

Mining Machinery
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Module - 02
Lecture - 04
Belt Drives, Chain Drives

Welcome back to our discussions on Mining Machinery. We have been talking about mechanical power transmissions.

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Belt drives, chain drives

After going through this lesson you will be able to:

- Explain the basic principles of Belt Drive and Chain Drive
- Solve simple drive calculation.

Motor
Belt Drive
Chain Drive
Driven Mach

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And, in this today you will be knowing about two types of drives that is belt drive and chain drive. So, after this class you will be able to explain the basic principles of belt drive and solve some numericals based on this applications of belt drive and chain drive.

As you can see here that we are having this two types of drive systems here, this portion is showing your what is our belt drive and here you can see this your this we are having our chain drive. In this chain drive and belt drive, basic difference is here from the electric motor you are transferring the power to a belt and from there you are going to a whatever the drive systems you are having.

You may have from this belt that from the electric motor the power has been transmitted to this belt and from this belt it is going to this your chain and from that chain to the machine which is being driven.

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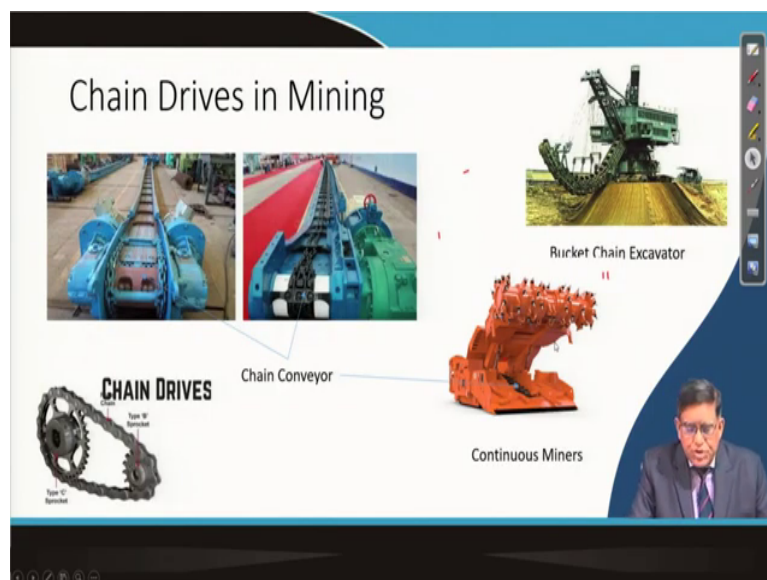


So, this basically what we do is our main purpose of this system is a to drive. As you can see here in this some of the applications simple you might have seen your rice mill near your town where there is a electric motor is giving and the power is being driven by belt drive over

here. There also you can see a conveyor belt is being used to drive that belt. There is a pulley on that exactly the electric motor, there it is connected with a belt and this just like a your a belt is running over here.

Similarly, that number of drives number of machines or number of shaft can be driven by when your this one that shaft which is connected to electric motor has got number of belt and which is going to drive number of shafts. So, these are the some of the things you can see.

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Similarly, the chain drive in place of blade that your belt you are having the chains. In mining industry there are number of places where you can see this chain drive that the chain is used for conveying purposes. You can see that here that electric motor is giving the power through your gearbox to the sprockets of the chain in chain conveyors.

In some machines like continuous miner there also once this drum is cutting the material and then that will be falling on through this your collecting the material and there is a chain conveyor chain drive is there which will be giving it to this. Similarly, there is a bucket chain excavator that whole boom there are number of buckets are connected to the chain and the chain drives this bucket for collecting the material and that that is a big machines are being used by using this drive systems.

But, basically you know you all have seen your bicycle has also got a chain drive. A chain drive is nothing, but it has got a chain and then two sprockets by which exactly you drive this there is just like you say here as a pinion and then the gear. In case of your gears here also you are having one small sprockets one bigger sprockets and then we are getting some velocity ratio of these stripes.

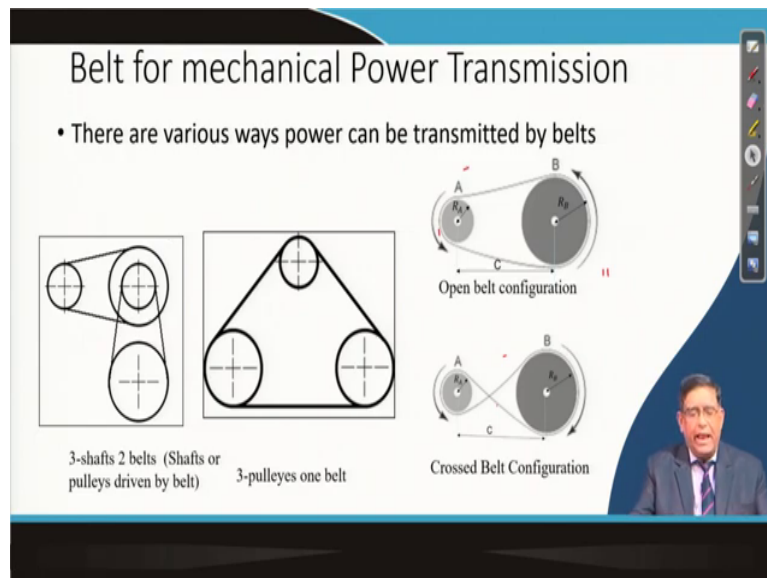
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Mechanical Power Transmission

- In case of mechanical power transmission, the working member receives the energy from the energy source by a series of mechanical linkages of components like shafts, couplings clutch, gears, belts, rope, chains, brakes etc. Thus in a mechanical power transmission power is transmitted from the shaft of the engine to the shafts of the working member.

So, similarly when we talk in a general way you know that mechanical power transmissions it is taking place by using number of components. In our last class, we talked about that this shaft, couplings, clutch, gears they are used; now, these ropes are also used over here.

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So, now, in this system exactly that your belt power, belt for mechanical power transmission systems can be arranged in a different way depending on the purpose, depending on this type of things you might have seen some of the fan belt in case of your if you have opened up in your cars hood or you can see that is from the engine how the fan is driven by a belt drive.

And, there are there could be your two belts and three shafts are there connected together. Sometimes by one belt itself three shafts are three pulleys are connected together. Now, these belts can be given as an open belt configuration or crossed belt configuration. Now,

depending on the use and then how the mechanical design goes this type of things you can see in different machines.

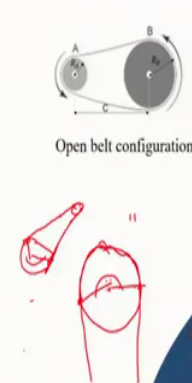
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The Angle of Wrap


$$\theta_A = \pi + 2 * \sin^{-1} \frac{R_A - R_B}{C}$$
$$\theta_B = \pi - 2 * \sin^{-1} \frac{R_A - R_B}{C}$$

where:

- θ_A is the wrap angle of pulley A.
- θ_B is the wrap angle of pulley B.
- R_A is the effective radius of pulley A.
- R_B is the effective radius of pulley B.
- C is the distance between the centers of pulleys A and B.



Open belt configuration



Now, there is one thing is very important here you need to know about the angle of wrap. So, basically when we are having a belt drive that is your belt is running over there so, this is your when a belt is going like this it is connecting with the pulley and then there is a center it is suspending an angle. This angle is called your angle of wrap.

And, this angle of wrap can be that is calculated at or it depends on this in type of in this type of your belt drive system there is for two pulleys are there; here pulley and this is a bigger pulley. And, in that pulley A and pulley B their angle of wraps it is can be connect calculated by this equations you can see here.

The difference is that is your here it is a little less here this angle of wrap has increased because when it is going from the bigger one to a smaller one exactly while it is going it is leaving at a this area. So, that is why this angle get increased, but here it get decreased.

That is why these equations you can remember that is the differences of the radius and then depending on that what distance of separation between these two that affects the angle of wrap. And, this angle of wrap has got a lot of importance regarding that how the tensions will be coming on into the different belt.

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Angle of Wrap

In the crossed configuration, the two wrap angles are equal and the wrap angle of the belt around each pulley is

$$\theta_A = \pi + 2 * \sin^{-1} \frac{R_A + R_B}{C}$$

So, one thing you need to know here that if we see here this angle of wrap can be for your cross belt and for your this both the configurations it is the same that is your in case of this configurations your cross belt configurations this is calculated by means of this.

So, here exactly in your smaller that your pulley also you are increasing the angle of wrap by giving this method. So, in this way your angle of wrap can be changed in case of your cross belt.

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RATIO OF BELT TENSIONS

A flat belt around a pulley with the angle of lap, θ and T_1 and T_2 are the tensions in the belt when it is about to slip.

If the tensions at the ends of an element subtends an angle $d\theta$ at the center and T and $T+dT$ are the reaction between the belt and the pulley is R , then resolving forces radially, we get

$$(T + dT) \frac{d\theta}{2} + T \frac{d\theta}{2} = R$$

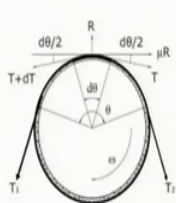
Therefore, neglecting the second order of small quantities

$$Td\theta = R$$

Resolving forces tangentially

$$(T + dT) - T = \mu R$$

$$dT = \mu R$$

$$dT = \mu T d\theta$$


$$\frac{dT}{T} = \mu d\theta$$

$$\int_{T_2}^{T_1} \frac{dT}{T} = \int_0^\theta \mu d\theta$$

$$\therefore \ln T_1 - \ln T_2 = \mu \theta$$

$$\therefore \ln \frac{T_1}{T_2} = \mu \theta$$

$$\frac{T_1}{T_2} = e^{\mu \theta}$$

Now, you can see over here, this how that belt tensions are coming. So, that means, when this belt is going around this pulley you are having that both the sides there is a tensions as this shown here T_1 and T_2 . Now, you know that whenever there will be another pulley like that when both of them are connected together by the belt the belt must be properly taut tensed.

Otherwise what will happen this the power transmission will not take place because here the power transmission is by the friction over here. To get the power transmissions this will have to be proper tension will have to be maintained.

Now, let us see here there is a there should not be any slip that is a power transmission. For that, no slip what is the conditions required? If you see here that is your if the tensions at the ends of the element subtends an angle your $d\theta$, then this tensions can be resolved into two components that is your T and then $T + dT$.

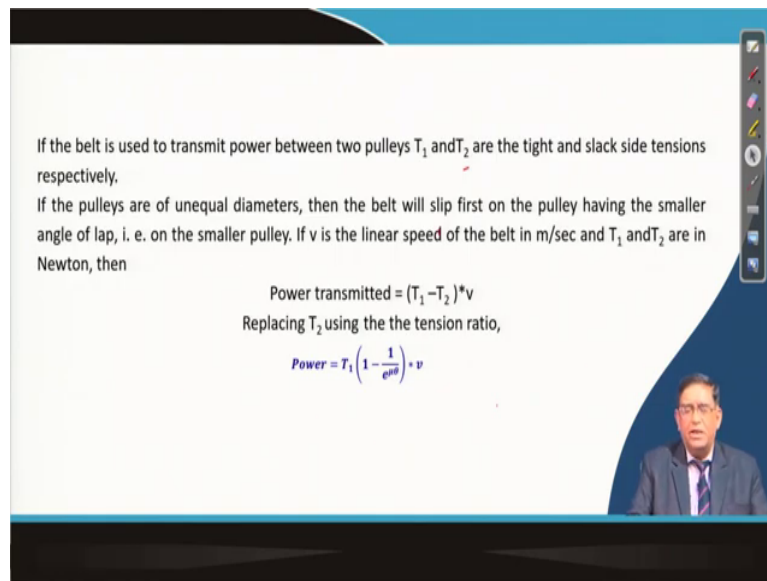
So, that means, from here it is coming over here slightly that it is getting tension increased and this part that is your if you see that resolve them into the force this is the reactions normal reactions. Then what it will be there? The relationship you can write down that $T + dT \sin \frac{d\theta}{2}$ and this together that all this your you are resolving them into this force.

So, these gives that if you now $d\theta \frac{dT}{2}$ this will be a very small infinitesimally small. That is why, your final thing will be $d\theta \frac{dT}{2}$ into $d\theta$ equal to R you can do this things. Then if you resolve it tangentially and what are those forces? Then this $T + dT \cos \frac{d\theta}{2}$ minus this T this is in the original directions it will be as a μR .

So, that ultimately what you are getting? You are getting this your that increase in that dT by this T equal to $\mu d\theta$. Now, if we integrate it and then between this two limits that is if we say that this tension has got exactly it is from T_1 to T_2 , then these integrations is giving you your \log of T_1 by T_2 ; that means, you are getting T_1 by T_2 is equal to e to the power $\mu \theta$.

This is exactly called Euler's equation and this equation is a very fundamental in all your belt drive related calculations. So, this tension ratio as you have seen this derivations that if it is your tight side and this is your slack side that T_1 by T_2 is equal to T_2 into e to the power $\mu \theta$ so that this part.

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If the belt is used to transmit power between two pulleys T_1 and T_2 are the tight and slack side tensions respectively.

If the pulleys are of unequal diameters, then the belt will slip first on the pulley having the smaller angle of lap, i. e. on the smaller pulley. If v is the linear speed of the belt in m/sec and T_1 and T_2 are in Newton, then

Power transmitted = $(T_1 - T_2) \cdot v$

Replacing T_2 using the the tension ratio,

$$\text{Power} = T_1 \left(1 - \frac{1}{e^{\mu\theta}} \right) \cdot v$$

If the belt is to be used to transmit power between two pulleys T_1 and T_2 and that tight and slack side tensions are given then you can calculate. Now, if they know how much power will be transmitted then. The power transmission is depending on that effective tension; that means, if your this T_1 is your tight side and T_2 is your slack side tensions, their difference is the effective tension by which it will get pulled in this direction.

Now, that effective tension into velocity that will be giving that much power will be transmitted. So, this once as you have got from the T_1 by T_2 is equal to e to the power $\mu\theta$ from that equation if you replace this T_2 here, you are getting the power is equal to this particular equation.

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Effect of Centrifugal Action

Let

- mass of belt = m per unit length
- radius of pulley = r
- speed of the belt = v
- centrifugal tension = T_c .
- centrifugal force acting on an element of the belt subtending an angle $d\theta$ at the center = F
- resolving forces radially,

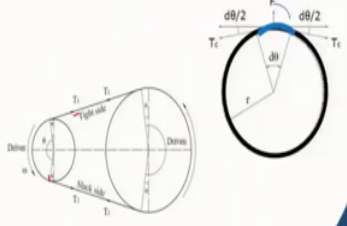

$$F = 2T_c \frac{d\theta}{2}$$

But

$$\text{Centrifugal Force} = \frac{mv^2}{r}$$

arc length, $s = r \cdot \theta$
 taking into your account mass of belt measured by mass per unit length (kg/m)

$$mr \frac{v^2}{r} = T_c d\theta$$

$$T_c = mv^2$$



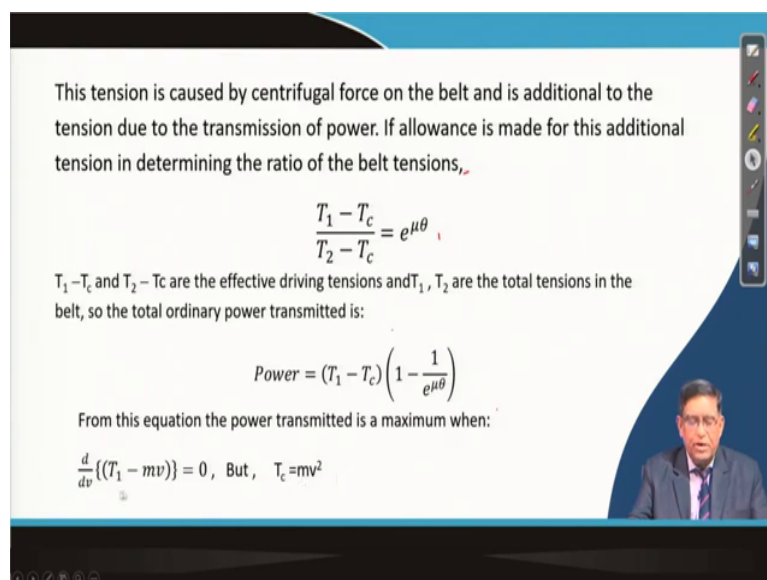
So, now the second question comes over here that there will be a centrifugal actions because when it will be rotating you know that there will be a centrifugal actions part of it.

Now, this will be depending on what is the mass per unit length of this belt, that is, your if you are taking this radius of that pulley is r and then the speed at which this belt is moving is at v and then let us take this centrifugal tension is T_c , then you can calculate that is exactly what will be the your that force which is coming over here F , this force can be calculated as this your twice this your this T_c part that is your centrifugal actions into that $d\theta$. This result; we can get it from the force resolution resolutions.

Then our centrifugal force which we know all of it is mv^2/r . Now, here this arc length which is there that is given by $r\theta$. So, from here if you just do a little bit of calculations you can find out that your centrifugal force is nothing, but mv^2/r .

This is also a very common equation. You might have done it in your earlier classes. But, this T_1/T_2 is equal to $e^{\mu\theta}$ and this centrifugal force is that is your coming centrifugal action given as a tension T_c is equal to mv^2/r .

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This tension is caused by centrifugal force on the belt and is additional to the tension due to the transmission of power. If allowance is made for this additional tension in determining the ratio of the belt tensions,

$$\frac{T_1 - T_c}{T_2 - T_c} = e^{\mu\theta}$$

$T_1 - T_c$ and $T_2 - T_c$ are the effective driving tensions and T_1, T_2 are the total tensions in the belt, so the total ordinary power transmitted is:

$$Power = (T_1 - T_c) \left(1 - \frac{1}{e^{\mu\theta}} \right)$$

From this equation the power transmitted is a maximum when:

$$\frac{d}{dv} \{(T_1 - mv)\} = 0, \text{ But, } T_c = mv^2$$

These two then this tension is caused by the centrifugal force on the belt and is additional to the tension due to the transmission of power because there was a because of the tensions in the belt we had got this T_1/T_2 . So, this coming into the boats that is why it is coming that if you consider the centrifugal action, the equations Euler equations will be changed to T_1

minus T_c by T_2 minus T_c that. What is this T_c ? T_c is nothing, but that mv^2 by mv^2 square r .

So, this T_1 minus T_c and T_2 minus T_c here this is the effective driving tensions and T_1 and T_2 are the total tensions, it is taken like that. So, that power required; that means, your total effective tensions will be coming the product of these two. So, this is the way how you can calculate out that power transmitted can be maximum when your the this if you resolve it their derivative will have to be 0. So, as our from their m value, we can put it from this equation that is your centrifugal tension is equal to mv^2 .

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$$\frac{d}{dv}((T_1 v - mv^3)) = 0$$
$$T_1 - \frac{mv^2}{3} = 0$$
$$mv^2 = \frac{T_1}{3}$$
$$T_c = \frac{T_1}{3}$$

The maximum power is then obtained by substituting this value of T_c and the corresponding value of v in the equation of the power.

So, if you put that value over here then you can get this the it will be mv^3 because of the value of the T_c has been put over here. So, then what it is coming? This is your if you take

the derivative of it ultimately the centrifugal tension is coming that maximum tensions into one third of it. So, this is the way how you can calculate it out.

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INITIAL TENSION

When the belt drive is selected, the belt must have an initial tension T_0 so that the power can be transmitted. During power transmission, the tension in the tight side increases from T_0 to T_1 and on the slack side decreases from T_0 to T_2 .

If the belt is assumed to obey Hooke's law and its length to remain constant, then the increase in length of the tight side is equal to the decrease in length of the slack side,

$$\Delta T = \Delta T$$
$$T_1 - T_0 = T_0 - T_2$$

Since the lengths and cross-sectional areas of the belt are the same on each side, then:

$$T_1 + T_2 = 2T_0$$
$$\therefore T_0 = \frac{T_1 + T_2}{2}$$

Now, how do you calculate this initial tension; initial tension that is when the belt drive is selected the belt must have an initial tension because if you do not have a initial tension then the you cannot drive it will be just slipping. So, now, this is because if you see that drawing where we have seen here your that both sides your this initial diagram you can see here that delta T.

This delta T part are remaining same if you consider that from the slack side and the tight side from the initial tension differences. Then from here we can find out that initial tension is nothing, but that will have to be the sum total of these two. So, that means, whenever we

make a tensioning arrangement in any belt or any belt drive that will be this much tensioning will have to be given initially.

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VELOCITY RATIO

When the thickness of the belt is NOT considered, the velocity ratio will be:

$$\frac{N_2}{N_1} = \frac{d_1}{d_2}$$

When the thickness of the belt is considered, the velocity ratio will be:

$$\frac{N_2}{N_1} = \frac{d_1+t}{d_2+t}$$

In case of compound belt drive, the velocity ratio is given by:

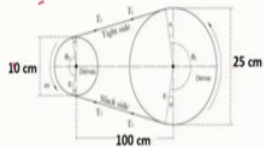
$$\frac{N_4}{N_1} = \frac{N_2}{N_1} \cdot \frac{N_4}{N_3} = \frac{d_1 \cdot d_3}{d_2 \cdot d_4}$$

So, the velocity ratio is the ratio of the say if your the driven pulley and the driving pulley their velocity is inversely proportional to their radiuses. This is just like in the gear also you had this, but if there is a you consider the thickness of the belt then this ratio will be considering the that T is the thickness of the belt.

So, if you are having a compound belt drive number of pulleys or number of drives are there then they will be just going on multiplying it over there. So, there is say for four pulleys are there – the ratio of the final drive one and that your initial drive one that will be given by the multiply of it. That simple calculations are there.

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The centers of two pulleys connected by a belt are 100 cm apart. The diameter of the larger pulley is 25 cm and that of the smaller one is 10 cm. Determine the length of the belt for open belt and cross belt applications (answer corrected to one decimal place).



From the figure,

$$L = \frac{\pi}{2}(25 + 10) + 2 \times 100 + \frac{(25 - 10)^2}{4 \times 100}$$

=310.6cm



So, now let us try to resolve this numerical problem that what it says the center of two pulleys connected by a belt of 100 centimeter apart. So, this is a two pulley. They are connected by this belt and their distance is 100 centimeter apart. The diameter of the larger pulley is given 25 centimeter and diameter of the smaller is given 10 centimeter.

So, now if you have to what will be the length of this that is your belt this belt length is a that is what is very important one because in any particular installations if you want to that select a belt drive you can have the that already there are number of belts or length of belts are available in the market. From there you want to select one and put it over here.

So, you need to know at what distance they will have to be separated and whether that ratio will be giving you the proper per requirement or not. So, that type of applications that is why you need to know in a particular installations how to calculate the length of the belt. And, this

length of the belt can be calculated from the just from the geometry you can find out that is your ultimately these equations will give you the belt length.

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As shown in the figure for open belt,

$$\alpha = \sin^{-1} \left(\frac{d_1 - d_2}{2x} \right)$$

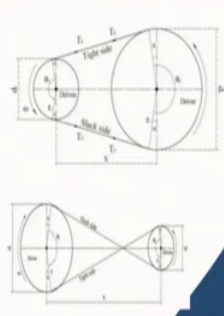
$$\theta_1 = 180 + 2\alpha$$

$$\theta_2 = 180 - 2\alpha$$

$$L = \frac{\pi}{2} (d_1 + d_2) + 2x + \frac{(d_1 - d_2)^2}{4x}$$

$$L = \pi (r_1 + r_2) + 2x + \frac{(r_1 - r_2)^2}{x}$$

The same equation is also true for cross belt as shown in Figure



Similarly, here we have got another problem that is you can calculate out that this lengths for different type of this as system. Say, exactly if it is for your open type or if it is a cross type, will the lengths of the belt will be different. That you can calculate by using this equations.

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An electric motor drives a 20kW machine part at 1750rpm using multiple V-belts. Groove angle = 18° and the unit mass of the belt is 0.215gr / mm. The pitch diameter of the motor pulley is 94 mm and the wrapping angle of the belt is 165° .

Calculate how many V-belts are to be used, assuming that the tension load in the belt is maximum 672 N and the friction coefficient is 0.20.

Given, Power: 20 kW,
Rotation speed 1750 rpm,
belt type, Groove angle $\beta = 18^\circ$, unit weight = 0.215 gr / mm,
Pulley diameter = 94 mm,
Angle of Wrap $\phi = 165^\circ$, $T_{\max} = 672\text{N}$ and friction coefficient $\mu = 0.20$

So, you can write down another problem. There is an electric motor drives a 20 kilowatt machine part of 1750 rpm using multiple V-belt. At a groove angle is 18 degree and the unit mass of the belt is 0.215 gram per millimeter. The pitch diameter of the motor pulley is given 94 millimeter and the wrapping angle of the belt is 165 degree.

Now, one thing you need to know here that is when it is a V-belt, V-belt is a different type of belt. Here exactly we are having the belt is normally the belt is of this cross-section. Now, when a V-belt it is exactly there will be a groove type of things exactly the belt cross-section is this type. So, that means, there is a groove angle is there this is called angle say beta.

So, then this your in a belt here T_1 by T_2 this will be given $\mu \theta$ by \sin of this beta. So, this is the belt tension in case of this your v belt that $\mu \theta$ by \sin beta, this portion is to be noted down. So, that means, whenever this calculation is coming for V-belt this which is very

common in use. Say for example, most of the power transmissions in your machines components you will be getting V-belt not that flat belt.

Now, this what is here in this particular problem it is given in this particular problem your first try to find out the given data that is your power is given that speed at which it is rotating it is given that belt type is given. It is a that is a groove type with a 18 degree groove is there and then your what is the belt weight mass that is mass per unit length is also given and the pulley diameter is given.

So, when your angle of wrap that is also given over here, then the maximum tension is also given. So, that is your coefficient of friction is given. So, you can resolve this problem now. How will you do it?

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For Vbelt, $\frac{T_1 - T_c}{T_2 - T_c} = e^{\mu \theta / \sin \beta}$, $T_c = mv^2 = 0.215 \text{ gr / mm} \times (r \cdot \omega)^2$

$$T_c = 0.215 \text{ kg.m} \times \left(\frac{94}{2 \times 1000} \times \frac{1750\pi}{30} \right)^2 = 0.215 \times 8.61^2 \text{ N} = 15.94 \text{ N}$$

$$\frac{672 - 15.94}{T_2 - 15.94} = e^{\frac{0.2 \times \frac{165 \times \pi}{180}}{\sin\left(\frac{18 \times 22}{7}\right)}}$$

$T_2 = 117.6 \text{ N}$, Thus

Torque = $(T_1 - T_2) \times r = (672 - 117.5) \times (94 / (2 \times 1000)) = 26.1 \text{ Nm}$

Power kW = torque, Nm x angular velocity, rpm/9550 = $26.1 \times 1750 / 9550 = 4.78 \text{ kW}$

For 20 kW motors, Total number of belts required = $20 / 4.78 = 4.18$ i.e 5 belts

Motor power that can be driven with 4 belts = $4 \times 4.78 = 19.12$,

Thus if the system can be run by 19 kW motor go for it.

So, we know that there is a this in a real life your why that mass is given that is a that mass per unit length is given. So, you can find out what will be the centrifugal action because centrifugal action depends on you know that is mv^2 . So, you can calculate mass is given, velocity is given, T_c can be found out.

And, then for the ratio tension that is tension ratio is T_1 minus T_c because this is the centrifugal action is there and in place of your e to the power μ theta will have to take e to the power μ theta by $\sin \beta$. So, that means, from here you can calculate out what is T_c that is your the centrifugal action is determined.

And, once you determine the centrifugal action then by putting this term in these equations then you can find out what is your this T_2 ; that means, in your belt the tension will be coming. Now, once you know this T_1 and T_2 , then you can find out the torque; torque is nothing, but that your effective tension into the radius. Radius is also given. So, that ultimately you know the torque.

Then what is the power required? That is power is your torque and into the angular velocity. Now, in this case this angular velocity your rpm is given. So, if you use this formula given for power, you can easily calculate out what will be the number of belts required.

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An electric motor drives a 20kW machine part at 1750rpm using multiple V-belts. Groove angle = 18° and the unit mass of the belt is 0.215gr / mm. The pitch diameter of the motor pulley is 94 mm and the wrapping angle of the belt is 165° .

Calculate how many V-belts are to be used, assuming that the tension load in the belt is maximum 672 N and the friction coefficient is 0.20.

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Pulley diameter = 94 mm,
Angle of Wrap $\phi = 165$, $T_{max} = 672\text{N}$ and friction coefficient $\mu = 0.20$

So, that is in the problem it was given that is your calculate how many V-belts exactly in a in a belt V-belt drive you may find over here that is exactly from that. If you if you are having a pulley like this so, this there will be number of grooves here and then this belt will be going like that number of belts will be there. So, that that means, your this whole power so, that number of this V-belt will be providing the power.

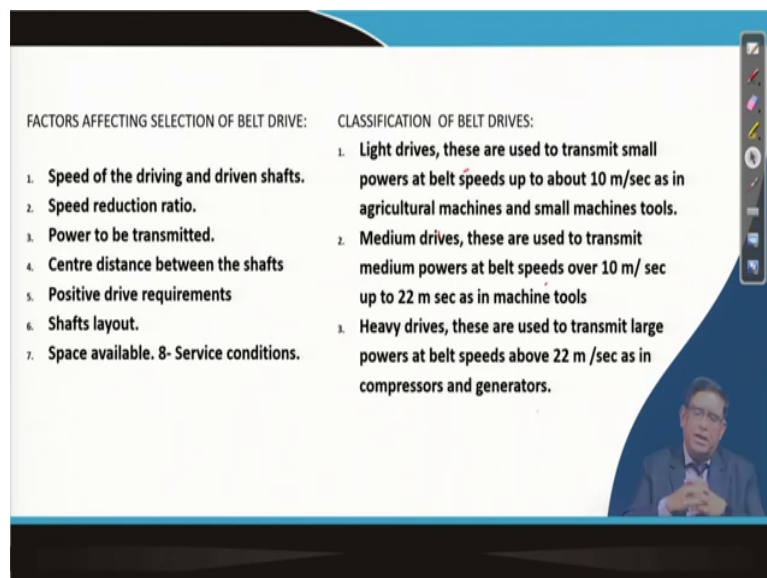
Now, for giving that one you can find out that the power which has come it is coming to 4.78 kilowatt can be the power by one belt so, but you have got a 20 kilowatt motor. So, when you are having a 20 kilowatt motor, then you will have to use if you as because it is just like unitary system one gives 4.7 78.

So, for 20 kilowatt motor it will have to have 4.18 belt, but belt you cannot make it as a fractional number. So, that means, you will have to go for 5 belt. Now, the question is that is

your if there were 4 belt, you could have gone 19.12. So, will you exactly then what you will have to do in a design you need to check because you are using the if you are going for 5 belt exactly the additional belt giving a power you are not going to get much.

So, in such type of situations what you will have to do is you will have to take if you can do the operations by 19 kilowatt motor or not. So, that is way how in a design part you do a little bit of iterations to get the things to done. So, but the basic principles of how exactly the tensions belt tensions are used for determining the power and then determining for a drive, how many number of V-belts you will be using can be given over there.

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FACTORS AFFECTING SELECTION OF BELT DRIVE:

1. Speed of the driving and driven shafts.
2. Speed reduction ratio.
3. Power to be transmitted.
4. Centre distance between the shafts
5. Positive drive requirements
6. Shafts layout.
7. Space available. 8- Service conditions.

CLASSIFICATION OF BELT DRIVES:

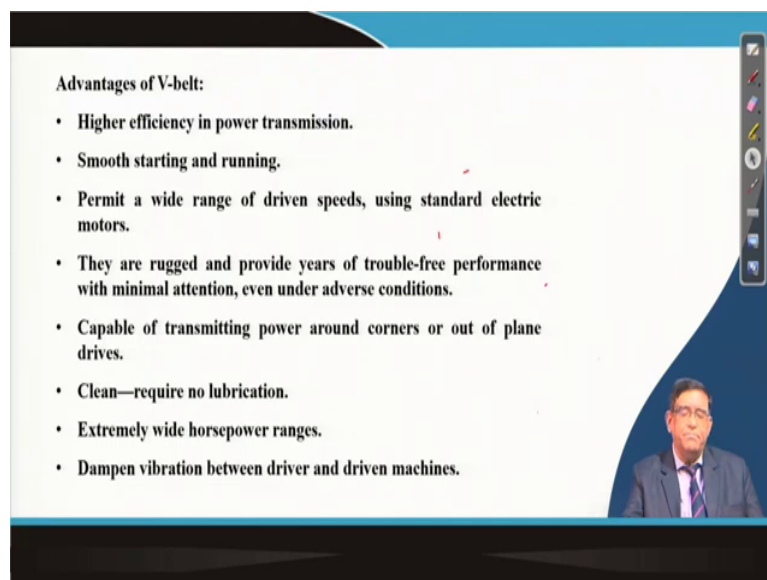
1. Light drives, these are used to transmit small powers at belt speeds up to about 10 m/sec as in agricultural machines and small machines tools.
2. Medium drives, these are used to transmit medium powers at belt speeds over 10 m/ sec up to 22 m sec as in machine tools
3. Heavy drives, these are used to transmit large powers at belt speeds above 22 m /sec as in compressors and generators.

So, there are various factors which affect this belt drive selection. Basically the speed of the driving and the driven shafts, so that speed ratio is very very important, then how much power

is to be transmitted, then center to center distance as I have said then the positive drive requirement that is drive will have to get exactly connected directly to the that your shafts.

Then this how the shafts are layout; that means, in how the space negotiations will have to be there that. Then you will have to also how can be we classify this belt drives in the market there are different types of belt which can be your light drive and can be your medium drive, there could be heavy drive like that.

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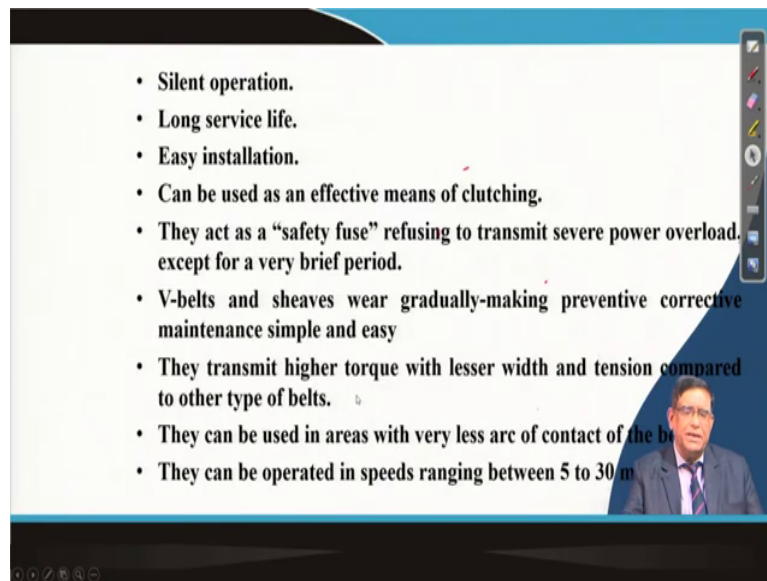


Advantages of V-belt:

- Higher efficiency in power transmission.
- Smooth starting and running.
- Permit a wide range of driven speeds, using standard electric motors.
- They are rugged and provide years of trouble-free performance with minimal attention, even under adverse conditions.
- Capable of transmitting power around corners or out of plane drives.
- Clean—require no lubrication.
- Extremely wide horsepower ranges.
- Dampen vibration between driver and driven machines.

So, there are number of advantages of V-belt you can get a high efficiency; smooth starting running and that it permits wide range of driven speeds; there are also it is a very clean. It is they need not give that your lubricating oil and all that thing in gear. So, that is why it is having less maintenance.

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- Silent operation.
- Long service life.
- Easy installation.
- Can be used as an effective means of clutching.
- They act as a “safety fuse” refusing to transmit severe power overload, except for a very brief period.
- V-belts and sheaves wear gradually-making preventive corrective maintenance simple and easy
- They transmit higher torque with lesser width and tension compared to other type of belts.
- They can be used in areas with very less arc of contact of the belt.
- They can be operated in speeds ranging between 5 to 30 m/s.

It is very silent in gear because of the metallic parts will be moving you get. So, you may find out lot of advantages are there.

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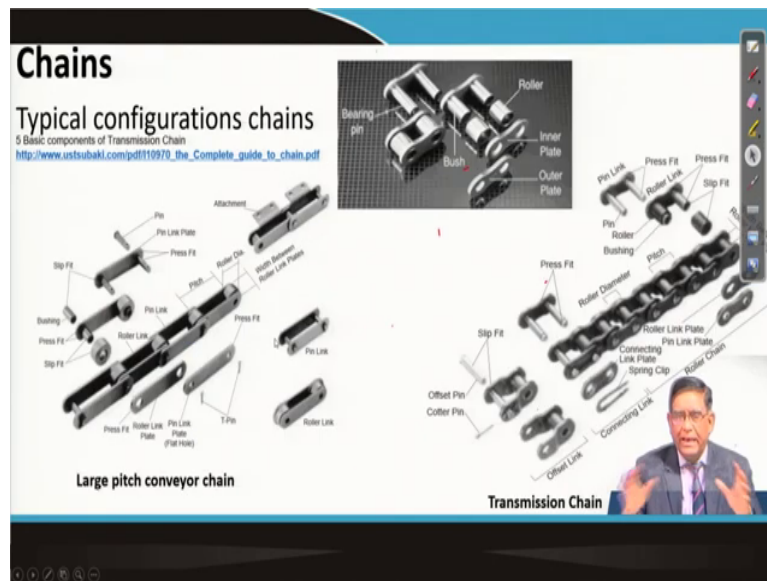
V-belts can be grouped into four construction styles

Construction	IDs	Description
 Classical	Heavy-Duty Belt A, B, C, D, E FHP 2L, 3L, 4L, 5	Standard V-shaped cross-section. <ul style="list-style-type: none">Compensates for mechanical misalignments.Made with oil and heat resistant materials.Usually includes Wrapped construction.Thinner than Wedged construction and not as strong.
 Wedged	Heavy-Duty Narrow 2V, 3V, 4V	Same width as Classical, but thicker. <ul style="list-style-type: none">Improved compensation for mechanical misalignment.More strength for higher horsepower and torque applications.Can be used in matched set
 Wrapped	Heavy-Duty V-Belt A, B, C, D, E FHP 2L, 3L, 4L, 5L	Belt construction includes protective wrap around belt. <ul style="list-style-type: none">Better resistance to abrasive environment.Improved wear qualities.
 Edge Cut & Notche	Notched V-Belt AX, BX, CX 7VX, 9VX Synchronous 3M, 5M, 8M, 14M	Edge trimmed with no wrap on outside. Inside edge is notched as shown in the illustration to the left. <ul style="list-style-type: none">Able to function at tighter radii on smaller pulleys.Works well in smaller space



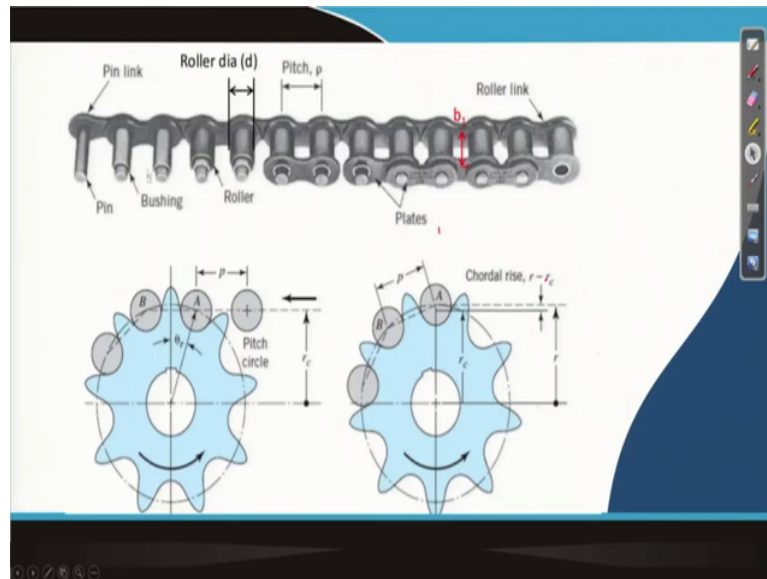
And, these are the different commercially available. V-belt you can see a design data book or that this type of belts, then what are their purposes and all how they are classified you can find out.

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Then the in case of chain drive it is a there are mainly five components in a chain, that is, there will be some bush, there will be a roller, there will be bearing pin and then there will be a inner plate and outer plate. They combine together depending on your long pitch you can see that this is a longer length this type of pitches are there to make chain and there are some transmission chain in which very smaller type of things you can you might have seen this type of chain in your bicycle.

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Now, whenever there is a chain drive this chain will have to be that distance between these two it is called the pitch you will have to make the sprocket in such a way that your this is matching over here. So, this arrangements of chain is there.

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Property	Drive Chain	Conveyor Chain	Engineering Chain	Lifting Chain	
				Leaf	Bush/Roller
Image					
Function	Transfer Power	Transport Goods	Lift or Transport Goods	Load Balancing	
Application	Used in thousands of applications to transmit power from one mechanical system to another.	Typically include special attachments for transporting objects from one location to another.	Conveyor or Lifting	The most common use for this chain is for lift trucks.	
Attachments	For synchronous devices	Standard or Custom	Standard or Custom	None	
Design	Precision made with roller bearings.	Precision made with roller bearings.	Are not always precision made, but usually custom designed.	Interleaved plates sharing a common pin.	Roller bearing
Direction Change	Sprocket	Sprocket	Sprocket	Flat Pulley	Sprocket
Load	Light to Medium-duty (can use multiple-strand chain to increase strength)	Light to Medium-duty	Heavy-duty (can use multiple-strand chain to increase strength)	Heavy-duty	Medium-duty
Pitch	Standard	Standard, but more commonly double	2 to 18 inches		
Plates	Standard Typically figure eight design	Standard Typically straight design	Thick Typically straight design	Standard	Standard Typically figure eight design
Speed	Low to High	Low to Medium	Low	Low	
Style	Roller Bearing	Roller Bearing	Roller Bearing		
Wear	Depends on environment and lubrication	Depends on environment and lubrication	Depends on environment and lubrication, however, is less wear resistant than precision chain.	Depends on environment and lubrication, however, is less wear resistant than precision chain.	

Different types of chains

And, there are quite a large number of different types of chains with just right from your that your watch chain to bicycle chain to some of the industrial chain. But, that properties mainly there what function they are used, what applications they are there, what type of attachments are made to it, what type of design you will be doing for and then the how whether you require a directional change or not, how much load will be coming, what should be the pitch and then what type of plates will be connected, depending on that number of different types of things are used.

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For the Chain calculation the standard procedure suggests the following:

- Chain length and centre distance
 - Chain must contain even integer number of links
 - Hence cannot pick an arbitrary centre distance and chain pitch
 - Nearest chain lengths (in pitches) for a contemplated centre distance, C_c are calculated by empirical formulae like (for a two sprocket system):
$$L = \frac{N_1 + N_2}{2} + \frac{2C_c}{P} + \frac{(N_2 - N_1)^2 P}{4\pi^2 C_c}$$
where N_1 and N_2 are the numbers of teeth on sprockets and P is the chain pitch
 - The result of which should be **ROUNDED UP** to the next even number to calculate the actual centre separation, C_a :
$$C_a = \frac{P}{8} \left\{ 2L - (N_1 + N_2) + \sqrt{[2L - (N_1 + N_2)]^2 - \frac{\pi}{3.88} (N_2 - N_1)^2} \right\}$$

Now, for calculation of the chain calculations you need to know that what is the nearest chain length. For that calculations if you know the that your chains driving and driven ratio and then if you know that center of distance and if you know the pitch then you can find out what will be the length of chain required for your.

Now, that is why this is one of the important calculations. Similarly, that is your the results whatever you will be finding out you can find out the center separations can be determined by this equation. So, normally you will have to do it.

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Assignment

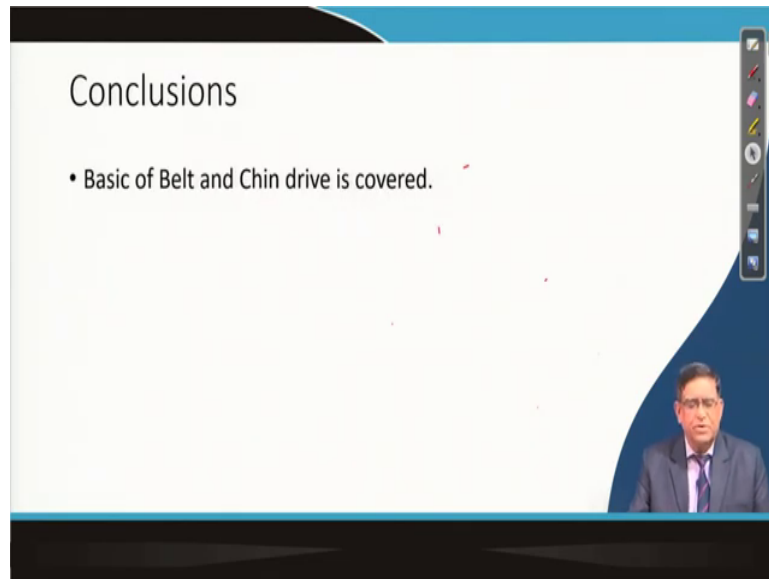
Referring to design data book, design a chain drive for a heavily loaded coal conveyor to be driven by an electric motor through a mechanical drive. The input speed is 900 rpm, desired output speed is 230 to 240 rpm. The conveyor requires.

Determine sprockets size, length of conveyor, Angle of wrap, transmitted power, select chain type

And, that I wish that you do a exercise as an assignment that is design a chain drive for a heavily loaded coal conveyor to be driven by an electric motor through a mechanical drive. The input speed is 900 rpm output speed is 230 to 240 rpm that conveyor requires. This is for that purpose you determine the sprocket size length of the conveyor angle of wrap transmitted power and select chain type.

So, this ones you will have to do as an exercise by following design data book of for chain conveyor and there are many other references are also available.

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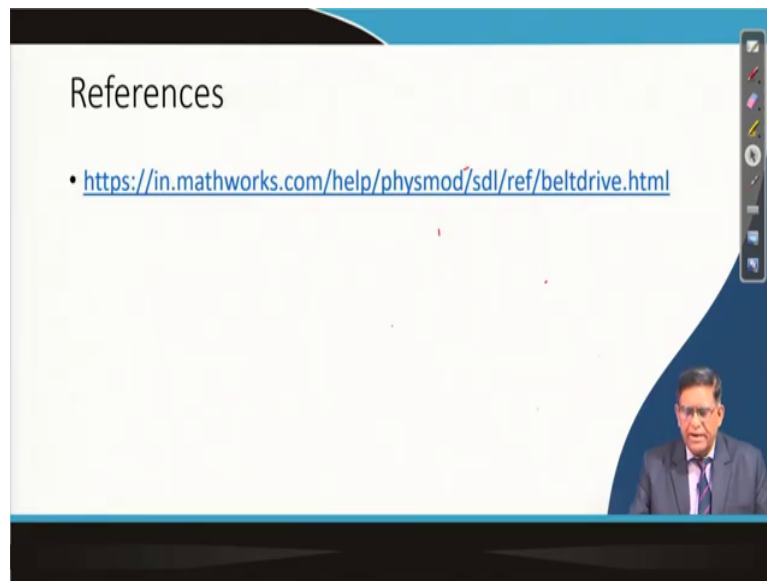


Conclusions

- Basic of Belt and Chain drive is covered.

But, here today we have just discussed the basics of belt drive and chain drive.

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There are some differences available over there and I hope if you go through that and do this exercise, solve the problems and take some your own as an assignment if you do a small design then you will be learning what it is there.

And, in the real life we will have to understand that how this belt drive and chain drive are used in different machines and for different transportation job and then how they are maintained. We will be discussing those when we will be going to discuss the special mining machinery for it, that maintenance aspect we will discuss it over there.

With this, thank you very much for listening.