Rope Haulage". Below the title, there are two diagrams. The top diagram shows a cross-section of a haulage system with a rope and a chain. The bottom diagram is a plan view of a haulage system with various components labeled. The text on the slide includes the following:

**Objectives:**  
Study of Rope Haulage for Underground Mine Transport

*Rope haulage is the means of moving loaded and empty mine cars by use of wire rope; generally used on steep inclines where use of electric mine locomotives is inefficient.*

The slide also includes the NPTEL logo at the bottom left and a navigation bar on the right side.

So, let us just go through quickly about what this endless rope haulage is. That one you have already you have studied that rope haulage. In any rope haulage, we are having a rope. Here we are showing an over rope, and in that rope our cars are connected with the help of a chain

that is they are couple together, cars, mine cars are couple together running over this rails and then your chain by chain you are connecting it to the wire rope or by some clip or that lashing it is done.

And now this system in an endless rope haulage system this is this rope is exactly connected on a return (Refer Time: 01:36) and then there will a; there will be a drive. So, then you can see here how it is being connected to the main haulage road. There it is bringing and then this rope one is your you can see this is one track, this is the loaded track is coming over here, and here you will be doing all the that is your empty canal shaft could be somewhere here, and then this written these empties will be going down hike like this.

So, you can see in an endless rope haulage these rope system at the end. So, this was connected here and this track is there, so it can be just coming over here, it will get detached from the rope and then you can pull it here. And again it will be attaching to the rope over here. So, that rope is endlessly moving and then your cars are being connected.

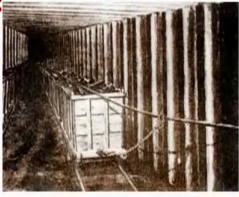
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**After going through this lesson you will be able to:**


- Determine the power required to drive Endless Rope Haulage

**Endless Rope Haulage:**

- This system consists of double track, one driving pulley & one return pulley.
- An endless rope passes from the driving pulley which is situated at the inby end & back again to the driving pulley.
- One track is used for loaded tubs & another track is used for empty tubs.
- Rope moves in one direction only with the speed of 3-7 kmph.
- Only one train of tubs is attached to the rope at a time but some times a set of tubs can be attached to the rope.
- The system is used where the gradient is less, generally less than 1:12 or where the ground is undulating.
- A squirrel cage motor is commonly employed.



OVER ROPE SYSTEM  
rope passes over the tubs



So, your in this system, we will be determining how the power required in a that is our main objectives today to do some calculations on the basis of this. So, this endless rope haulage it is a as we have already discussed it is consists of double track one driving pulley and one return pulley. So, if we somebody ask what are the main components? Very simple double track is required one driving pulley and one return pulley.

And then the driving pulley, it could driving drum whatever the case maybe. Then an endless rope haulage passes from the driving pulley which is situated at the inby end back again to the driving pulley. And then one track is used for loaded one, other track is used for the empty one.

Rope moves in one direction only with a speed of 3 to 7 kilometer per hour. And only one train or tubs is attached to the rope and at one time, and sometimes a set of tubs can be also

attached to it. So, the system is used where the gradient is less that is your 1 is to 12 gradient you can use. You can just see that difference with that in the direct rope haulage, you can work with a very steep gradient also.

And then if it is a type of motor which is used for driving this endless rope is your squirrel cage induction motors are used.

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**Advantages of Endless Haulage**

- 1) Because of slow speed, less wear & tear to the tub wheel & track.
- 2) Less maintenance is required.
- 3) Accidents do not cause much damage.
- 4) Less motor power required.
- 5) Continuous flow of mineral or coal is attained.

**Disadvantages of Endless Haulage**

- 1) It requires wider roads.
- 2) Not suitable for Steeper gradient.
- 3) Load on the rope is large hence a rope of large cross section require.
- 4) Large number of tubs & clips are required.
- 5) It cannot serve a branch road.
- 6) Extension is not simple.
- 7) Minor injuries to hands & feet are common.

The diagram illustrates the mechanical components of an endless haulage system, including a motor, clutch, and tensioning arrangement. It shows a rope loop with tubs (labeled 'Loaded' and 'Empties') and a 'Clifton Pulley' at the top. A 'Tensioning Arrangement' is shown at the bottom, and a 'Brake' is located near the motor. A small video inset in the bottom right corner shows a man in a dark vest and glasses speaking.

So, we have already discussed in our previous class that advantages and disadvantages of this endless rope haulage system is because of its low speed wear and tear is less. So, maintenance requirement is less, and a accident even if takes place sometimes their damages are not much, then your less motor power is required and a continuous flow of mineral or coal can be getting because all the time the rope is moving, so you are connecting.

So, it is coming, though it is given in a batch we cannot say it is a continuous operation because the material coming at sequence at a different interval, but the rope is running continuously. But the disadvantage is, it requires a wider road and it is not suitable for steeper gradient. So, if someone ask that what type of haulage system rope haulage system will be used if your seam is inclined in say 1 in 7, 1 in 6.

So, in that case your endless rope haulage cannot be (Refer Time: 05:14), direct rope haulage is main and tail rope haulage can be used. Now, load on the rope is large, hence a rope large cross sections is required because there is as you I told you in the previous class that more number of cars can be connected over there at any time.

There will be one loaded train on empty train, and then this because of that the rope will have to take more load and as you and studied in your wire rope calculations, if the more load is to be taken the wire rope diameter will increase. If the rope diameter is increased; that means, more metal is there, its self-weight is increased, more power is required. So, on and the other disadvantages will be coming.

Now, and then it is exactly when the road are branching out at that time you cannot do it very easily. Then, it cannot serve branch road and then extension is possible, but not very simple that is your the rope connecting and other things will be there. Then, because this rope if it is in a under rope, that any time if it is going out of the road where the people are walking by the side and then this rope may sometimes say hit the people and accident take place.

If you study some of the case studies of underground mine accidents, you will find that is a hit by the moving rope is a very common accidents that takes place.

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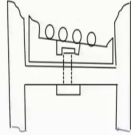
**Driving Pulley or Surge Wheel**

**Types of Driving Pulley & Surge Wheel**

- 1) Clifton pulley.
- 2) V-grooved pulley.
- 3) Foulers pulley.

**1) Clifton Pulley:**  
This pulley has tapered throat lining of renewable cast iron or soft steel segment having a taper of about 1 in 8. These segments are bolting to the rim to protect the main pulley from wear. The rope is coiled several times ( $3\frac{1}{2}$  -  $4\frac{1}{2}$ ) around the pulley & it enters the pulley at larger diameter & leave the pulley at smaller diameter. This pulley is commonly used in mines in endless haulages.

**2) V-Grooved Pulley:**  
This pulley consists of two segments made of renewable cast iron or soft steel. These segments are bolted to the main pulley in V shape. The rope takes only a half turned around the pulley & takes the necessary grip by becoming wedged between the two inclined segments. The grip on the rope is directly proportional to the




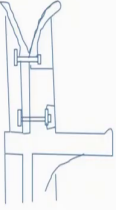
So, what exactly we have said that as you can see here there is a main called Clifton pulley. This is that most important thing for the drive this drive component can be of different types. There are called Clifton pulley, V-grooved pulley, and foulers pulley, that type of different type of pulleys are there.

So, this is a Clifton pulley which is as a tapered throat lining, and then there is a very soft segments. As you can see here also that you are a taper that is a where the loaded one where it is coming over there empty one going like this, but there is a tapered pulley that type of pulley is call your Clifton pulley.

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**V-Grooved Pulley:**

- This pulley consists of two segments made of renewable cast iron or soft steel.
- These segments are bolted to the main pulley in 'V' shape.
- The rope takes only a half turned around the pulley & takes the necessary grip by becoming wedged between the two inclined segments.
- The grip on the rope is directly proportional to the tension in the rope.




Similarly, a V-grooved pulley, a in a V-grooved pulley our there is a as the load is there that rope can be accommodated over here. So, this is a type of pulley which is used. And that there exactly two segments are there, and they are bolted together that is a bolted together and connected like this. So, that is the grip exactly if that more tension is there they will be just gripping it tightly. So, that is how a how it works.

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**Fouler's Pulley:**

- It consist of number of bell shaped pivoted segments made of renewable cast iron or soft steel.
- These segments are pivoted to the main pulley as shown in figure, the pressure of the rope on bottom of the segment towards each other so that they grip the rope in proportion to its tension.



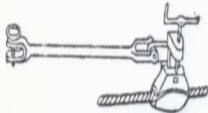
So, now there is a fouler pulley in which number of this is a bell shaped pulleys are there and they are just exactly connected to the that is your on your the main part you are just connecting this bell shaped one. Now, why it is a separable? If any wear and tear take place it will take place of the this portions, you take it out and connected another one and you can go on using.

But if you are having the only one sheave on which this rope will be moving, then what will happen? Because of this friction between the rope and that sheave then sheave will have to be replaced. So, now here only this your the upper portion it will be replaced, so that main thing, that main shaft and is a main pulley it does not get replaced. So, this type of different type of systems are there.

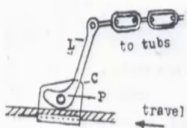


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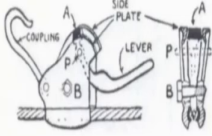
**Types of Clips**



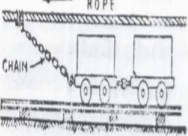
Screw clip



Cam clip



Small-man clip



Lashing chain

- 1) Screw clip.
- 2) Small-man clip.
- 3) Cam clip.
- 4) Goose neck clip.

**Smallman Patent Haulage Clip**  
21 Sizes to suit all conditions.  
Automatic Detachment  
Perfect Adjustment  
Maximum Grip  
Instant Release  
Light Weight

<http://gujaratmining.blogspot.com/2017/10/rope-haulage-notes.html>

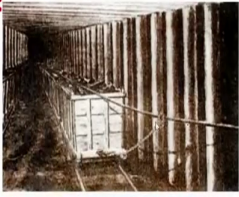
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OVER ROPE SYSTEM  
rope passes over the tubs



Now, the second thing is as you have seen in the previous diagram as a here this ropes it will have to be connected say this is your over rope, now this chain which is connected to the tub here and then it is connected to the rope here. Now, this connections is done by different types of your this clips. This is the rope where there is a screw type of clip is there, you can see that there is a two part in between you just turn this one it will tightly grip over here. You open you take it out. So, this is a screw clip.

There is a cam clip by which exactly a cam management is there and then it get when because of this movement whenever the load will be coming through this it will be pulling in these directions and it will get tightly gripped over here. So, when this rope is moving like this and then your this tub which is being pulled, so that load of this it will make these cam portions will give a tightly connected to this.

And then the detaching is very simple. If you make it move it in the opposite direction if you will just pull it this directions it will come over here, the grip will be released, so you can take out of that. So, you just appreciate the engineering involved over here. There is a simple mechanical engineering, simple machine principles are used and the things make it and that work in shape.

So, now, there is another that is a clip which is call your small-man clip, which is having this your liver system by which exactly that when your you will be coupling to on that the tub or car will be connected to this one and then automatically this side plates will be giving a grip onto this rope and that is the how the small-man clips are there. So, a lashing chain, so this chain will be connected to this, that is a lashing chain type of connections are there.

So, there are this cam, lashing chain, screw clip, small-man clips, these are the very much used over here. And that you can see that small-man clip inside that how it is there, with that help of this liver exactly this portions whenever the load will be connected over there they will be giving a grip to the rope.

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A train of mine cars having a weight of 50 tef is attached to a **direct haulage**. The speed of the haulage is 9 kmph. The inclination of the haulage road is 1 in 10. Length of haulage plane is 1000 m. The coefficient of friction for the mine cars is 1/50 and that for the rope; it is 1/20 . The rope weight is 2.73 kgf/m. Calculate the power requirement of the haulage engine.

**Solution:**  
**Forces acting on the system.**  
1.Gravity component of the weight of the tubs and ropes.  
2.Frictional resistance of the tubs and the ropes.

1.Gravity component of the weight of the tubs $50 \times 9.81 \times 1/10 = 49.05 \text{ kN}$ (A)	3. Friction force for the mine cars: $50 \times 9.81 \times 1/50 = 9.81 \text{ kN}$ (C)
2.Gravity component of the weight of the rope $2.73 \times 1000 \times 9.81 \times 1/20 \times 1/1000 = 1.34 \text{ kN}$ (B)	4.Friction force for wire rope $2.73 \times 1000 \times 9.81 \times 1/20 \times 1/1000 = 1.34 \text{ kN}$ (D) Total force = 62.88 kN

Power =  $62.88 \times 2.5 = 157.2 \text{ kW}$  Making an allowance for the rotating parts (=25%) and taking efficiency as 90% We get the power of the motor as 225 kW (say)

So, now I think you can do that whatever the basic principles you have learned on that you can take up a small numerical say a train of mine cars having a weight of 50 ton force is attached to a direct haulage. The speed of the haulage is 9 kilometer per hour given, and the inclination of the haulage road is given 1 in 10.

Now, the length of the haulage plane is given 1000 meter and the coefficient of friction of the mine car is given as a 1 is to 50 and that your that of the rope it is 1 is to 20. Now, the rope weight 2.73 kgf per meter. So, that is the weight of the rope per meter. Now, you will have to calculate the power requirement of the haulage engine. These apply your school day physics and you can find it out.

So, what are there? The what are the forces acting on the system you will need to separately calculate out, one force is your gravity component that is the weight of the tubs and the rope

that will have to be overcome by the your; what are that is exactly, one basic principle is you need to find out the tractive effort. That is say what is the total tensions or whatever the tractive effort coming over here.

And if you know that is in kgf or Newton that whatever the total kgf or Newton is coming and then if you multiply by the meter per second at speed Newton meter per second is Watt. So, you can find out that will be the required power. Now, that required power the motor we will have to give.

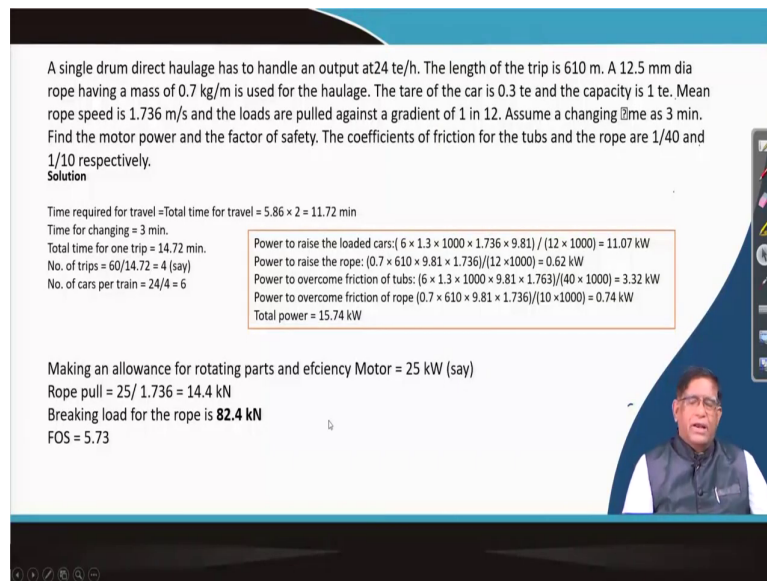
But for that the motor efficiency could be that something showed that what will have to do if the motor is efficient say 90 percent, then by whatever that what you are getting divided by 0.9, you will find that what should be exactly the minimum rating of the motor or the power you will have to use. Because if you use less then that then this motor will not be able to draw your system. So, that is there.

So, from the given things you have got a 50 ton force. That means, how much Newton? And then it is working inclination is there, so you are getting the total this much kilo Newton it is coming and then your gravity component of the wire rope it is working which is a coefficient of friction is working over here. So, you can overcoming the total, you are getting this much Newton that is your gravity component.

And then the friction force on the mine car that is separately you calculate and the friction forces on the wire rope you calculate. So, what is the total force coming you are getting that. So, the total force and then the velocity you multiply you get that total power which you are getting.

So, and then once you are getting this much you give some allowance because some additional things will have to be there because of the efficiency of the motor and then you can suggest a power. So, that means, that some of the assumptions you will have make here you have given an additional 25 percent you can say the motor power, you can say as a 70 percent or you can say 80 percent depending on that you can do it.

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A single drum direct haulage has to handle an output at 24 te/h. The length of the trip is 610 m. A 12.5 mm dia rope having a mass of 0.7 kg/m is used for the haulage. The tare of the car is 0.3 te and the capacity is 1 te. Mean rope speed is 1.736 m/s and the loads are pulled against a gradient of 1 in 12. Assume a changing time as 3 min. Find the motor power and the factor of safety. The coefficients of friction for the tubs and the rope are 1/40 and 1/10 respectively.

**Solution**

Time required for travel = Total time for travel =  $5.86 \times 2 = 11.72$  min  
Time for changing = 3 min.  
Total time for one trip = 14.72 min.  
No. of trips =  $60/14.72 = 4$  (say)  
No. of cars per train =  $24/4 = 6$

Power to raise the loaded cars:  $(6 \times 1.3 \times 1000 \times 1.736 \times 9.81) / (12 \times 1000) = 11.07$  kW  
Power to raise the rope:  $(0.7 \times 610 \times 9.81 \times 1.736) / (12 \times 1000) = 0.62$  kW  
Power to overcome friction of tubs:  $(6 \times 1.3 \times 1000 \times 9.81 \times 1.763) / (40 \times 1000) = 3.32$  kW  
Power to overcome friction of rope:  $(0.7 \times 610 \times 9.81 \times 1.736) / (10 \times 1000) = 0.74$  kW  
Total power = 15.74 kW

Making an allowance for rotating parts and efficiency Motor = 25 kW (say)  
Rope pull =  $25 / 1.736 = 14.4$  kN  
Breaking load for the rope is **82.4 kN**  
FOS = 5.73

Another problem you can just say a single drum direct haulage has to handle an output of say 24 ton per hour. The length of the trip is 610 meter, 12.5 millimeter diameter rope having a mass of 0.7 kg per meter is used for the haulage. The tare of the wear car that is 0.3 ton, 0.3 ton weight car and the capacity is 1 ton. Mean rope speed is 1.736 meter per second, and the loads are pulled against the gradient of 1 in 12.

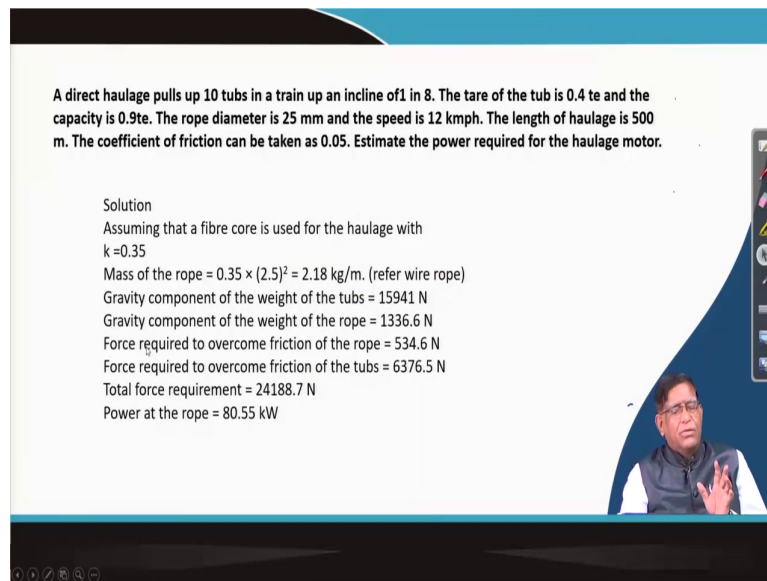
Assuming a changing time of say 30 meter. Find the motor power and factor of safety. The coefficient of frictions are given. So, if this data is given you can easily find out first find out what is the total time of travel, then you find out what is the total time for changing, and the total time mean one trip will be calculated out once you know the time; and the number of trips how many will have to be there in 1 hour. So, number of car per train how much. These are the basic informations you determine.

Now, for the power to raise the loaded car you can total resistance and the speed multiplications will be giving you the power to raise the rope, how much is the level differences it is coming from there you can find that. And a power to overcome the friction tub that also you find out. And then power to overcome the friction of the rope if you find the total power can be calculated.

So, this is just simply just like your in convert calculations is also we did, that is what is the running for the empty, running for the mass, running and raising for the this a mass that will be giving the total power.

And once you know that you can find out that if the motor power is one how much pull will be coming on to the rope, and then what will be the breaking strength of the rope, from there you can find out the factor of safety. So, this is how the rope calculations are made.

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A direct haulage pulls up 10 tubs in a train up an incline of 1 in 8. The tare of the tub is 0.4 te and the capacity is 0.9te. The rope diameter is 25 mm and the speed is 12 kmph. The length of haulage is 500 m. The coefficient of friction can be taken as 0.05. Estimate the power required for the haulage motor.

Solution

Assuming that a fibre core is used for the haulage with  $k = 0.35$

Mass of the rope =  $0.35 \times (2.5)^2 = 2.18$  kg/m. (refer wire rope)

Gravity component of the weight of the tubs = 15941 N

Gravity component of the weight of the rope = 1336.6 N

Force required to overcome friction of the rope = 534.6 N

Force required to overcome friction of the tubs = 6376.5 N

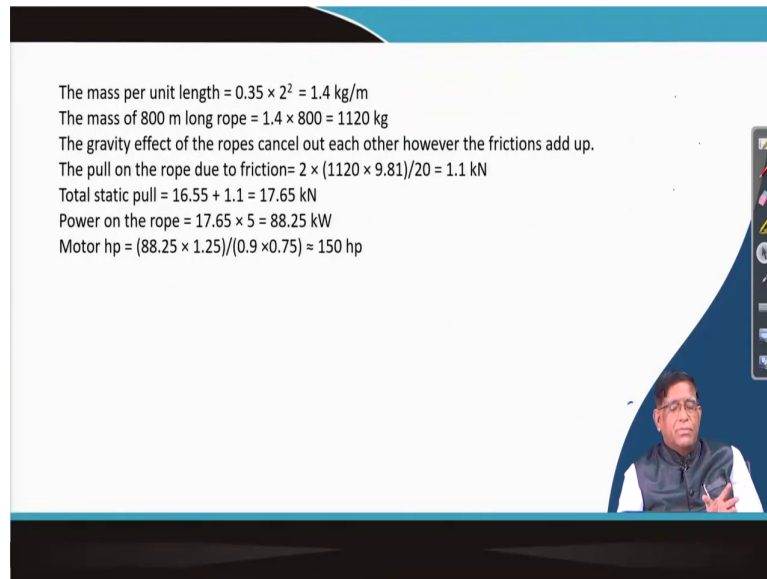
Total force requirement = 24188.7 N

Power at the rope = 80.55 kW

So, you practice some of these questions like, a direct rope haulage pulls about say 10 tubs in a train up and incline in 1 in 8. The data are given. Populate the data do the calculations. Practice such type of problem it will be good for you.



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The mass per unit length =  $0.35 \times 2^2 = 1.4 \text{ kg/m}$   
The mass of 800 m long rope =  $1.4 \times 800 = 1120 \text{ kg}$   
The gravity effect of the ropes cancel out each other however the frictions add up.  
The pull on the rope due to friction =  $2 \times (1120 \times 9.81)/20 = 1.1 \text{ kN}$   
Total static pull =  $16.55 + 1.1 = 17.65 \text{ kN}$   
Power on the rope =  $17.65 \times 5 = 88.25 \text{ kW}$   
Motor hp =  $(88.25 \times 1.25)/(0.9 \times 0.75) \approx 150 \text{ hp}$

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**CALCULATIONS FOR ENDLESS ROPE HAULAGE**

The number of cars ( $z$ ) required for a haulage capacity  $Q$   $\text{te.hr}^{-1}$  depends on the net weight ( $G$ ) of the car.  
It is given as:

$$z = \frac{Q}{G}$$

The time interval between the cars:

$$t = \frac{3600G}{Q}$$


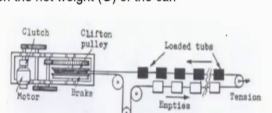
$t \geq 25$  sec for cars supplied to the rope by gravity  
 $t \geq 40$  sec for cars supplied to the rope manually

The conditions for the time interval are:

The distance between two cars is calculated as:

$$l = vt = \frac{3600Gv}{Q}$$

Number of car on each side of the endless rope is:

$$z = \frac{L}{l} = \frac{QL}{3600Gv}$$


Now, if you see that is a little bit of you can apply this physics develop a generalized equation. So, what exactly you will be working mainly that if you are asked that you develop a simple excel or a simple small program to do a rope calculations. So, how can you develop a small app to the mining engineer to do the rope calculations? All that principles you can derive, and then you can easily convert it to a small program or in a small app you can make it.

So, exactly if you are how many number of cars is required? Very simple. If you know the total capacity and if you know what is a total weight it can carry, so from there you can calculate the number of tubs. And then what will be the time interval between the cars? So, that means, see when a car is coming to that is you are connecting the tubs at different time.

Now, when it is coming and then the rope is going continuously. At the time where you are taking out the loaded tub for your loading to the case, that when you are taking it out after that this you will have to put it over there the second will have to come, whether the one persons can do their job or you will have to keep two persons will depend on at what interval they are connected.

So, that connection interval you can find out from their exactly how many time you will have to require and then from there you can find out this the distance between two cars. It will be depending on that what is the speed by which it is coming, and then what is the total time interval between the cars. If you know that you can find out this distance between these two, and then you can calculate out what will be the total number of cars along the whole length can be connected.

So, your; that means, from your one point to the end point the total how many number of cars at a time you can connect also be calculated. So, this is here in endless rope haulage you did not connect this as all as a train some time, you can just individually you connect it and it will go, unlike your in main and tail ropes.

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**Weight of Rope**

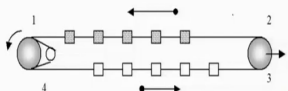

The initial tension ( $S_1$ ) in the endless rope is normally taken as 250-300 kg weight. The formula for determining the weight of the rope per metre of rope length is given as:

$$\rho = \frac{z(G + G_0)(W_E \cos \beta + \sin \beta) + S_1}{\frac{k}{m\beta^2\gamma} - L(W_E \cos \beta + \sin \beta)}$$

**Tractive Force and Motor Power** The tensions at ends are given as:  
 $S_1$ : 250-300 kgf

$$S_2 = (S_1 + \rho l + 0.1G)(W_E \cos \beta \pm \sin \beta) \quad \frac{S_2}{S_1} \leq e^{\mu\alpha}$$

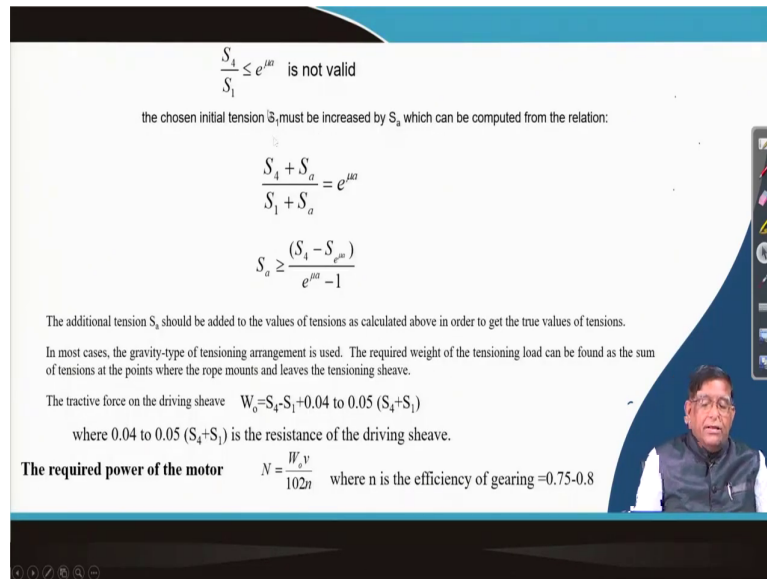
The Euler's law of friction should be used for verifying the absence of slip between the driving sheave and the rope  
 where  $\mu$  is the coefficient of friction between the driving sheave and the rope; and  
 $\alpha$  is the total angle of contact between the rope and the driving sheave.

So, then how you select the weight that is your weight of the rope, that is your selection of this density as I said in the previous class that same way you can calculate out the tractive force and motor power by knowing how much will be the this your total load coming onto the system.

So, that exactly here in a wire rope just like your conveyer calculations, that total tensions that rope will have to be maintained at say this ratio the maximum tension at the point 1 and the tension at that is your slack side tension at 4 their ratio is that your e to the power mu a, where a your angle of rap that is how this rope is connected over here. Now, sometimes this rope is giving a turnover here, so that your this angle is increase, so that this tension can be maintained over here.

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$\frac{S_4}{S_1} \leq e^{\mu\theta}$  is not valid

the chosen initial tension  $S_1$  must be increased by  $S_a$  which can be computed from the relation:

$$\frac{S_4 + S_a}{S_1 + S_a} = e^{\mu\theta}$$
$$S_a \geq \frac{(S_4 - S_1 e^{\mu\theta})}{e^{\mu\theta} - 1}$$

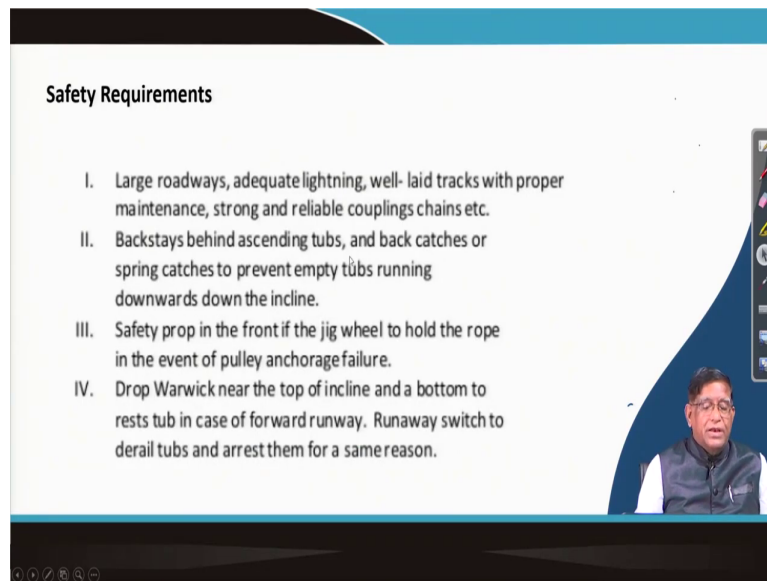
The additional tension  $S_a$  should be added to the values of tensions as calculated above in order to get the true values of tensions.

In most cases, the gravity-type of tensioning arrangement is used. The required weight of the tensioning load can be found as the sum of tensions at the points where the rope mounts and leaves the tensioning sheave.

The tractive force on the driving sheave  $W_0 = S_4 - S_1 + 0.04$  to  $0.05 (S_4 + S_1)$   
where  $0.04$  to  $0.05 (S_4 + S_1)$  is the resistance of the driving sheave.

**The required power of the motor**  $N = \frac{W_0 v}{102\eta}$  where  $\eta$  is the efficiency of gearing =  $0.75-0.8$

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**Safety Requirements**

- I. Large roadways, adequate lightning, well-laid tracks with proper maintenance, strong and reliable couplings chains etc.
- II. Backstays behind ascending tubs, and back catches or spring catches to prevent empty tubs running downwards down the incline.
- III. Safety prop in the front of the jig wheel to hold the rope in the event of pulley anchorage failure.
- IV. Drop Warwick near the top of incline and a bottom to rest tub in case of forward runaway. Runaway switch to derail tubs and arrest them for a same reason.

So, this if this chosen tension you will have to collect that to say exactly the different tension when you are connecting over there that is your this conditions which will have to be maintained for the wire rope to be working smoothly and the power to be transferred, so that it can do the work without any trouble. So, this connection is there.

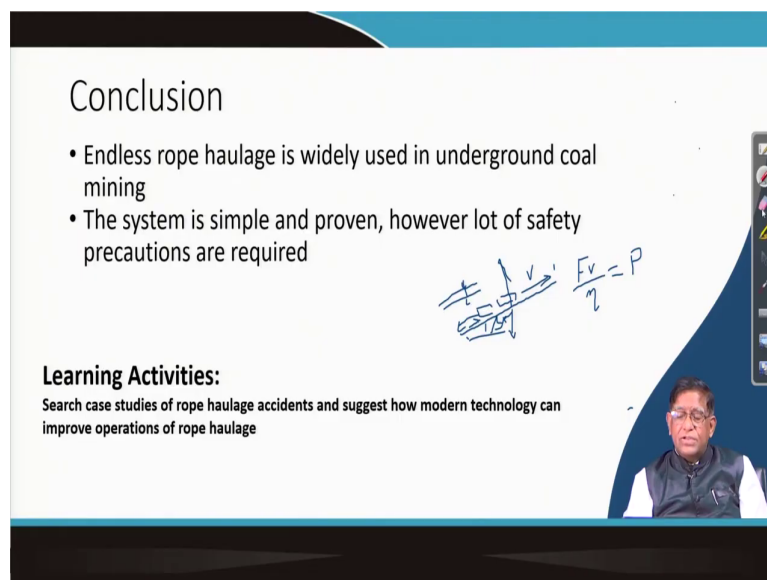
So, the tractive force on the sheave what will be coming it can be calculated by using this formula and then your required power of the motor can be calculated. Once you know that motor power, then your exactly whole you can prescribe that what will be what type of motor and all will be connected. So, that is a basic endless rope calculations simple one. And then a safety requirement is a very very important thing. So, you will have to maintain the gallery.

So, that the main problem is the people who will be working and then travelling around they should not be getting affected. Now, there are some devices called backstays. So, that is

exactly if a number of cars are going over there at the backside there will be a rod, so that if it is sliding down the a gradient it will be stopping over there. Then there will be the safety props.

Then another system called drop Warwick that is how it will have to if that any train a number of in a direct rope haulage say, a number of trains are coming down then there will have to be a safety device, so that it will stop over there. So, in your coal mining methods you will be studying about those things.

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**Conclusion**

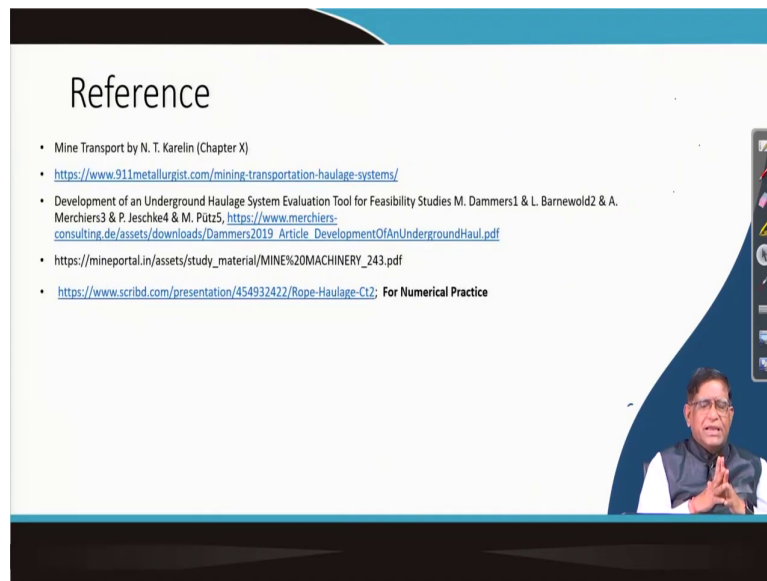
- Endless rope haulage is widely used in underground coal mining
- The system is simple and proven, however lot of safety precautions are required

**Learning Activities:**  
Search case studies of rope haulage accidents and suggest how modern technology can improve operations of rope haulage

$$Fv = P$$

The slide features a diagram of a rope haulage system on an inclined plane. A hand-drawn sketch shows a rope passing over a pulley system, with a car on the incline. A velocity vector  $v$  points down the incline, and a force vector  $F$  is shown at the end of the rope. The equation  $Fv = P$  is written next to the diagram. A small video inset in the bottom right corner shows a man speaking.

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Reference

- Mine Transport by N. T. Karelin (Chapter X)
- <https://www.911metallurgist.com/mining-transportation-haulage-systems/>
- Development of an Underground Haulage System Evaluation Tool for Feasibility Studies M. Dammers1 & L. Barnewold2 & A. Merchiers3 & P. Jeschke4 & M. Pütz5, [https://www.merchiers-consulting.de/assets/downloads/Dammers2019\\_Article\\_DevelopmentOfAnUndergroundHaul.pdf](https://www.merchiers-consulting.de/assets/downloads/Dammers2019_Article_DevelopmentOfAnUndergroundHaul.pdf)
- [https://mineportal.in/assets/study\\_material/MINE%20MACHINERY\\_243.pdf](https://mineportal.in/assets/study_material/MINE%20MACHINERY_243.pdf)
- <https://www.scribd.com/presentation/454932422/Rope-Haulage-C12>; For Numerical Practice

So, basically your endless rope haulage system is a widely used in underground coal mining and this system is very simple and proven. And then mainly you will have to just maintain at safety. So, as a though it is a very simple system you can think of some of the monitoring depending on the situation.

So, a learning activity here is such case studies of rope haulage accidents, and suggest how modern technology can improve operations of rope haulage. The modern technology means, how exactly you can do a monitoring and then how you can exactly improve. Say for example, that is the rope requires changing or not, that is the rope ok.

So, you can have some testing devices on the roadsides it will be scanning and finding out if there is any damage of the rope is taking place. Then, your there are that exactly wherever there is a guide roles are there is the rope coming out of the guide role near to the guide role



from the top you can have a scanning systems by which that will be telling and giving an informations that there is a exactly the it is not properly going or the guide route has got worn out.

When the sheave is on that you are you are having say for example, in at that pulley there is a liner, on that liner if it get damaged then sometimes the pulley will have to be damaged. So, that conditions can be monitored. So, like that there could be number of things.

So, what are the basic things you need to do is say in any these inclinations whenever you are having this mine cars will be moving, then you need to find out that exactly depending on this angle your how much exactly the force is getting into these directions and then how much is your this normal reactions, and then how much this pulling force will be coming up over there because of there is a resistance to motions in these directions, and then your weight is in this directions.

So, all the component you separately calculate it out and then you can find out what is your exactly basically the tractive effort or the force by which you will have to be applied into the motor. And then if you know that velocity then you can just find out that this is your that Newton meter per second, and then if you can find out the efficiency of your motor you can get the motor power.

So, that means, once you know this motor power then you can find out what will be the that is if that much force this will give also that rope that what should be the diameter of this rope and your selection.

So, this is the basic calculation part. And then after that it should operate trouble free. There you can think of your innovative way, so that the stoppages of the system due to the, that operational trouble you will have to find out by the mining history and then you develop a new device and that can be used.

Now, you can also suggest that what should be the that is your house keeping how that the whole thing can be arranged in underground mine, that will exactly if you see some mines in

the field you will be able to prescribe and that is what is expected from the new generation of mining engineers. That is the working conditions and quality of life in underground will have to be improved and there you should feel a sophisticated operating condition.

For that at present wherever you can see that the people working by the site should feel that that is nothing will happen. So, that means, in underground that is while by the operation of the rope itself can it be changed that is you can think of on that some innovative ideas which are always welcome.

And then for that you read some of this, and then particularly these references where all the numerical practices you can do it number of; I have taken the numericals in that from that. But what I found those numericals are somebody has put it over there it was a Norman Brooks, a very old is book is there *The Mechanics of Bulk Solid Handling*.

In that book of Norman Brook, he has given the theory very simple and simplistic manner which is a very good for becoming a become an engineer. And to look into the problems from the engineering perspectives you should read that Norman Brooks book which is of course, nowadays I think it is an obsolete book you may not find but what I found those website link which I have given here, they have exactly all that material which are there in that book the numerical and all, somebody has very nicely put it over there.

So, I suggest you please go through that, and then start thinking of producing your own that is what I have said as a how can we improve this our 100 years old technology of rope haulage by applying modern technology, particularly for the monitoring and for the trouble free operations, so that no mining accidents can take place.

Thank you very much.