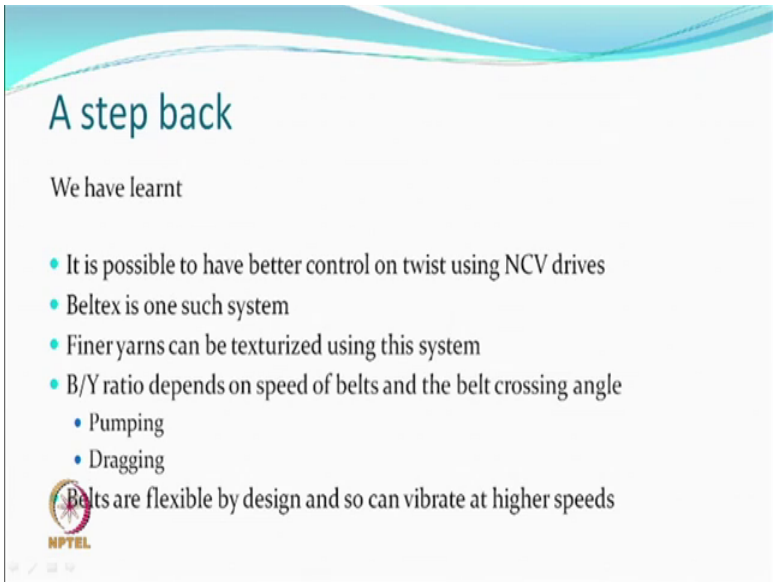
Textured Yarn Technology
Prof. Kushal Sen
Department of Textile Technology
Indian Institute of Technology, Delhi

Lecture – 20
Friction draw texturing

So, in this lecture we will just cover one of the other ways in which the twisting can be done for the false twist draw texturing systems.

(Refer Slide Time: 00:35)

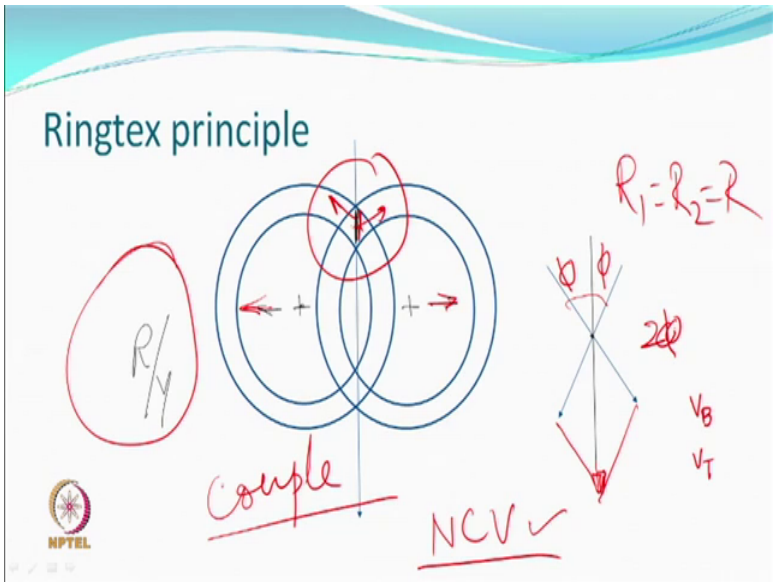


Till now what we have done is that we have understood that it is possible to have a better control on twist using nip controlled vector drives. Beltex is one such system, which was almost similar to hand spinning. And, because of this better control on twist finer yarns can be texturized using this system. Finer yarn means whose individual denier per filament maybe sub denier.

The B by Y ratio as it defined in the beltex system depends on the speed of the belt and the belt crossing angle. If, these two things are first defined then theoretically, if everything is as per the design then B Y ratio B by Y ratio is automatically determined. Therefore, the quality parameters in some sense could be considered as independent of the B by Y ratio.

But, in case it is not absolutely ideal situation, then one may have a situation where more yarn is being fed by these belts and so you may be pumping the yarn or reverse of it where less is being fed, as determined by the speed of the belt in the crossing angle you maybe dragging. We also have learnt, that the belts by design are flexible, because they are endless and they have to keep rotating over let us say two sets of rollers continuously compression and expansion would take place and based on the frequency of such compression and expansion the temperatures can also rise and at higher speeds the vibration can also set in a flexible system, at some not so nice time they may actually touch also and so vibration of the belts can also take place because, the distance between the two surfaces is very small which is just equal to the diameter of the yarn. The other thing which is similar to this, but different also, which is also based on the nip controlled vector drive system called the Ringtex.

(Refer Slide Time: 03:31)



So, what do we have here, two sets of rings overlapping at certain point for example, this is the point where they may be overlapping and because of this you may have a force acting in this direction, and the other force acting in the other direction, which is trying to create a couple. As, we said that they also have nip controlled. So, there is a nip which is being created between the two surfaces which overlap and so some positive control on the twisting mechanism is there and we can again get some force diagram, velocity diagram, where as we said in the previous case also, you have two ring velocities of the bottom ring or the top ring and when we look at their composite effect there is a yarn

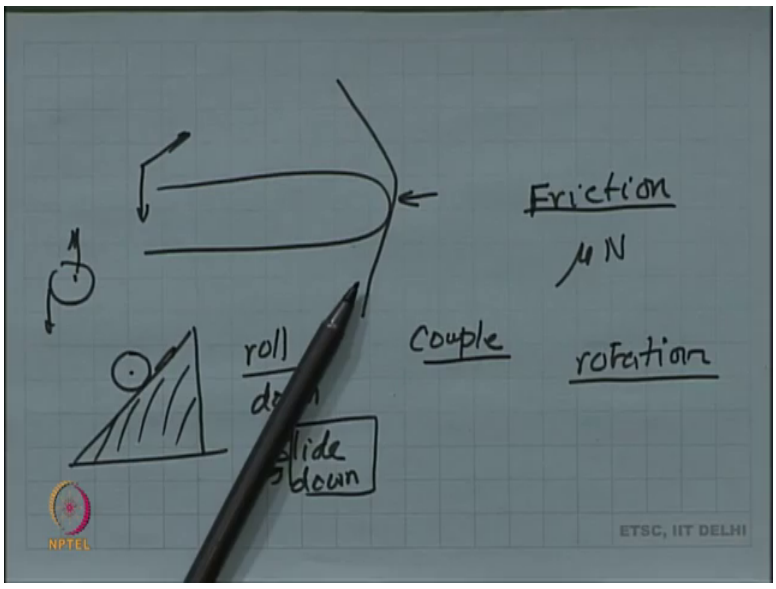
being pushed. At least when we talked about the positorque system also, yarn while being rotated was also being pushed.

One is that you in the that disc system you had untwisting; untwisting will take place here as well right. But, when they are in contact with the disc at that point and contact in the with the ring nip in this case there is a forwarding motion the yarn is being pushed there also it was being pushed like a corkscrew mechanism. So, when you rotate a screw in a cork. So, all the you are giving a rotatory motion, but the cork the screw can go in the cork or vice versa it can come out. So, linear motion also is setup by this that is also a corkscrew mechanism if it is rolling over just the over the disc. So, there is a forwarding motion there as well and there is definitely a forwarding motion here.

Like the case of the belt or a Beltex system we assumed that the speed of the belt, bottom belt, and the top belt are same. Here also we can assume at any given point of interaction or a contact the speed of the ring; one could be equal to the speed of the ring two, and which could be R and therefore, you can define something called an R.

I just said there is something called the couple being generated you have frictional force and a couple. So, whenever some rotation has take place there has to be some couple.

(Refer Slide Time: 07:07)



If somebody ask this question how was; where was the couple getting generated in a disc system when you had a disc?

So, friction of course, was there because you had mu and a normal force, which was there in the yarn. From where did you get the couple, because that is how you rotate. So, if rotation has to happen, there has to be couple generated. In the case of belt one surface is moving in one direction, other surface is moving in the other direction on both sides of the yarn and so you had the couple from where do you get the couple here you remember. If you put a roller on a inclined plane what happen, what do you expect, if you keep this roller on an inclined plane.

Student: (Refer Time: 08:26).

What is that?

Student: It will roll down.

It will roll down, why will it roll down?

Student: (Refer Time: 08:35)

Why should it not slide down? Because of gravity.

Student: (Refer Time: 08:48)

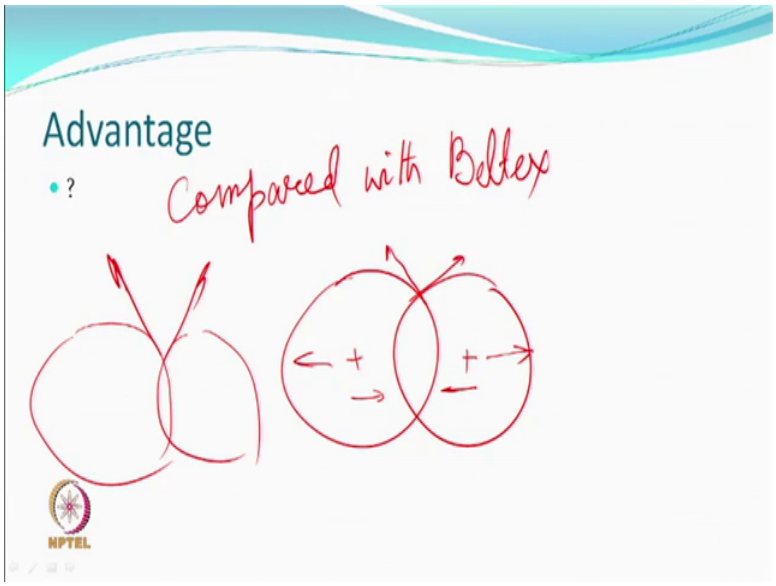
Student: Friction force and gravitation force (Refer Time: 08:51)

That means, you are saying that one force, which is in this direction the other is in this direction they are causing thing.

Student: (Refer Time: 08:58) no sir their component of (Refer Time: 08:59)

All right so for a couple to be created there has to be a friction. If, there is no friction, it will slide down. In this case also when this friction is there and there is a rotation, this rotation from the middle of the let us say the yarn mass, you will have one opposite and the other in the other direction and so you can create a couple there as well, that is why it rotate you cannot create a couple there will not be any rotation, it will generally only be dragging or slipping. So, in this case is relatively more simple to understand that there is going to be a couple.

(Refer Slide Time: 09:43)



So, we have the Beltex system and now we have the Ringtex system, so obviously, an slightly different technology, so people talk about compared with Beltex. What likely advantage is here, both are nip controlled, both have very easy way to generate a couple so that rotation can take place both have nip, both will forward the action and so rotation and forwarding both will take place in some sense, they are both dependent on the yarn crossing, the belt crossing angle or the ring crossing angle and the speed.

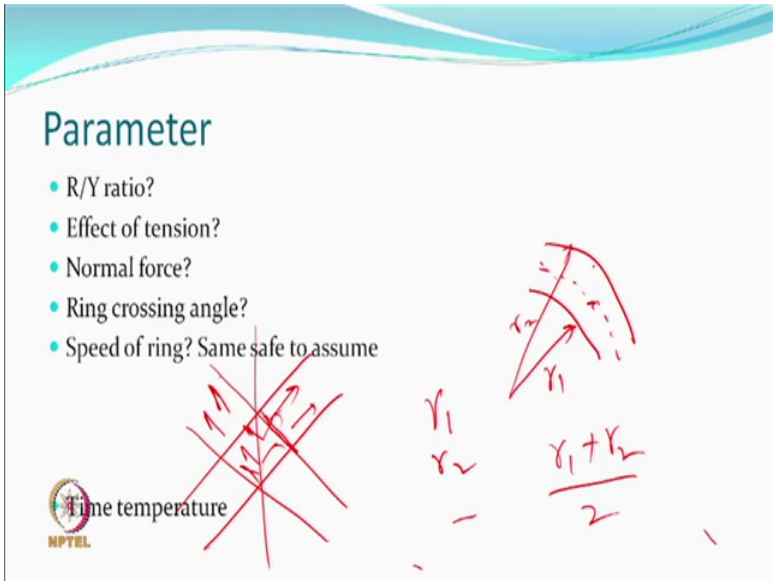
So, if we consider either both of them are equal or they are different.

So advantage which the designers talked about of the ringtex over beltex was that the adjustment of the angle, which is the ring crossing angle is easy in this case all you needed to do was change the centre of the rings, rotating rings, outwards or inwards and the belt crossing angle will change if you change this, because if the belt crossing angle let us say you are defining a tangent in this way here, and a tangent in this way here. This can be changed when you change the overlap, if the overlap is less, then you can have different angle.

So, what it says is in the other case, you had to move the whole twisting assembly for changing the angle, which means all the drives also had to be changed. Let us say something you rotating with a belt or a valve system, then whole of that must change in order that the belt angle has to be changed. In this case they felt that is so easy just move either outside or inside simple screw mechanisms, you could just rotate and then it goes

in and goes out. So, this is one advantage which was being claimed by the ringtex designers.

(Refer Slide Time: 13:06)



So, some of the controlling parameters R by Y ratio yes, so what did we say about the R by Y ratio? In case your crossing angle and the speeds are fixed, then R by Y ratio cannot change it automatically get determined and therefore, this used to be a very important parameter as far as the disc is concerned, in this case this is a parameter, you can talk about it you can calculate, but something else it determines.

So, they are independent, this is not an independent parameter which can be changed. If you have fix them and therefore, the same statement can be made that the quality of the textured yarn produced on a ringtex system, may be independent of the R by Y. In case of an ideal nip system, because this will be equal to what is the forwarding speed and so if it is equal to that there is no issue at all.

Also, if it is really ideal in that case the quality should be the best. I mean theoretically it you have completely have a control over the rotation of the yarn and so it is neither rotating more than what it rotating, there may not be any slip and if there is no slips so all those problem there were associated with friction, discs where slip was the main thing, here the slip should not be the main thing in case nip pressure is high, then slippage actually means too bad, then your characteristic really undesirable, then you will be actually breaking. So, if otherwise you should get the best result.

In this case also the tension would be there, the tension control has to be done because you are going to be doing, you cannot say that there will be no tension, because you still have a situation of a draw ratio and a drawing draw texturing machine. So, you will be pulling the yarn in any case, you cannot have a situation where the yarn is being pulled at the nip. The yarn is being pulled still at the between the feed roller and the takeup roller. And, therefore, this nip pressure is only to ensure twisting and not to create a nip where nothing can move all right.

And so, the tension will be there, but you will always be happy, if output tension is equal to the input tension. Otherwise, you will again have a situation of dragging or pumping. So, best situation will be where both the tensions are equal, their magnitude would change depending upon the draw ratios that you set up. Here also the tension is not providing the normal force, the normal force is an external externally created situation not a force. So, we have to press the rings, then we have to press the belts. So, that is an external independent relation. So, independent of tension, it is not dependent on tension of course, one can always say if the tension is too high, then maybe everything will slip for example, if you want to twist a steel yarn, steel multifilament yarn, under good mode of tension you may find steel is stronger than the belts which is so, flexible everything is slipping nothing is happening but, in a case where the textile filaments are being used which are the polymer based polyester nylon polypropylene then we are under a different situation.

The ring crossing angle problem here is how do we define a ring crossing angle. So, the tangent here or the tangent here, if you carefully draw at a point you have a tangent, but if you have concentric circles and you try to define at a point where something is going to be crossing which; obviously, is not going to be in the centre of this, this centre could be here, in that case this tangent and this tangent may have different directions, you get the point or not.

This tangent and the tangent here and the tangent here of different concentric circles as you cross let us say here, this is this direction, this is this direction and this may be another direction. Because, you just have a line and depending upon the overlap the line maybe on any part of the concentric circle. So, how do we define this? So, we define for a ring system at the centre point.

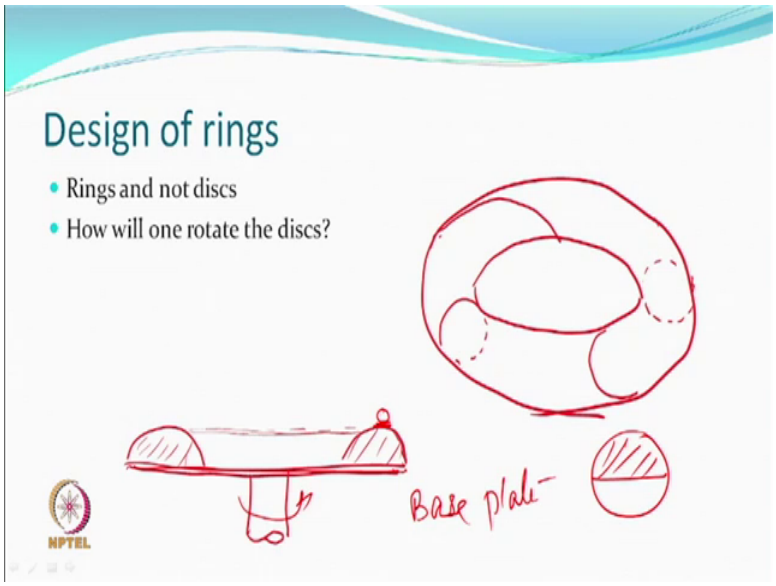
So, this maybe this centre of the thing, if there is r 1 is the radius of the inner circle, r 2 is the radius of the outer circle then, r 1 plus r 2 by 2 is the midpoint and we say when the midpoint is crossing, then you define that is the point where we call it a ring crossing angle otherwise, at absolute outer and absolute inter value will be different so, just to ensure that everybody is talking the same thing then you define it a point.

In the case of belt this was not so much of a problem, because every part of the belt was moving in the same direction all along, they all moving in the same direction, here also it is moving in the same direction, here also it is moving in the same direction, this is also moving in the same direction, every part wherever it going to be a contact.

So, in this case this is different, because we have changed the mechanism of the motion, speed of the ring is safe to assume that both the rings are moving with the same speed, the theoretically if one of them which is also being rotated by some belt slips, so, speed maybe slightly different so this will be slightly different, then the slightly different actions will be there.

So, whenever you are trying to make sure that everything because they are generally driven by through a transmission system and then a belt they do not have individual drives and even if you have an individual drive you can still have differences, but they should be linked in such a manner, that their speeds are same otherwise more complex phenomena will generate. Time temperature for the both the system will have to be optimized based on the material that you are looking at which does not change in any manner.

(Refer Slide Time: 22:56)



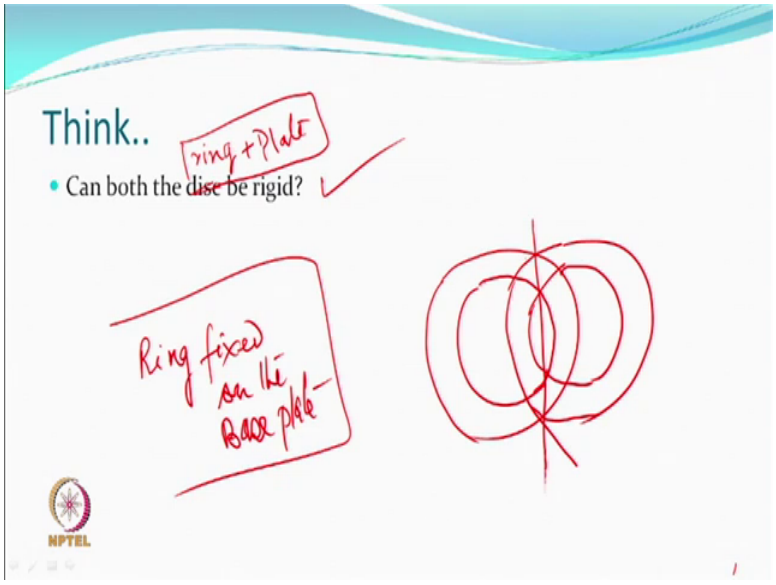
So, these are rings and not discs we had asked this question last time and we left how would you rotate ring, a disc or the discs, which you have to rotate and rotate accurately. Did you think about it, you this type of article is the shape of a Taurus you see that the people play with the rings right. So, let us say this is rubber right rubber or a polymer that you are looking at and we cut into half, we slice it half so, if you slice the full of it, then it is circle, if you slice completely through the thing, you would have one section and the other section may not be there. So, instead of having a full Taurus ring you have a half Taurus ring that you have and what you do you fix it on another rigid body, another rigid body like this.

So, you have a base plate on which this half Taurus is mounted and fixed, frozen, glued and now you can rotate this base plate and, so, this will rotate, because the contact surface is this; the contact surface is this, where the yarn is going to be placed at some point and the others ring will be on the opposite side. So, the ring is actually fixed on a plate, which is which can be rotated very easily. So, this is the cross section of the whole thing. So, there is a plate on which half of the Taurus is fixed. So, if you look at one ring this will be looking like this as a cross section part of it and so this can be rotated like in a bicycle, you have spokes, only then your tire runs you need to have something.

So, in this case you have a base plate. Now, the base plate is rigid. This Taurus may be a polymer, polyurethane or something similar, which is relatively softer, flexible, but

unlike the belt in the beltex system, which had hardly any support here you have a support. Therefore, they also say that this is more rigid and therefore, any damage happening because of vibration will be less you can press it also much more controllable way, because there is a rigid plate right. So, they said now vibration issues will be less, changing the ring angle ring crossing angle will be easy and so damages will be less more control. So, this is an engineering solution if you say I will do this you have to have something else supporting you as well not so, difficult, but still a problem which has been addressed.

(Refer Slide Time: 27:36)



Now, this is interesting. So, one ring, the other ring both are on the base plate, base plate is rigid. Now, we said if there is a rigid body in contact so vibration issues are going to be taken care of. So, both are rigid now, no harm to the fibre, it is not too ceramic surfaces are going to rub the hard surface is away. The one which is going to contact will be a polymers base surface right.

So, yarn is not going to be damaged, if we look at that. So, both can be rigid systems in that sense, but the question still remains can both the discs be sorry is not discs rings. Ring and disc system actually know, because there is that base plate this makes it rigid. So, ring which is fixed on the plate. So, this is together their rigid ok.

So, the question is now there are two of such things can both be rigid, does not look like ring all right. So, the question is this and the yarn is passing through this let us say. You

see any difficulties here one of the difficulty you can easily say is you are creating two units; one at the top other at the bottom. The direction of motion is bottom ring and the top ring at two different points is not same; that means, one nip is doing something else, the other nip is doing something else.

So, if you have both the rings; both the rings with the rigid base plate, then it is a very confusing system. In the case of belt you had only one nip, here you are creating two nip, you do not mind having two nips. If, they were doing same job like in a stack disc system, the many discs rotating, but all of them trying to rotate the yarn in the same direction, will this happen here. What will be the direction of let us say forwarding yarn, forwarding motion, that also has to be checked.

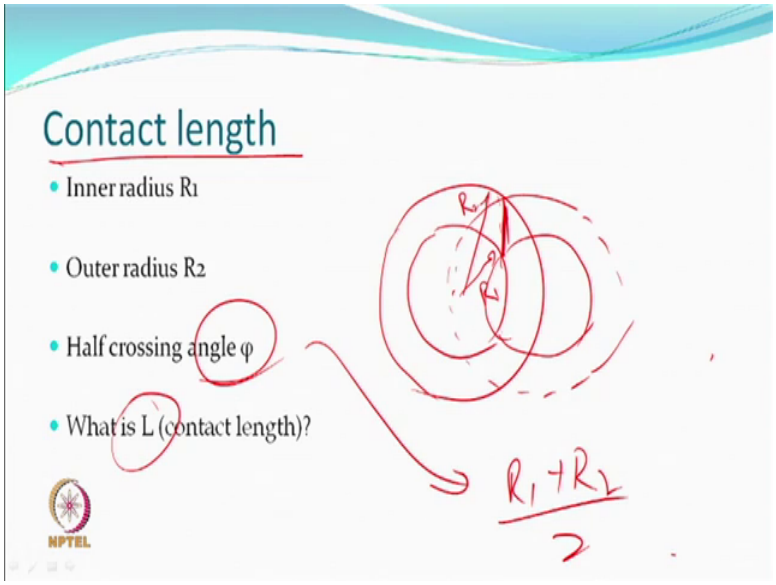
So, you might find it does not work something ones you throw on one side, the other ones you throw on the other side and that means, it should have only one nip, which is operational nip, other should be free, if you do not do that then you have difficulty. So, what do you want to do you want to create one nip and have rings two sets of one set of ring, one set of two rings right. So, what do you do now? That means, you create a design and you fill it immediately after creating a design, but they that is did not try to address this which was well. Because, there is no wrapping and the friction normal frictional force is coming by external means. So, theoretically you say well at one position there is normal force acting, at the other position normal force does not act, then there will be no friction, there will be no twist rising.

So, provide the normal force only where you want, you are moving the yarn upwards or you want to move the yarn downloads based on that you create real nip at that point. So, they said well, well said and therefore, if you have both the rings rigid, you press at any point of time, the pressure will get transmitted to the other side as well. So, you may say that I am applying only here, but they are rigid body and there is an axes or a point which is through which is being rotated so it is fixed there also if you apply pressure there everywhere the pressure is same.

So, if you have two rigid bodies we apply a pressure in the centre everywhere that is it. So, how do you apply a normal force at one point and not apply at the other unless and until you have one of the ring as flexible and the other as rigid. So, where you create a nip, because of the external pressure the whole body reacts like a rigid system, on the

other side it is a flexible ring theoretically you can design to take it away, the flexible because the plate is flexible, instead of the both the plates plane being parallel all the time in one case, you can deflect the plate little bit, so the pressure does not get transferred the normal force and then goes back just a deflection a minute deflection and then is just comes back. So, you cannot have both the rings rigid.

(Refer Slide Time: 36:22)



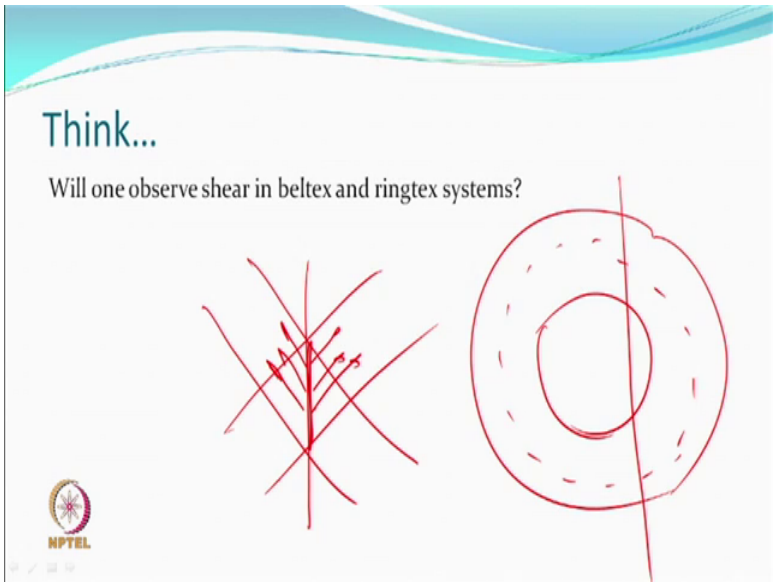
So, you have obviously, there is an overlapping ring also, wherever let us say here only. So, you can define your half crossing angle at R 1 plus R 2 divide by 2 at this crossing you can define this. So, you are interested in this finding out this. Why, I both the things in the case of belt as well as hair, we are trying to say the contact length, because if the contact length is 0, then also you have difficulty.

So, there is a finite contact length. So, you write some equations and integrate over this length, like in the other case also if we have to find out the total impact. So, we have wrap angle, which is called the wrap angle you integrate over these wrap angle and finally, find what exactly a small change is occur. So, therefore, as the yarn enters it has no twist, the twist case generated from the first point itself and will get equilibrated as it reaches the other point this can happen.

Let us say, we assume lot of things there are no slips from points entry point to the exit point in between everything is there which may not be true, neither in a belt nor in this case, but let us assume that, but this contact length L is going to be important. So, will

you able to find the contact length L in terms of R 1, R 2 and half crossing angle. Like in the other case also I think you did not get the right expression, then both the cases try to get the right expression to find the contact length.

(Refer Slide Time: 39:30)

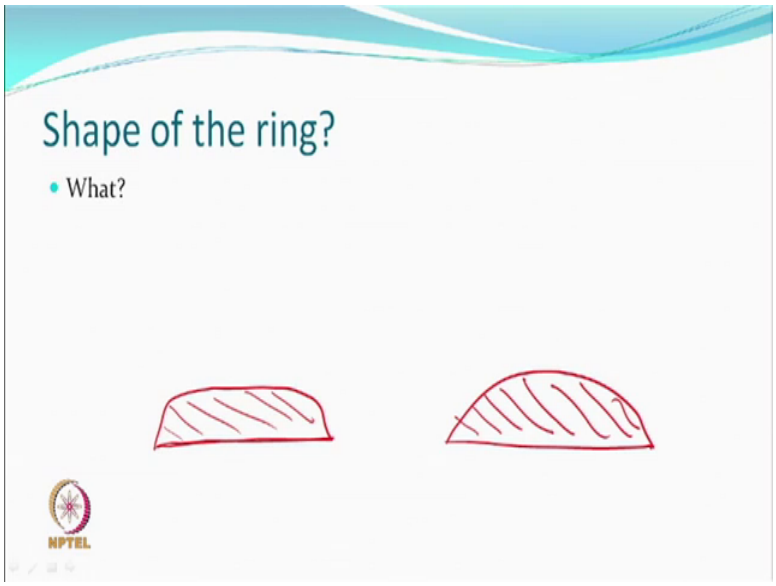


So, this is another question both are nip controlled. So, we expect nothing can move against the wishes of the ring or the belt. So, this is a question what we say. In the case of belt, along this length which is in contact, the force that is acting on this at any given point will be this. So, interaction is going to be like this, you see there is no change in direction of motion.

So, we may in theory can say we should not get shaft during this twisting process in the belt system. On the ring system, because of the concentric circles coming to picture, you can expect the direction of the tangent at different points on this line which is the yarn will not be same. If the direction is not same and yarn is moving in whichever way it is moving. Therefore, at every point of contact, the force direction is different and if that is true; that means, the shear is inherent in a ring system shear is inherent which is not in the case of belt.

So, you have two systems one have one type of advantage, the other has other type advantages so you choose what you want.

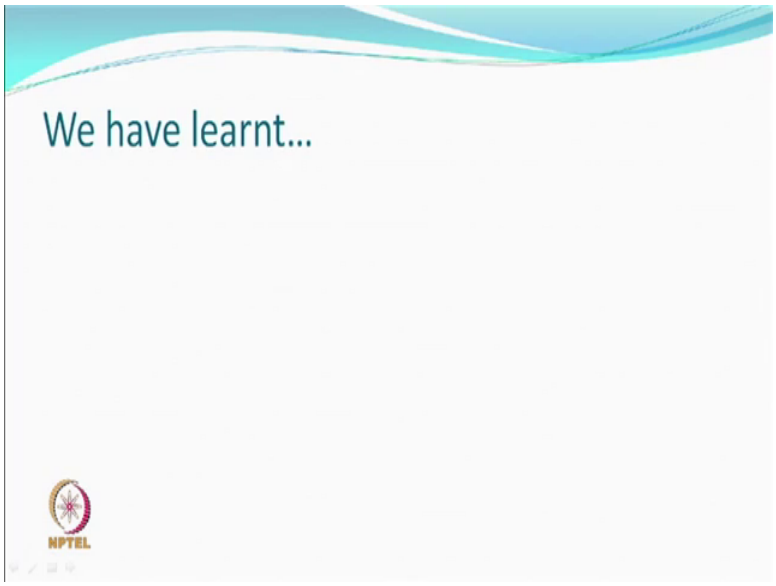
(Refer Slide Time: 41:56)



Now, if shear is to take place then what we do, say reduce the contact length so less shear, increase normal force, reduce contact length these are the kind of thing that you can do; obviously, without damaging the fibre itself. So, one can have the shape of the ring like this or you can have the shape of the ring like this.

So, based on both of them will have their own advantage, disadvantages, higher the length will be higher length will be provided by one, shorter length will be provided by the other. One will give you better contact, but may also give more shear, other will have less length contact length, but shear will be less. So, again you choose what you want kind of thing.

(Refer Slide Time: 43:04)



So, this is what we learnt, what have we learnt, that there is a possibility of having a better control on twisting, by using a nip controlled systems; belt or ring or two what we have discussed, which you could always think belt plus ring, belt plus rod, ring plus rod, various kinds of things people will like to have and their advantage disadvantage can also be thought can also be worked, but definitely because of these systems you are able to process finer yarns because, the control in if all parameters are set correctly the chances are that you will get a better quality textured yarn. So, we stop here.