Good day, today as I have seen we will be discussing about the Belt Drives, so this is lecture number 30. Now normally, we call this belt drives also by another name called flexible machine elements, and these flexible machine elements are normally used for varied industrial applications.

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If you look at the board, you see that these flexible machine elements are used in conveying system, used for transmission of power, replacement of rigid type power transmission system, what this means? This means see a gear drive is also a power transmission system, so in case of instead of a gear drive we can also think of this type of belt transmission system. Now it has got an inherent advantage in the sense that it can take off and good amount of shock and vibration absorbing capacity.

It has got a very good shock and vibration absorbing capacity what I meant to say, and it can take care of some degree of misalignment and for this reason flexible machine elements are widely used in industrial applications, as a matter of fact normally the power transmission can be carried
out over a longer distance or in comparison to other transmission systems this is also an added advantage for the flexible machine elements, so which we commonly called as the belt drives.

Here, we consider as far as flexible machine elements are concerned only the drives belonging to flat belt drive and the V belt drives, although we are having some other drives like a rope drive and timing belt drive etc. but we are not considering those aspects.

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If you see once again that towards the board this is a common type of belt transmission system is as shown in this figure. This you can see this is one pulley, this is another pulley, this particular pulley we call it as a smaller pulley and this is a larger pulley as you can see from the figure also, and here is this particular one is the belt which is wrapped over here. Now in this case what is happening? That if we consider this smaller pulley to be the driving one then this driving pulley will be transmitting motion to this particular belt.

And the motion of this belt in turn will give a rotation to this pulley and thus the transmission of power from driving to the driven pulley is accomplished, in this case this figure what has been denoted over here is called an open belt drive system. And some of the nomenclature for the open belt drive systems are as follows dL is the diameter of larger pulley this one, then dS diameter of the smaller pulley this is the diameter of the smaller pulley.
Then we are having alpha L that is angle of wrap of the larger pulley, so what is this one you can see when the belt is going over this one so this distance from here to here there is an contact that is taking place okay from here to here the contact is taking place over the pulley and that angle we are calling as an alpha L. And similar situation you can see now this is the angle which is coming in contact with a smaller pulley.

So from the geometry we can simply say that the total amount of angle axis of this 180 degree is the similar fashion it will be the lesser over here for the smaller pulley, and C is the center distance between these 2 pulleys that has been shown over here. Now in this case the simple formulas for this alpha L, alpha S etc. are like this, so angle of wrap for the larger pulley is 180 degree + this one is the 2 beta why this is one angle and this side is an angle so this is +2 beta.

In the similar fashion alpha S is given by 180 -of this angle and this angle which is again coming out to be as 2 beta, and L0 is the pi/2 dL+dS+2C this is the belt length what we call this is the belt length means what is this entire belt length is coming out to be in this fashion, now here this beta angle what has been shown over here this beta angle is nothing but sin inverse dL-dS/2C, so this is the value of the angle beta which you can easily verify from the simple geometry.

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Now once we consider this type of drive as an open belt drive then we find out that this one is the cross belt drive you can see this particular one is a cross belt drive. Now here in this case if
you look for the open belt drive one situation you can see is that whenever you are considering this open belt drive then the direction of rotation of the pulley if we consider in this direction, then the other pulley also moves in the same direction means if it is rotating from the top in an anticlockwise rotation then this is also having an anticlockwise rotation.

And secondly, if we go for the cross belt drive we can see the direction of rotation is changing if it is in the anti-clockwise and this gives a clockwise rotation. Now in this case here in the both the cases the angle beta is subtending on these 2 sites, so therefore, the angle of wrap alpha \( L = \alpha S^L \) this is alpha S, this is alpha L both are the same in this case and it is given as 180 degree +2 beta.

And in the similar manner the length of the belt for the cross belt drive comes out to be this one this is the entire length of the belt for the cross belt drive, and that is given by this formula \( \pi/2 \text{dL+dS+2C+dL+dS/2 whole square 4C} \) and here you can see the beta angle what was defined earlier has got little difference which also can be seen from this geometry which comes out to be sin inverse \( \frac{dL+dS}{2C} \).

So if we compare once again the expression of the open belt drive then you can see that this is the length of this one I think in just one second this is the length of the belt in open drive \( dL \) and so there is a difference is in +or- but here you can see the angle of wrap is little different from what we have seen for the cross belt drive.

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Now it is important in this case that what are the belt tensions? Now one has to know that this drives that means these belt drives are primarily runs on the friction principle means the friction between the belt and the pulley is responsible for transmitting power from one pulley to the other pulley, or in other words the driving pulley will drive or keep a motion to the belt and the motion of the belt will be transmitted to the driven pulley, and all these transmissions are done through the friction.

Now the situation comes like that due to the presence of friction between the pulley and the belt surfaces the tension on the both sides of the pulley are not equal, one will be higher and other will be lower. So it is important that one has to identify onto a pulley and belt system that which one is an higher tension side and which one will be the lower tension side. Here, this figure on the board represents a simple method by how you can find out the belt tension?

Just you look at this one you can see for this is the one which we called as an driving pulley that means this pulley is attached to a prime mover or some machine which is giving an motion to this pulley okay, so motor or some IC engine or something like that is there which is giving an power to this particular pulley. And the belt has got tensions namely T1 and other one is T2, now the simple idea of the friction will suggest in this particular manner.
Now you can see just for the purpose of explanation this belt has been drawn little away from the pulley actually it will be touching but just for the explanation purpose we are putting a little away from the pulley, so when this pulley starts rotating then what is the idea the simple nature will say that this belt well imply a friction force on to the pulley in the direction as shown over here, so this particular friction on to the pulley will be in such a way that it will try to oppose the motion of the pulley, so it will be in this direction.

So thereby the friction on the belt will be on the other direction, so other direction means opposite to this particular direction, so you can see that this particular friction on to the belt will do what? It will we will just push the belt in this direction does creating a motion of the belt as shown by this particular arrow, so if we just look at this particular belt you can see that there is a T2 that is acting on this side, there is a T1 acting on this side and the friction force is acting on to this side.

So simply equilibrium of the belt suggests that this T1>T2, so that has been mentioned over here T1>T2. Now onwards we will always refer in this particular discussion that T1 is the tight side and T2 is called the slack side that means this is T1 is higher tension side and T2 is lower tension side. Now when we consider this fact that T1 is a tight side and the T2 is a slack side, in the similar manner we called this is the tight side of the belt and this is slack side of the belt.

Now you can see in is particular one that the slack side or the pulley drive has been kept on to the upward side or to the upper side, now this has got an implication, the implication is that you will be learning very soon that if you are having and belt drive then what is happening? That if you are putting an belt the tight side means something like this is going, and slack side means exaggerated something like this so it is that what we are calling as a slack and this we call as a tight.

Now due to this slackness what will happen? You can see the angle of contact or angle of wrap is coming out to be more, so that is the reason what is happening? That if there is a more contact there will be it will be shown also mathematically after sometime that there will be more contact
means there will be more friction acting on to this belt surface and thereby the power transmission will be better in this particular case.

On the other hand, if it is other way around that means if we consider the slack side to be on the lower side and the tight side to be on the upper side you understand that similar situation will be can be drawn, so this is tight and this is the slack, so you can see in the exaggerated figure obviously, the angle of wrap is decreasing thereby the power transmission capacity will be decreasing.

So you please keep in mind that whenever you are trying to design a belt drive then always keep that tight side on to the top surface and I am extremely sorry that tight side onto the lower side and slack side I onto the upper surface, this is true for the what we call when we are having the horizontal transmission. But here I would like to mention that this belt drives particularly when you will be talking about the V belt drive, you will see that V belt drives need not to be always in the horizontal direction.

And it can be seen in several applications that any orientation of the pulley centerline axis can have duly for a belt drive system to run, but normally when we consider about the flat belt drive in majority of the cases it will be in a horizontal manner. However, this suggests one important situation is that we will be always keeping this slack side onto the top and the tight side onto the bottom surface.

Now continuing our discussion on to this belt tension once again you can see that this belt which is continuous one actually I just I have made in the 2 figures, whenever you can see that is this belt which is again having motion in this particular direction, now you see this is a driven pulley so this is not rotating at the very initial stage this is not rotating okay this cross means this is not rotating, now but the belt has got a motion the belt is giving an motions.

So the basic nature of friction is again suggesting that this particular driven pulley which is not in motion will create in opposing manner it will give a friction force, and so the pulley itself gets a friction force in this direction as shown in the figure okay just I okay you can see this figures that
this gets a friction direction on this side. So the moment this pulley gets a friction in this direction this frictional force will create a motion of the pulley in this direction.

So this driven pulley what has been written in this color, you can see this arrow this arrow means that it is creating an motion, and driving pulley means this is actually creating an motion I am sorry it is already in motion due to prime mover. So once again if you see to the entire situation then this you are having a tension onto the other side and the friction force on the other side, so obviously again you find this is T2 and T1 and thereby T1 is again is found to be >T2.

So we find that in case of whether it is an power drive or it is a drive where the belt at the very beginning is in the state of impending motion and then it creates a motion of the pulley, then in both cases the belt tension directions will be something as discussed over here, and this is the way one can first find out which one should be the tight side and which one should be the slack side.

So I hope that this figure will help you to understand that how to determine the tight side and slack side of a belt drive whether the drive of or the pulley and the belt drive is driven pulley or a driving pulley. Please remember driving pulley means the pulley is powered, pulley has got a motion it gives a motion to the belt, the driven pulley means the belt is in motion and it creates motion on to the driven pulley.

So driving pulley creates a motion onto the belt and driven pulley means the belt creates a motion onto the pulley. So from these ideas you can find out that what are the belt tensions? That should be onto the belt drive system, so one will be at tight side and another will be slack side.

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Now let us look into some other aspects of this particular pulley drive, here you can see that we have selected one drive system having an $T_1$ and $T_2$ belt tensions that means what is happening? If this is $T_1$ and this is $T_2$ the belt will be in motion in this directions is it correct, so that means belt drive will be given a motion in this direction and thereby what will happen? A friction force will be acting on to this belt in a surface in this directions.

And pulley will get a friction force onto this directions, and thus creating a motion of the pulley. So here, we are considering a simple situation where a portion of the belt has been selected and at as it is shown in this particular figure, this is on the belt and a segment of the belt is this one this yellow color is the segment of the belt and let this segment of the belt is creating an angle or subtending an angle $d\pi$ at the center.

So length of this particular belt will be obviously coming out to be $r\,d\pi$, now let us see that what are the forces that is acting on to this small belt segment? Now you can see that as because this belt has got a movement in this way, so just at the impending condition you understand the impending condition means at the point where the belt and the pulley is just having an relative motion, so under that situation the forces those are acting onto the belt segment are shown on to this particular figure.
Please look at the figure you find that this belt segment is acted upon by a normal force acting from the pulley onto the belt segment, and due to the impending motion the frictional force will be acting onto this direction that has been shown over here, and this is given as $\mu dN$ and that you know I need not explain where the you know is that what it is called? The $\mu$ is the coefficient of the friction.

So $\mu dN$ is a frictional force acting onto this one, and here is the centrifugal force due to the motion of the belt there is an centrifugal force that will be acting onto this belt segment and which has been given as a value of $CF$ and this value of $CF$ is computed over. Here, you can see the centrifugal force $CF$ is nothing but $m r d \pi$ what is this $r d \pi$? $r d \pi$ is a belt length and this $m$ is actually what? The mass of the belt of unit cross-section for an unique length.

That means what is happening? This is basically mass of a belt of unit cross-section that is a belt mass, belt mass will be what? This is the belt mass for an 1 m length suppose, so this is what we get as that $m$ and so $r d \pi$ is the length of the belt the total mass of the belt and $v^2/r$, so $v^2$ is a peripheral velocity of the pulley, so that means $v$ is the we can call in short as pulley speed.

I think you should write a better way I mean more appropriate will be it is an I think it will be better belt velocity you can just consider this as the belt velocity okay or the pulley surface speed, so belt velocity this is what we are getting as $v^2/r$ so entire situation comes out to be $mv^2 d \pi$, so this particular mass of the belt is once again to have an consistent unit you know that it is very important so this comes out to be mass means kg per meter know.

So this comes out to be what $v^2$ means $m^2/s^2$ so this meter cancels so kg meter per second square is equivalent to newton, so this is a centrifugal force acting over there is the in this particular direction. Now this particular belt is having a differential tension at any section it is given as the $T$ so it is implemented onto the other side as $T+dT$ as shown in this figure, so because this is an $T_1$ this is $T_2$, so this side is an higher tension side and this is a lower tension side.
Now so these are the forces acting onto this particular belt segment, so you know for equilibrium what we know that the belt should be under the force balance and here we are defining this direction of the centrifugal force as a normal direction and this line perpendicular to this one is a tangential direction. So we know that the equilibrium will suggest the force should be some of the force should be \( = 0 \) in the tangential direction as well as in the normal direction.

Now our duty is just to write the force balance and then find out that what is the ultimate relationship that comes in terms of the belt geometry, and the respective tensions that and the centrifugal forces etc. acting onto the belt. So here if we look into this particular force balance see this is \( d \pi \), so half of this angle is \( d \pi/2 \) so \( T \) if we take all the force balance in this direction so \( T \cos \frac{d \pi}{2} \) is due to this force taken care of.

Now this force in this direction is -this is positive directions so \(-T+dT \cos \frac{d \pi}{2}\) and the friction force acting in this direction is \( \mu \cdot dN \) and that summation=0. And the second one we see that summation of normal force should be=0, so which gives us the idea that this the centrifugal force in this direction so \( mv^2 \cdot d \pi \) as we have computed over here \( mv^2 \cdot d \pi + dN \) this is the normal force acting in the same direction is that is a \(+dN\) and - of what - of \( \sin T \cdot \sin \frac{d \pi}{2} \), and this is also - of \( T+dT \cdot \sin \frac{d \pi}{2} \)=0.

So this is the 2 force balance equations what we find out from this free body diagram of a belt segment, so let us go to the next slide.

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You see that once again we are just repeating these particular equations what we have written in the earlier slide, now here we have an assumption that this normal $d\pi$ is small, so we know from the geometry that $\cos d\pi/2$ can be approximated as 1, and $\sin d\pi/2$ can be approximated as $d\pi/2$. Now if you substitute this relationship over here you can see that you are only having what? This term and this term is cancelled and $dT\cos d\pi/2$ is 1.

So you are only having $dT$ and this comes out to be sorry $dT$ and with the minus sign of course and this comes out to be $\mu*dN$ that=0, so this expression for the normal force this $dN$=dT/\mu that is the coefficient of the friction. And in the next one we have this $mv^2/d\pi$ remains as it is, this $dN$ is replaced by $dT/\mu$ from this equation, so this is the replacement of $dN$, and if you look to this expression once again then what we can see? See these 2 gives us an idea $2T$ of $\sin d\pi/2$.

So that comes out to be how much $\sin d\pi/2 d\pi/2$, 2 2 cancels so that simply gives $T d\pi$ of course the product of $dT$ and $\sin d\pi/2$ can be very well ignored in this particular equation. So the simplified form of the equation if we just transpose it then comes out to be $dT/T-mv^2$ = $\mu*d\pi$, so this is the equation what we get from the equilibrium of the force system. And you can see that we are having this one from $T_2$ to $T_1$ is a tension of the belt.
So we integrate it in this limits T2 to T1, so that comes out to be dT/T-mv square and you have seen in this particular pulley what you are drawn earlier so this comes out to be your angle of warp that is an alpha we are considering, so we consider from the 0 to alpha the entire length from where T2 to T1 has occurred, so this is 0 to alpha mu d pi. So our preliminary integration gives us the T1-mv square=e to the power mu alpha.

Please note that this particular one what has been underlined over here in this equation is one of the very important equation so this relates you can see the tension the belt material, the belt speed the angle I mean the coefficient of friction and the angle of warp that is how much the angle is in contact with the pulley that means how much angle the belt is having an contact with the pulley, so belt speed or the pulley surface speed tensions in the belts, the belt material property it is mass primarily and the coefficient of friction and angle of wrap.

So everything is included in this same particular equation, so this is one of the very important one in the calculations of the belt drive, and sometimes you will be finding in your earlier course that this T-mv square both in the denominator and numerator were not present which means that if you neglect the centrifugal effect, then the equation comes out to be very well known what you did in your preliminary course maybe as T1/T2=e to the power mu alpha. So this equation will be utilized in the design of the belts.

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Now next, we go to the situation this equation we have already done and this one the Elastic creep and initial tension. Let us understand what is this one, the presence of friction between pulley and the belt causes a differential tension in the belt that you have just seen that means you are having and T1 and T2 tensions on the both sides of the pulley, now what happens? in one side due to the tension the belt elongates while when the belt leaves the pulley other side it contracts and makes the tension on to the other side to be slack.

So this creates a relative motion between the belt and the pulley surface which actually is created due to a phenomenon which is called an elastic creep. What is this elastic creep? Then if we try to understand that means what is happening if we just look into this one suppose we are having some tension side okay, so this is the well just one second, so this is T1 side and this is T2. Normally, what happens that whenever onto from the T1 side suppose this is being moving.

So when it is going like that on the higher tension side the belt has got a tendency to elongate, now once it is elongating in this zone just at the entry to the pulley, then what happens say it is having an velocity some velocity say v1 then this velocity will be the same as the pulley peripheral speed velocity. Now as it comes over here then this elongation due to this that this particular one what is happening? That in this case as I told you there will be an contraction in this zone.

And when it leaves this pulley so what is happening that this tension which was higher tension due to this contraction what is happening it loosens the belt on this side and then it makes this particular tension to the lower one and this is the call this particular one is called an elastic creep, one thing just I did not mention that when it is leaving here then the velocity is not v1 it is a lower velocity say something like v2.

So this means this velocity is lower than the velocity at this one, so this relative motion of the belt is caused due to the thing called the creep or what you are considering as an elastic creep. Now on the tight side whatever the elongation of the belt is somewhat proportional to the T1 well this is TI-Ti what is Ti? This is called the initial tension what is this Ti? Once again this is the initial tension.
What is initial tension? If there is a belt drive then this is the belt so initial tension $T_i$ this is very much required otherwise you cannot keep the belt in position at the very beginning, and you have to put some amount of initial tension so that a friction creep is there at the initiation, now the moment it starts moving then this initial tension changes to either $T_1$ or $T_2$ depending upon the direction of the belt motion or the pulley whichever you consider.

And considering the fact by which we decided which one should be higher tension side and lower tension side in the earlier slide, anyway the idea is that this initial tension do not keep the same it is only same on both the sides when the pulley is stationary, so tension on the both sides of the belt=$T_i$ when the motion sets then one will be $T_1$ and other will be $T_2$. Now this elongation in the tight side will be proportional to as I told you it is proportional to $T_1-T_i$. And onto the slack side the contraction will be proportional to $T_i-T_2$, so if the elongation equals to contraction that means the belt drive remaining same you can see very easily that $T$ initial tension is given this is given by the $T_1+T_2/2$. Now the interesting fact is that in this case suppose you go on imposing more and more initial tension onto the belt system, then what will happen?

That in this case the $T_1$ will go on increasing and at the same time $T_2$ will go on decreasing at one time it can happen the $T_2$ comes out to be $=0$ and that is one condition where you will be having an maximum amount of power transmission. However, this initial tension is very important, so just once again just before coming to that one. If the $T_2$ comes out to be 0, then you can find out that this particular $T_1$ will come out to be something has twice of the initial tension, so this is 0 means $T_1$ comes out to be twice $T_i$.

So this is one situation where we will be finding out that power transmission to be maximum. Now coming back to the point whatever I just trying to tell you that initial tension is very important, just by increasing the initial tension you can increasing the power transmission capacity, at the same time the initial tensions are responsible for the calculation of the bearing loads ultimately, which will be onto which this initial tension situation will come into picture.
So now in general what happens? That some sort of initial tensions are set on to the belt for the better power transmissions and also for the creeping’s, but anyway the initial tension can be computed from the fact from the equation what just has been shown over here as $T_i = T_1 + \frac{T_2}{2}$, so this is what we talked about the elastic creep the phenomena of how the friction is actually responsible to create this type of motions in the belts set motions into the belts, and the phenomena as I told you is the elastic creep is responsible for that.

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![Velocity ratio and Power transmission formula]

Now the other 2 important situations that comes into picture are velocity ratio, now this velocity ratio or sometimes it is called also the transmission ratio, this is the NL/NS means if it is NL the N is a pulley speed of rotation, and NS is the smaller one as you understand, NL is the larger pulley, so that means comes out to be in the form of these 2 values $dS + t / dL + t$ understand the diameter of the smaller pulley $+ t$ this is the belt thickness $t$ is the belt thickness.

And this particular one is $1 - S$ and what is this $S$? The $S$ is called the belt slip, this is one situation that normally the all belt there will be always certain amount of slippage between the belt and the pulley, it will be more prominent where the angle of wrap is small and all drives will have a slip at there by 100 % transmission is not possible. Now well in this case the type of belts will be telling later on that the efficiency of the drives depends upon this slip for both cases of the flat as well as the V belt drives.
Normally, the flat belt drives will have a little more higher efficiency compared to what we will be getting in case of a V belt drive. However, the V belt drive do have a little more power transmission capacity compared to the flat belt drives because of the groups create some additional frictional forces. Now in this case if we understand this particular idea then this velocity ratio is \( NL/NS = \frac{d}{dL} + t \times (1 - S) \).

Normally, we will see that 3% well it is not a final one but around 3% slip is something what we can consider to be a standard value, so if we consider a 3% slip that means it will be actually 0.03, so you can understand 1-0.03 that is 0.97 will be coming out to be value of 1-S, so thereby certain amount of velocity ratio is lost due to this particular slip because we know that in one \( NL \times dL = NS \times dS \).

So this is the very standard formula but which gets lost due to this particular belt slip, now the expression for power transmission is very simple power \( T_1 - T_2 \) into the belt velocity \( v \), so once again you know \( T \) is in Newton okay *\( v \) is in meter per second so Newton meter per second is what? So that is the reason power is what? That a convenient way of putting the power is kilowatt there by a factor of 10 to the power 3 sometimes can be utilized.

But anyway let us put down the expression in this form a corresponding units should be in SI as I have told but only thing this multiplication factor will be considered depending upon the design problem, but anyway the power is always in what in SI unit and this kilowatt is simply a higher unit means is multiplied by 10 to the power 3. Now we have considered all the basic aspects of a belt drive.

Now just once again what is the belt drive basic things? That is a cross, open belt drive one situation, cross belt drive you know, then the how we determine the belt tension that is also clear to you, then we have derived was the very important equations of \( T_1 - mv \text{ square/}T_2 - mv \text{ square}=e \) to the power \( mu \text{ alpha} \), and the initial tension expression is also \( T_1 + T_2/2 \), velocity ratio as is shown over here and the power transmission is also \( T_1 - T_2 \times v \).
And normally, what happens that these terms what has just been explained okay remains the same for type of drives what will be considering that is the belt drive sorry the flat belt drive or the V-belt drive, some minor changes will come into picture that we will be indicating after certain time.

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So if we consider the fact then we see that we start our discussion on the flat belt drives, so in this case the flat belt drives is something like this means the bells have just a configuration like this, this is a longitudinal okay, so this is what we called as a flat belt, and drives utilizing such belts are called flat belt drives. Now one thing you should know that in this case of the flat belt drives in the market you will be getting the flat belts of different width, different thickness, different material, in form of big coils.

So just like the way you purchase some I mean some length of thread if you tying thread or wire from the market, how you go you just you give me 2 meters of wires or 2 meters of thread like that. In the flat belt drive also one has to decide upon the belt length from the calculation or the equations that just what you have seen and from there once he or she finalizes the what should be the length of the belt that much of the length of the belt of a given specification can be cut and join together to form a belt.
So one of the situation that comes into picture is that this belt requires a joint somewhere okay, so much design aspect or design considerations should be put over here in this joint means one should be careful that the joint should be made, so that it is very near to a joint less case means that this should be cemented in a very nice way, otherwise this is a location from where the belt normally gets snapped or if it is fixed up with some sort of clips and other things means this is a source where the noise also comes into picture whenever the belt drives run.

So what people do that they can use a cemented belt from the factory itself or with here one can joint this belts with various clip systems that are available in the market. Normally, the flat belt drives do not have any limitation of center distances, it can go as long as possible, as a matter of fact the belt conveyors are one of the situations where really you are having an very long distance, but of course the speeds are not high.

Because if you are operating at a long I mean center distances and also very high speed then what will happen that the centrifugal force will be acting largely onto the flat belts, so a judicious choice of the center distances is required in cases of flat belt drive that means although it take up a large distance, but the care should be taken that it should not be very large or I mean the reasons just I have told you.

Now the case of the belt material what we get are the leather belt that is oak tanned or chrome tanned. Rubber canvas or cotton duck impregnated with rubber, let me just clear this one. Then plastics are this one the thin plastic sheet with rubber layer are being used as in belts. Now these belts one can see is that can be looked upon that this is one layer, this is another layer, this is another layer like that also one can make are built up a belt thickness.

Now this one are called the word ply that is the number of layers is what we understand by the ply. The last of the belts are the canvas or woven cotton ducks, so these are the most used belt materials that is a leather, rubber, plastic and the fabric. So these belt materials are to be chosen depending upon the use and the applications.
Leather oak tanned belt and the rubber belts are sometimes are very are the belts which are most commonly used, but the plastic belts have a very good strength almost twice the strength of a leather belt. Well, we have just discussed about the belt materials you can have more knowledge of the belt materials from the hand books and with this we complete today's lecture, and we will talk about this flat belt drive again in the next lecture, thank you.

Good day, today we continue our discussions on the belt drives, this is lecture number 31. Now in the last class we started with the belt drives, so just to recapitulate very quickly, we started with a belt material. Now normally for the belt drives leather, rubber, plastic and fabric are the materials which are most commonly used for the manufacturing of the belts.

Now in the leather belt material you are having you can see the oak tanned and the chrome tanned types of leathers are available. In the rubber basically what happens a canvas or cotton duck impregnated with rubber, this is the construction of the rubber belts. Plastic belts as it was told it consists of a thin plastic sheet with a rubber layer and which could be having more..