Science and Technology of Weft and Warp Knitting
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Module - 2
Lecture - 7
Circular Knitting

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Welcome participants. Now we are going to move to lecture 3 for week 2. Today the topic is circular knitting. It is more sort of similar to flat bed knitting machines, but fundamentally, the only difference is the bed which was flat in case of flat knitting, but now it is going to change to circular. Apart from that, we are also going to learn some of the new machine elements which is very critical during knitting process. So, let's, before we start, let's quickly recap what we covered in the previous lecture.

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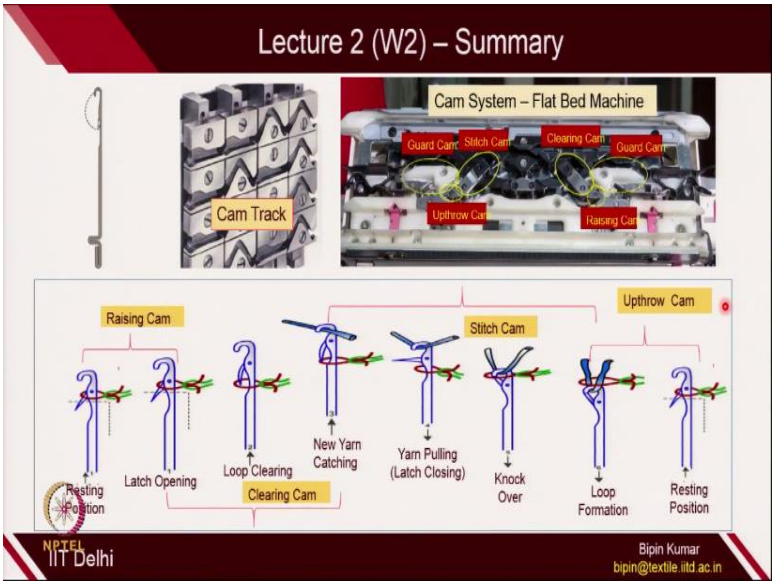

In the previous lecture, I give more emphasis on the cam track, because this is the fundamental principle elements during knitting process. Because the cam interacts with the cam track which is created by cam system. I also introduced to you the cam jacket of single bed flat knitting machines. Some of the knitting cams was also explained in details, including raising cams, how their positioning on the cam jacket is important synchronized, which helps the needle to perform certain movement in a certain fashion to make the knitting successful.

So, raising cams, how it helps in latch opening; clearing cam, it is, make sure the old loop is knocked out and also the new yarns are getting catched. In stitch cam, you can see the needle goes downward movements. It starts pulling the yarn, then the latch get closed and the old loop is knocked out. And finally, the upthrow cam, once the job is done, the needle is raised again to go to the similar resting position.

So, this was the resting positions. And again, this become the resting position. And each of these cams is shown in the figure here. And also, we explain in details, the importance of each of these cams. Now, we are going to change the technologies.

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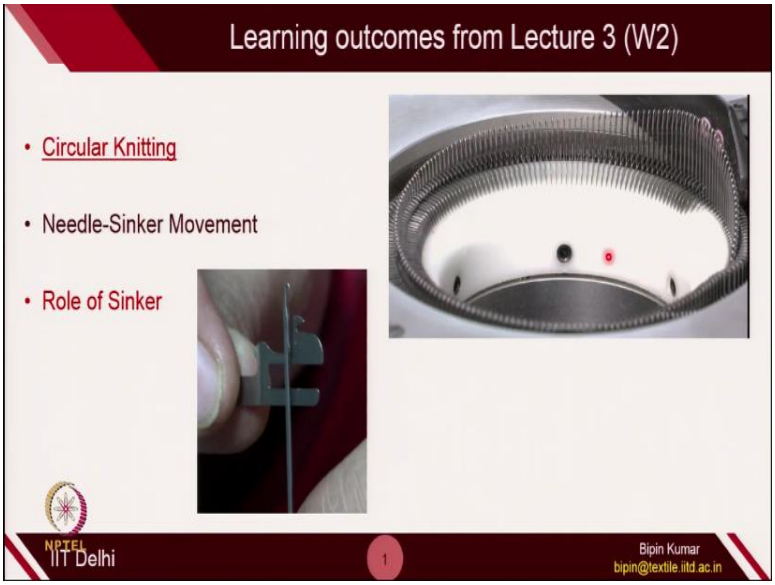

In this particular lecture, we are going to introduce you new technologies related to circular knitting. So, as the name suggested, circular knitting, the knitting is done in a circular fashion. Now, the new element, I am going to give more emphasis which is called the sinker. In the last lecture also, I introduced the sinker word, how the sinker loop is getting formed. But this time, you are going to see a new element which is the sinker which play a major role of knitting during circular knitting machine.

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Let’s start. Circular knitting;

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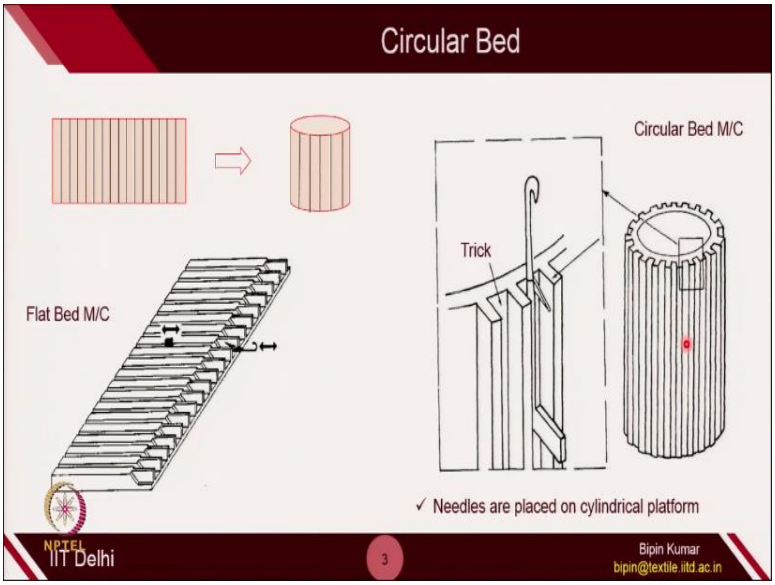

Fundamentally, if you see the bed of flat bed machines, the slots was there and the needles was placed in a parallel fashions in each of these slots. So, you can see here, this is the rectangular platform on which slots was created. And each slots, 1 needle was placed. To make a circular bed, the design is extremely simple. You just rotate, if you rotate this bed, it will act like a circular.

The only difference is, if you see the flat beds, both the ends are open, but in circular bed, ends become permanently closed and it is, it acts like a circle. So now, this rectangular platform, it changed to a cylindrical platform. So, here is the machine, how it looks. The schematic you can see here. It is a cylindrical platform. And on this cylindrical platform the slots was created. And each of these slot which is called trick, one particular needle is placed.

And these slots are separated by 2 walls which also plays a very important role which I am going to discuss you in next few slides. The only difference is, here in flat bed, the needles are placed on a flat surface. Here, in circular bed, the needles are placed on a cylindrical platform. So, that's why it is called circular knitting.

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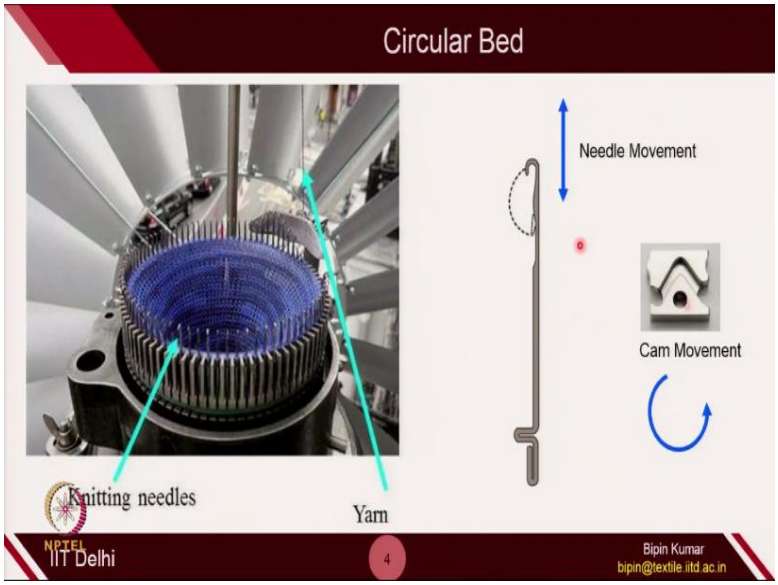

Here is the actual diagram of the machines. You can see here, the needles are placed on this vertical slots or the tricks and yarn is getting catched. Fundamentally, the interaction of cam and needle remains same or similar as of flat knitting machines. The needle moves upward and downward reciprocative movements, depending on how it interacts with the cam. So, the cam rotates along the curved surface of the machines.

Because of that, the needle raises up and goes down depending on the cam track which is there on the cam jacket. So, this is fundamentally, the interaction of needle and cam, I have already discussed in details. So, I am not going to give more emphasis on that.

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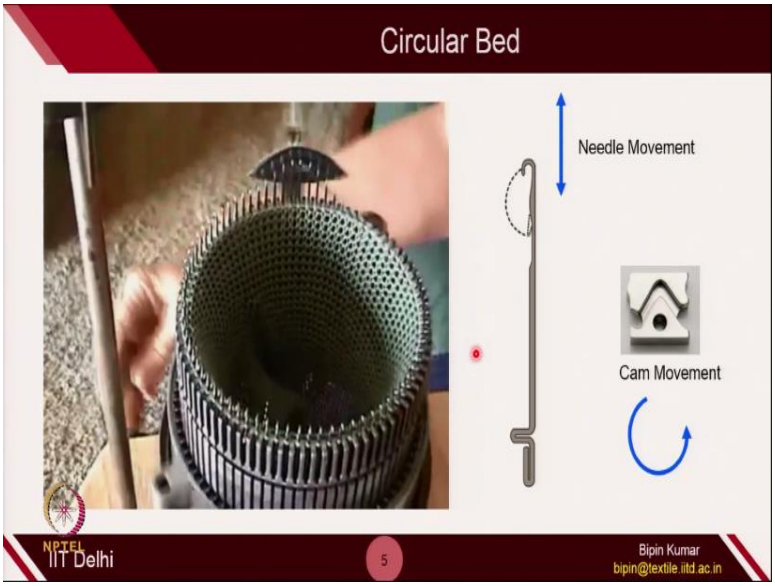

Here you can see how it works. **(Video Starts: 05:06)** So, you are rotating the cam on the curved path. And because of this, the needle is going up and down and making the fabric.

And the fabric is pulled. You can see, these are the **(Video Ends: 05:17)** green color yarn. The fabric is pulled from the downward direction. So, the movement of needle and the cam remain perpendicular.

So, this needle moves in vertical directions and the cam is rotating on a horizontal platform in a circular fashion. So, this is how the circular bed or circular knitting is designed. Fundamentally, there are 2 different things in the circular knitting also.

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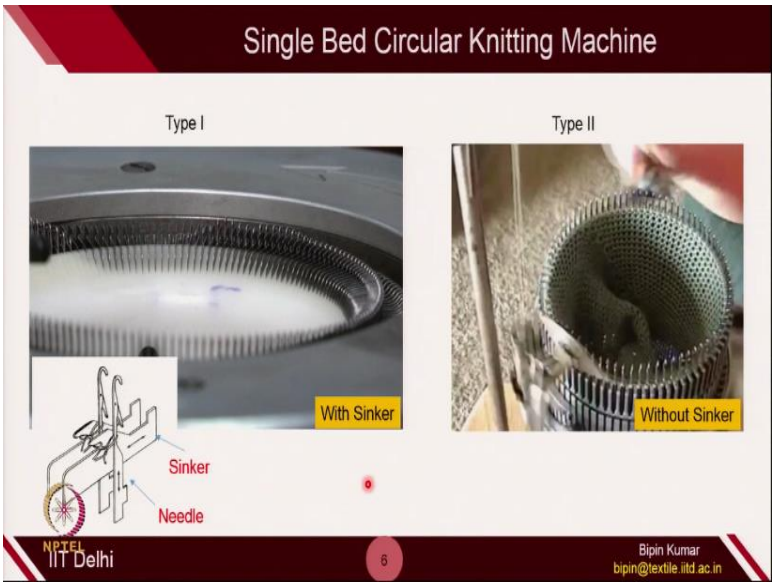

In one of the circular knitting technologies, we have sinker element which is present. And in another one which you just saw the video in the previous slides is without sinker. So, sinker is one of the major element which is required on the machines to do the knitting, especially in case of circular knitting. Sinker is also very important in warp knitting. Once we introduce you warp knitting technologies, there you will get to understand the role of sinker.

But in circular knitting, sinker become extremely popular. And most of the knitting products, especially hosiery, they have this type of sinker based machine. So, sinker is no doubt, one of the key element in knitting technology. So, we need to understand the functioning of sinker element extremely well, so that it will help you to understand the knitting process.

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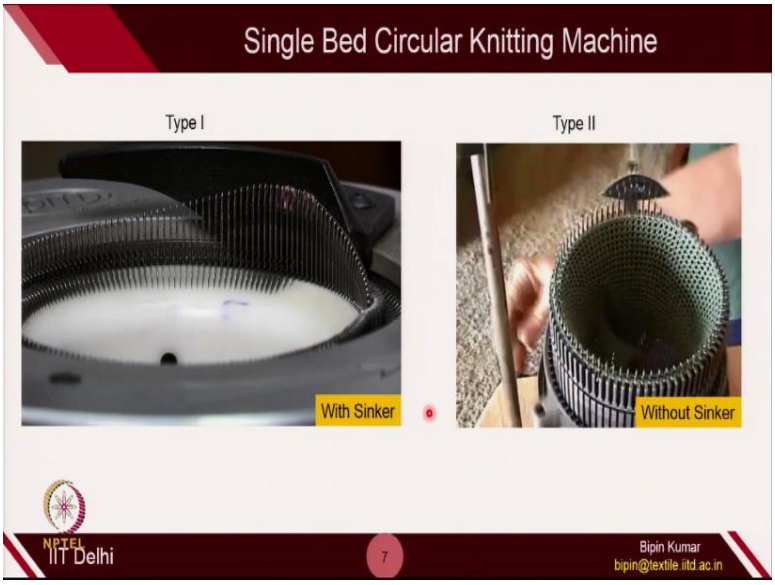

Let's see, I have the small videos of running 2 machines simultaneously. So, with sinker, at this moment you would not be able to properly absorb how the sinker is happening, **(Video Starts: 06:53)** but at least I will try. You can see here, there is something going inside and coming out. So, this part is the sinker part which goes inside and come outside and the vertical directions, the needle is doing the actions. **(Video Ends: 07:12)**

We are going to understand this particular motions more in detail once we introduce to you the sinker elements. The other machines in circular knitting is based on without sinker. So, here you can see, there is no sinker elements. Only needles is going up and down and cam is doing its role. So, in sinker, similar to the needle which is going up and down, sinker is also doing the reciprocative movements perpendicular to the needle directions.

So, that is the fundamental difference between with sinker machines and without sinker machines. So, 2 elements are simultaneously play an important role in loop formation. Without sinker, only needle is sufficient to make the loops; but with sinker, you need needle as well as cam in a proper fashion. **(Video Starts: 08:00)** Here you can see, only the needle is going up and down. So, most of the machines in circular knitting is based on sinkers.

So, in this particular lecture, **(Video Ends: 08:11)** I am going to prioritize mostly on these type of machines where there is a sinker attached on the circular knitting machine. Needle sinker movements: So, let's see how it looks.

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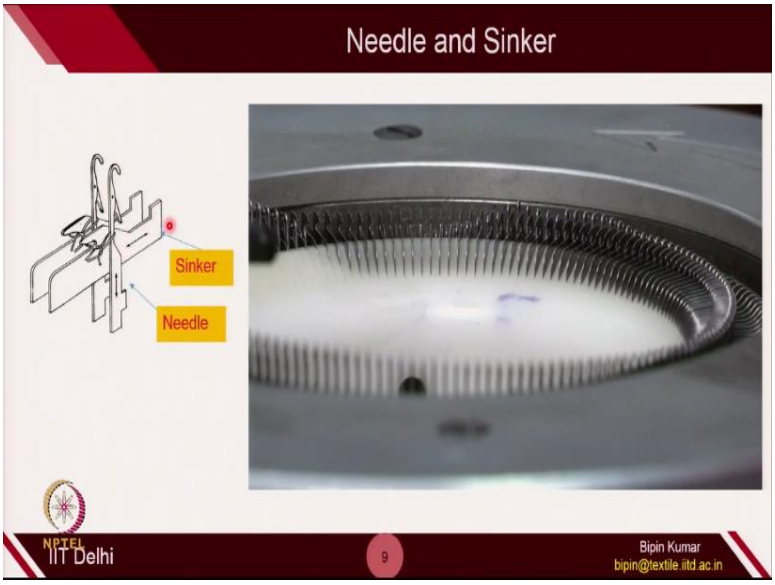

So, you can see here, the needle, if you see the schematic, each needle is placed between 2 sinker elements. On this photo also, if you try to observe, these are the sinker elements. And between each sinker elements, 1 needle is projected upward. If you try to enlarge this part, it will look like this. So, needles are placed along the circumference in a vertical trick and sinker are placed along radial directions. Okay.

Between 2 sinkers, 1 needle is projected upward. And these 2 elements does perform the reciprocative movements during knitting process which we are going to understand in detail. So, the needle moves upward movements, while the sinker moves in the radial direction. So, it comes out and goes inside on the cylindrical platform along the radius. So, you can see here, the direction is also shown in the arrow. And the direction of needle is in the vertical direction and the sinker is going in the radial directions.

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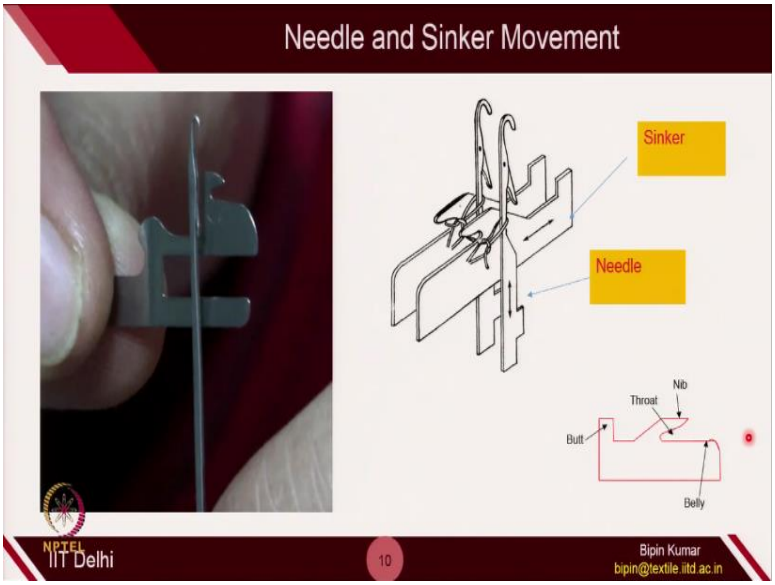

This is the actual sinker elements which you can see there. Lot of sinker designs are there, but at this moment, I have just one photo is with me. So, if you try to observe this sinker elements, there are certain parts of the sinker. Similar to the latch needle where hook, latch, there are so many important elements of the latch needle which helps in knitting process. Sinker also have very important elements which helps in knitting process.

So, the first one is the butt. So, similar to the butt of the latch needle which do the reciprocative movements in upward and downward directions, sinker also doing a kind of reciprocative moments. So, you can see here, the sinker is doing a kind of reciprocative movement. And this is only possible with the help of butt. So, this is the butt part. At this moment, the butt is hiding with my finger.

So, the butt part is this part. And to do the reciprocative movement naturally, we need a cam track to which the butt can follow. So, once the butt engage with that cam track, this sinker moves, does a kind of reciprocative moments. Apart from butt, it has certain other elements in its structure. The first one is the nib part. You can see here, this is the nib part. And this weighted part is called throat with the free part. And the platform, this one, is called the belly. So, these 4 parts plays a very important role in loop formation on circular bed machine.

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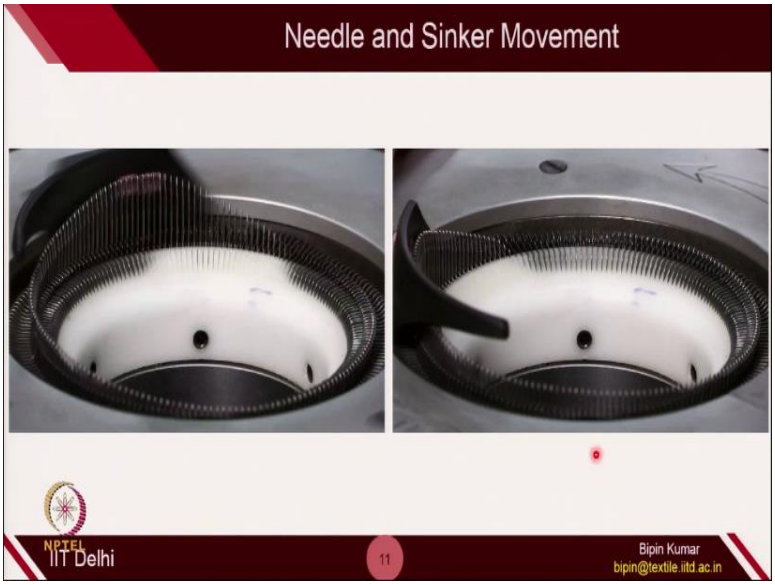

So, let's try to understand this. So, before that, let's, I have a small videos which you can able to see and observe the movement of both of these elements. **(Video Starts: 11:25)** So here, you can see, the needle is going up and down, although the speed is much higher. So, and here you can see in a very slow movement. So, here you can see, there is a, some objects which goes inside.

And at this moment you can see the sinker part. And this is the needles which is going up and down. So, at here, the needle is in the download position. Here, needle is in the upward positions. And you can see here, now the sinker is coming out. And at this moment, all the sinker is inside. So, this is how it works. **(Video Ends: 12:05)** I will introduce you all those moments in a while.

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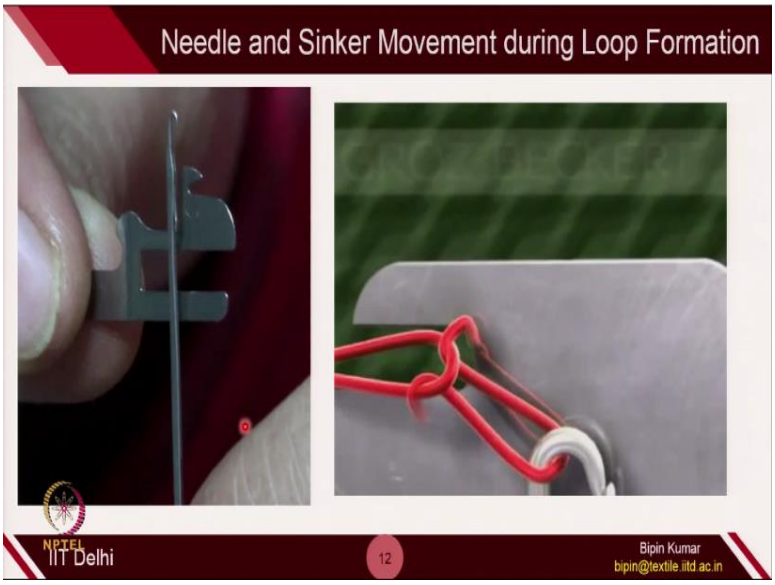

How this needle and sinker interacts and helps during the loop formation? **(Video Starts: 12:15)** Let's see it. So, once the needle goes up, the sinker moves back, catches the yarn. Once it catches the yarn, again sinker moves forward so that it holds the loop. So, you can see here, once the needle goes up, sinker moves back; once it catches the yarn, sinker goes inward to catch the loop. **(Video Ends: 12:36)** This is how it works. Let's try to break down each of these movement;

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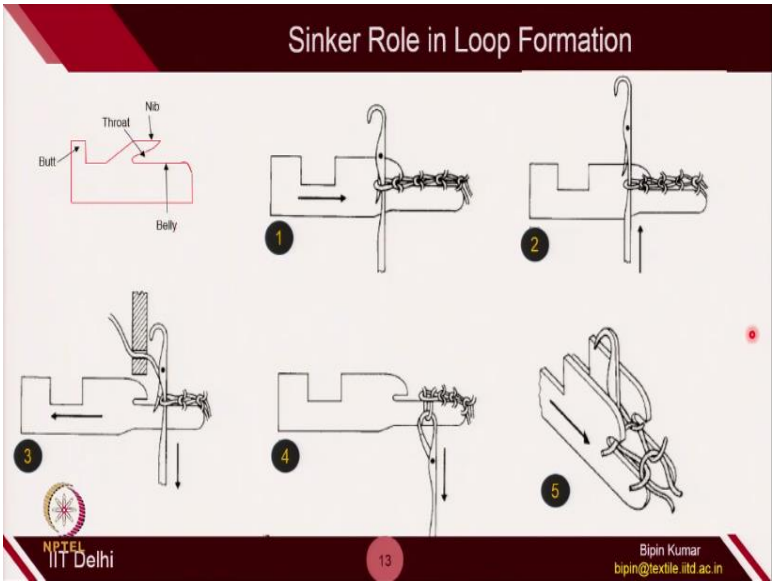

And try to understand the role of each of these parts of the sinker. So, the first thing. Once a needle is having the loop and needle starts to raise, at this moment, the sinker movement is forward. Forward in the sense, because the moment needle starts to raise on the cylinder, it has to hold the fabric. So, to hold the fabric, naturally the throat is the right options, because, between the throat you can hold the loop.

So, that's why the sinker moves straightaway forward direction, so that it can catch the loop. Loop in the sense, in this throat part, actually it is catching the sinker part of the loop. So, the moment the needle starts raising, since the sinker part is fixed in this throat part which will not allow the fabric to raise up along with the needle. So, in the second part, you can see here, once the needle is raising, because the fabric is hold or the sinker loop is hold between the throat part, due to which fabric remain in the same position.

Only the needle raises up. So, once the needle starts rising up, the latch is opened because of the old loop, similar to the flat bed; where, because the needle is raising up and the old loop remain stationary. So, with relative, as soon as the needle raises up, the old loop interacts

with the latch and latch open up. So, you can see here, the latch is getting open. And this is only possible because the movement of the fabric is restricted because of the sinker.

So, sinker definitely has a huge role to play during fabric formation. And it is the throat part which is responsible here to catching the fabric during needle rise. Once needle rise, the hook is now free to catch a new yarn and new yarn is fed. So, once the new yarn is fed, the downward motion of the needle is started. But at the same time, since the yarn is going to be catched by the needle, you need to pull this yarn in the downward direction.

At this moment, you have to release the fabric. So, that's why this sinker starts moving backward directions. The reason is, because it has to release the fabrics so that it can catch the new yarn and new yarn can go and fit inside this throat part. So, as soon as the needle starts downward movement, sinker is now going in a backward direction and the fabric is almost released. Okay.

After that, you can see here, now the fabric is released, the sinker is placed here, the needle is still moving down. So, once the needle is moving down, you need support to create sinker part of the loop. So, that's why, the belly, you can see here, this belly is playing crucial role, which is giving support to the needle to make sinker loop formation. So, needle is naturally carrying the head and 2 legs, but the sinker part, the belly is helping to create.

And once job is done, again sinker moves forward. You can see here and holds the fabric. And this is the resting position of the needle. So, you can see here, each of these parts: the butt helps in reciprocative movements, the right and left along the radius; the throat which is created by nib and belly helps to hold the fabric; the belly platform and this especially this longer platform actually helps to create sinker loop part of the loop during downward movement of the needle.

So, each of these parts of the sinker is designed very carefully. Also, the movement of sinker as well as needle is synchronized properly so that all of these knitting actions act takes place in a synchronized fashion, in a timely fashion. So, the cam design as well as the structure of needle sinkers is properly timed.

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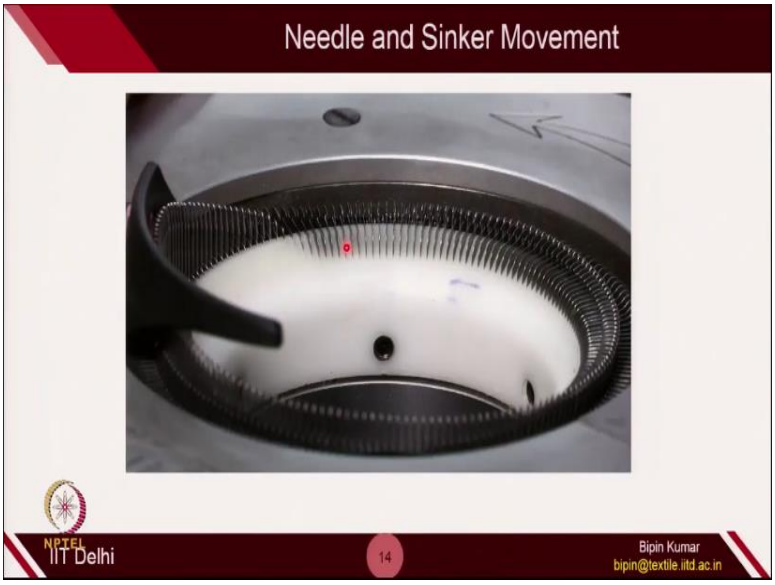

So, here you can see in a slow motions. **(Video Starts: 17:07)** So, you can see, once the needle is in the highest position, this is the highest position, the sinker is going down. And once the needle is coming down, you can see here, the sinker is coming out. So, once the needle is going down, you can see here, the sinker is coming out. So, needle is going down, you can see here, the needle is going down and sinker part is coming out and it is providing the belly platform. **(Video Ends: 17:34)**

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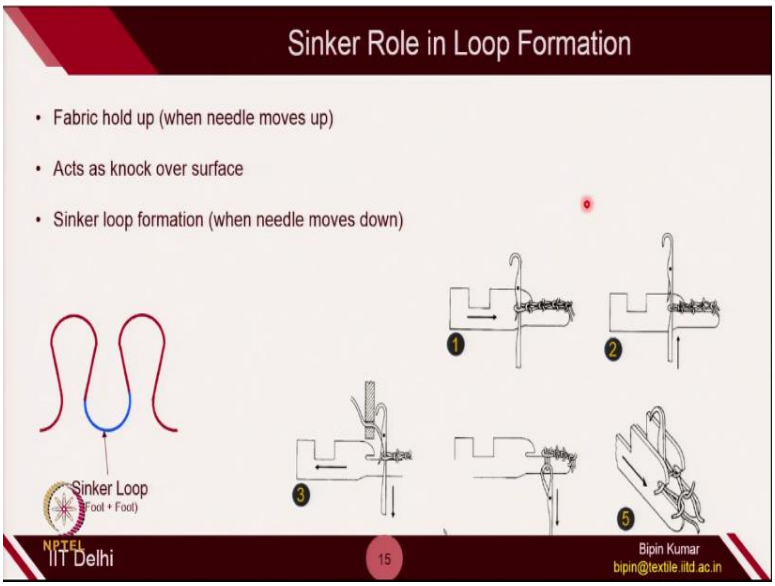

So, in summary, if you want to understand the sinker loop in knitting process, it helps in fabric hold up. Because once the needle moves up, it is holding the fabric, especially the sinker part of the loop to not to allow the fabric to raise along with the needle. It is also acting as a knock over surface, because during the downward movements, once the once the loop is released, obviously it is supported by the belly part.

Also, it helps to form the sinker loop formation. I hope you will be understanding how sinker loop, the name is given, because it is the sinker element of circular knitting machines which helps in sinker loop formations. So, this is why this sinker loop is named, because this sinker element is responsible for creating this sinker loop part.

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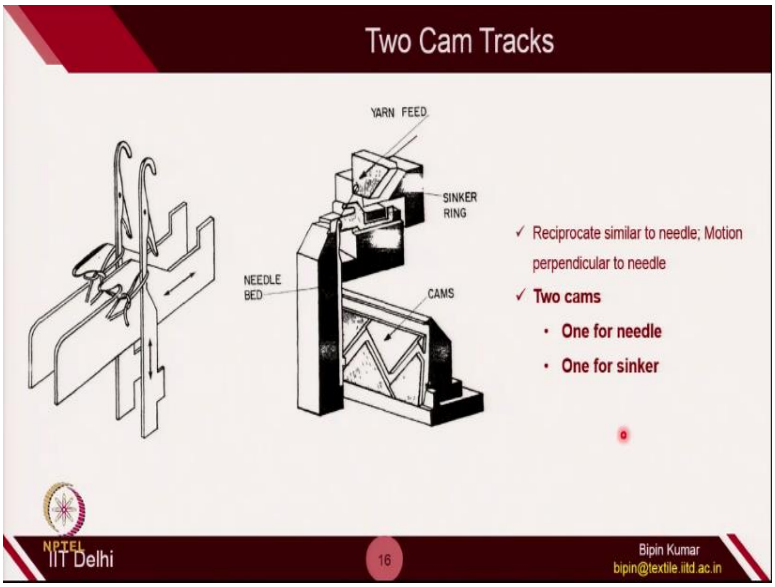

Obviously, because both the needle and sinker are playing simultaneously, we naturally need 2 cam tracks. I am not going in the detail on the track design, because obviously, in the last lecture, we have given sufficient time in understanding the different cams, how they are placed in a certain fashion for the interaction with the butt. As the interaction of butt is defined according to the cam jacket and the reciprocative movement of needle is decided.

In similar fashion, the sinker cam and you can see here, this is the cam profile for needle. And the sinker, sinker butt is here. A similar cam track is designed for the sinker movement depending on its position on the machine with respect to the knitting process. And the designing principal remain same, obviously the track, timing, raising, the distance traveled, all has to defined as per the requirement.

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This is the actual machine; how the fabric **(Video Starts: 19:33)** is created. You can see here, the process is extremely fast. It is very difficult to actually understand anything on the running machines. But if you break up each of these process, obviously it follows the same sequence; the latch clearing, old loop clearing, knock over, catching yarn, all those processes of loop formation **(Video Ends: 19:59)** follow the same sequence.

And to support the needle in this process, the sinker also does some kind of reciprocative movements providing support in knock over, holding the fabric. So, definitely sinker become a integral part of machine in fabric loop formation.

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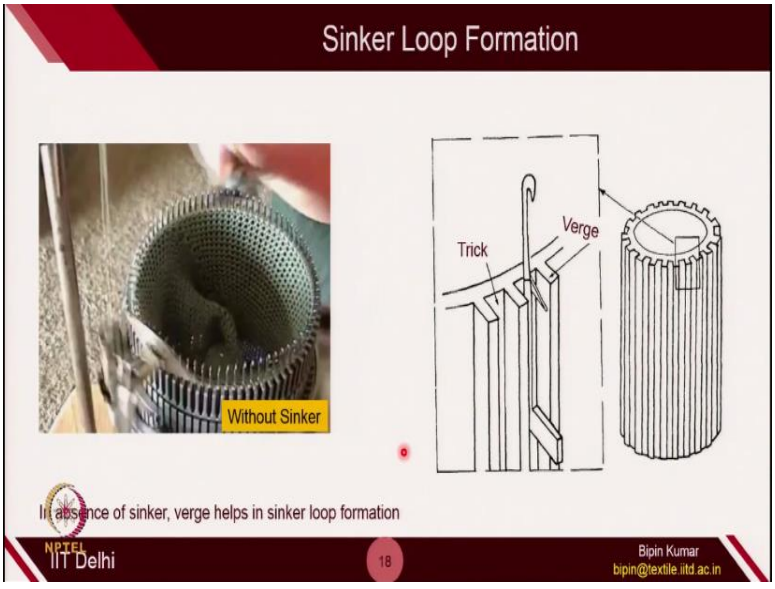

In case of other machines where you do not find sinker, which I showed you also in the last slides, you can have the verge. So, actually, the end of this trick wall. So, the trick is the slot.

To create trick, there is 2 walls. You can see here, in between 2 walls, this needle is placed. So, once needle goes down, it creates the head and leg part, but the sinker part is actually supported by this platform which is the end of trick wall.

So, this end of trick wall is called verge. I also introduced this word in the last lecture where on the flat bed you have seen some projected metallic bar between which the needle was moving in or out. The same principal is applied here. Once the needle goes down, sufficiently below, it catches the yarn, it makes the head and leg part. But because this is a hindrance and sinker loop is getting struck here.

And this is how the sinker loop is created. In absence of a sinker on a particular machines, especially in circular knitting, verge actually helps in sinker loop formation. There is nothing new in this, but most of the circular knitting market, 90% of the machines is sinker based machines. So, that's why sinker become most popular in circular knitting.

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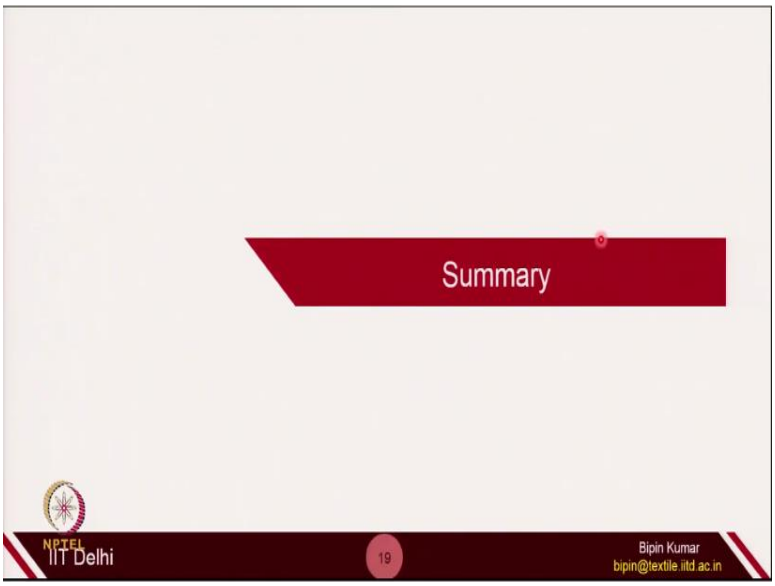

Now, let's summarize what we learned in this particular lecture.

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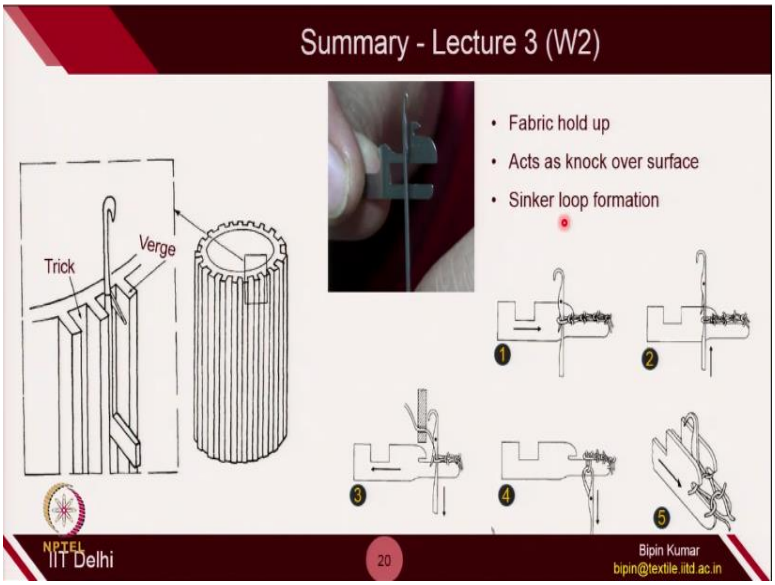

We tried to understand the circular knitting; how the needles are placed on a circular platform, the tricks are created. The principal remain same, similar to the placement of needle on a flat bed, on the trick on the slot. You just rotate those flat bed, make it such cylindrical, you will get a circular knitting machine. But I give more emphasis on the another machines where you have the sinker elements.

So, this in the sinker part. Sinker actually helps in fabric hold up. Once the needle rises up, you can see here, the fabric is holding up. It also gives our knock over surface, because once this goes down, the old loop is released and that old loop is supported by this belly part. It actually, sinker helps in knocking of the old loop. Also, once the needle moves sufficiently down, sinker provides its belly to create sinker loop.

So, that's why sinker loop of a particular knitting loop is given its name because of the sinker functioning. So, this is how I am going to end this particular lecture. In the next lecture, we are going to introduce you some new terms, some new terminologies, some new machine elements. Stay tuned. Thank you.