Science and Technology of Weft and Warp Knitting
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Module - 3
Lecture - 13
Weft Knitting - Double Circular Beds

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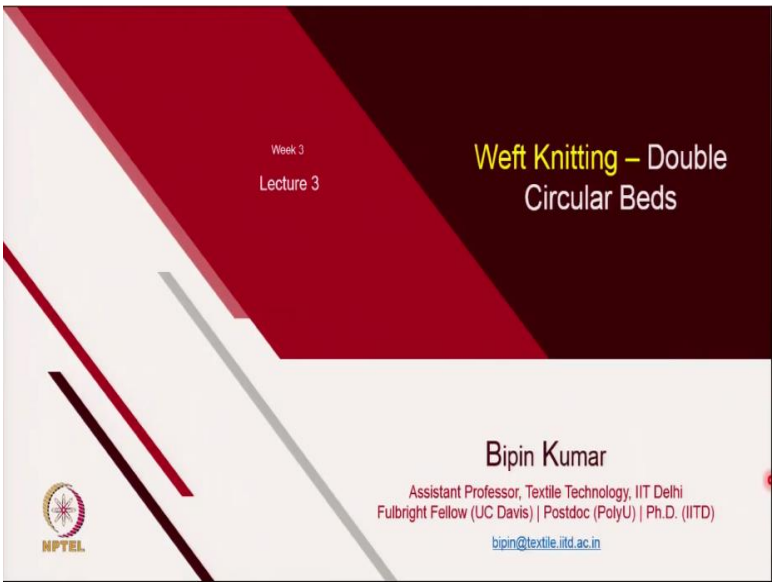

Welcome participants. Now, we are going to move to lecture number 3 in week 3. Today's, the topic is all about circular beds in case of double bed knitting technologies. So, in the last week, we have seen machines related to weft knitting, double flat bed technologies. But today, our focus is on circular beds.

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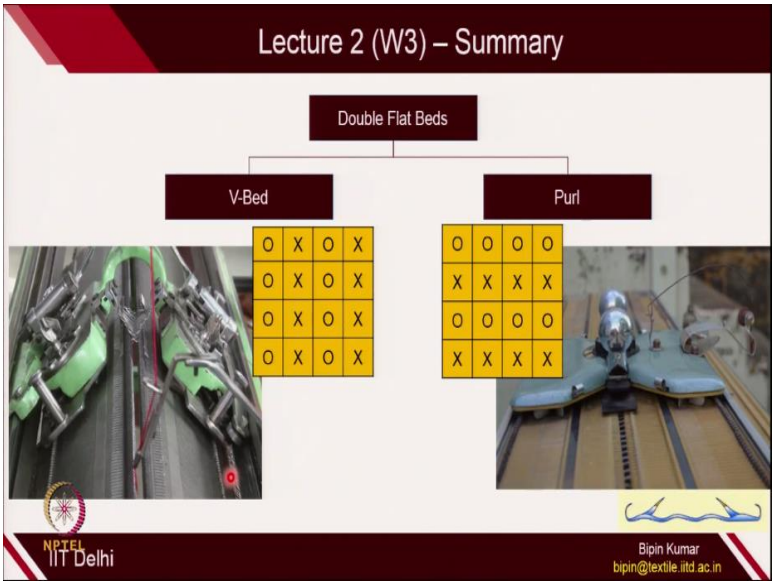

So, let's see a quick recap of what we covered in the last lecture. In last lecture, our topic was mostly related to double flat bed machines. Here, the needle bed is actually in the flat shape. So, they have the flat panel and on which the needles are placed in the tricks. And these double flat bed machines was categorically divided into 2 categories. One is V-bed machine and the other is purl knitting machines.

Depending on the nature of arrangement on the needles, the V-bed machine was able to create technical back and front loops in the course direction. While in case of purl knitting machines, the needles that was used on purl knitting machines was double hatch needle. And after making 1 course, the needle was shifted from one bed to another bed. The purl knitting machine, due to its nature, it was making the entire course of technical back and technical front alternatively.

So, here you can see, this is the technical front course. And then it is creating technical back course. So, in flat category, when the knitting technology having 2 beds, these are the 2 machines which is popular in this category. But, in the market, you will see mostly V-bed machines, because this gives you lot of flexibility. So, when we will move to lectures in coming weeks, you will realize this particular V-bed machine is highly flexible in terms of fabric design.

We can use this particular machine as a single bed. We can also use it for making technical back and front loop simultaneously. We can use it for making entire technical back or front loops, depending on what bed we are selecting. V-bed machine is the most popular one in case of weft knitting technology, in flat category. Now, let's see what we are going to cover in this particular lecture.

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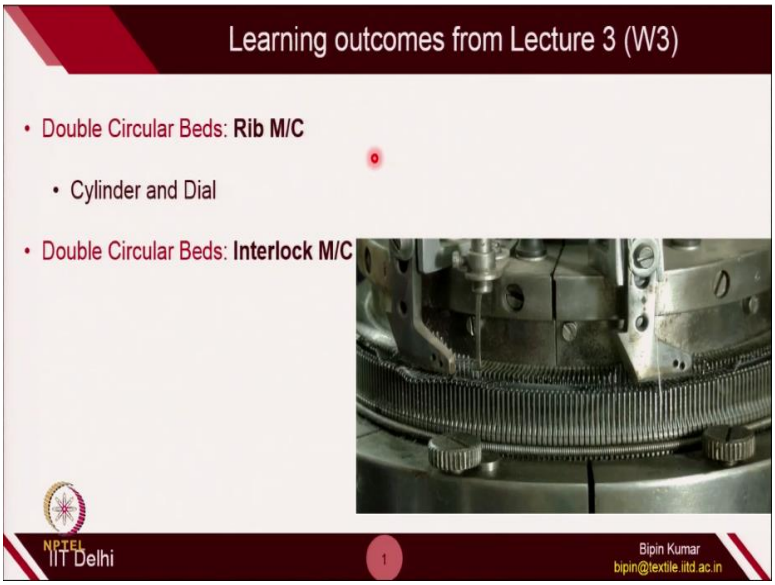

So, in this lecture, our main focus is double circular beds. So, we are still continuing with the production of double jersey fabrics which requires 2 bed. So, we have seen the flat category. Now, we are going to move towards circular category. And we can create double jersey fabrics. So, the first machine which we are going to learn in this particular lecture is rib machine. So, in rib machine, you will see 2 machine beds; one is called cylinder and the other one is dial, where the needles are placed.

And they actively take part in knitting process to create double jersey fabrics. Also, you will see another category of machine in double circular beds, which is called interlock machines. In terms of design or the look, both rib and interlock look similar, but only the arrangement of needles on 2 beds are different. So, that we are going to understand in this particular lecture. Now, let's move to the first part, which is rib machine.

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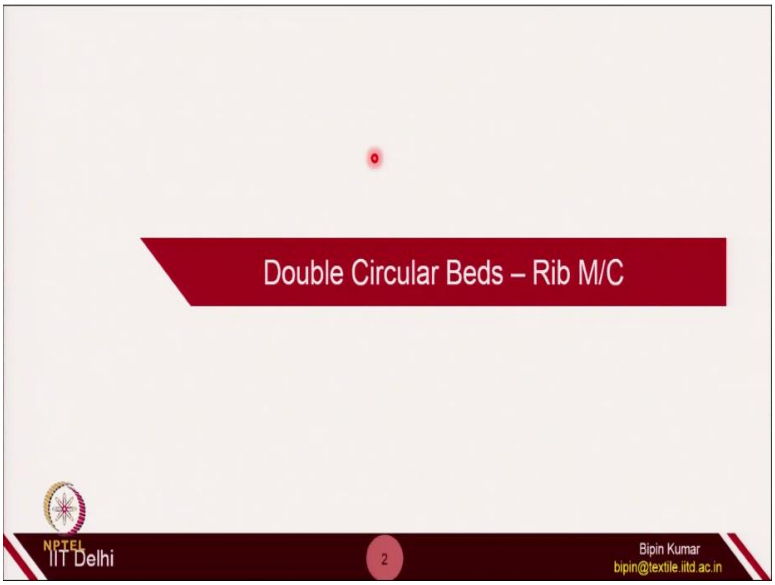

So, rib machine actually comes under double circular bed category. It is similar to double flat bed machine. The only differences is, here the needles are placed on a circular panel; it could be cylinder or it could be a disc. So, you have seen;

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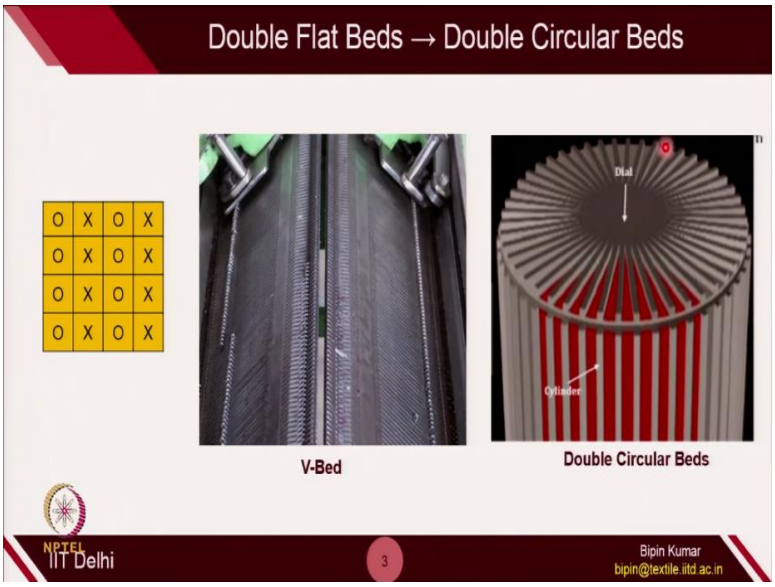

To create a double jersey fabrics in a single course, when you have to make technical back and technical front loops, you have the V-bed. So, one bed is making technical front, if we are watching from this side; and the other bed is making technical back. So here, there are 2 beds. To create a double bed on a circular nature, we can simply turn this flat bed and make it as a cylindrical platform, which is possible.

So, which we have already seen in single knitting technology. So, in single knitting, single flat bed, if you rotate, it will generate a cylinder. And on that cylinder, the needles will be

doing reciprocative movements. So, the similar principle can be applied here, where one of the bed, we can rotate to create cylinder for double circular beds. In case of other bed, we naturally have a different kind of arrangement where you have a circular disc and where needles are placed in radial direction.

So, this is the actual diagram of double circular beds. So, where you have 2 beds; one is cylinder and the other bed is dial. So, we are going to understand why these 2 are important. So, for the time being, these 2 beds are now replaced by cylinder and dial in case of double circular bed knitting technologies.

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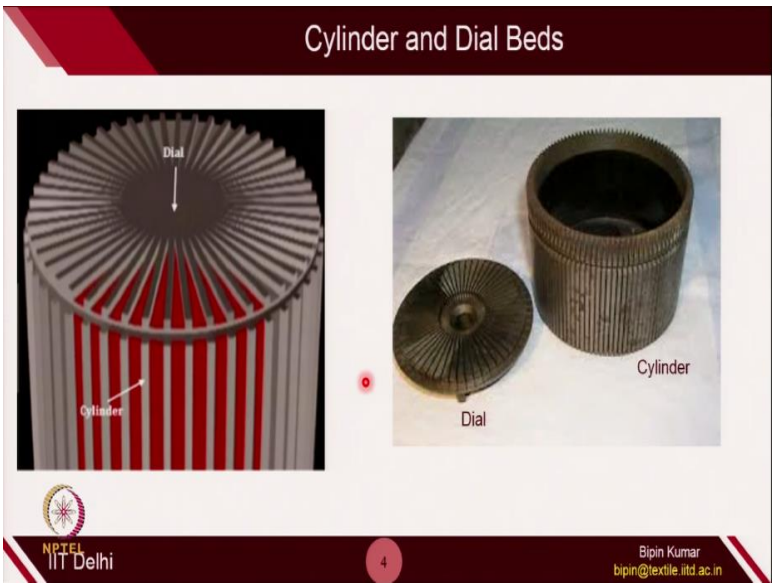

Here you can see, here the dial, the slots or the tricks is created in radial directions. So, you can see here, this is the radial direction. And the slots are created. In each of these slots, you fit needles along the radius. So, the direction of movement is along the radius. And the vertical cylinder, again the slots are created. And on each of these slots, you fit needles. So, this is how the arrangement of 2 beds are done in circular knitting technologies, which is having 2 beds.

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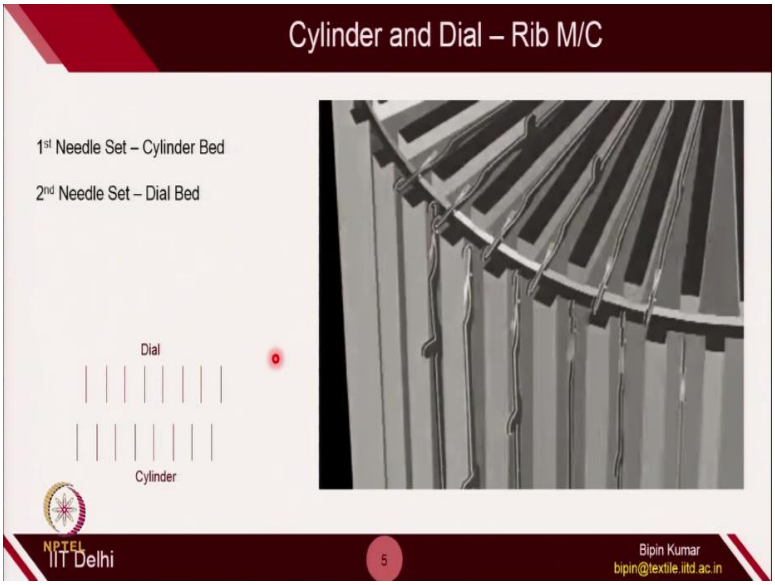

Here, I have a small animations where you can see how the needles are placed and how they are taking part in movement during, for making fabric. **(Video Starts: 06:39)** So, here you can see, there are 2 beds. So, the circular disc is dial and the vertical cylinder is called cylinder. So, here you can see, the 2 needles are placed and they are doing reciprocative movements. Cylinder needles are actually doing reciprocation in the vertical directions.

On the dial, the needle is doing reciprocation along radial directions. The key point here is, while doing this reciprocation, you can see, they are not striking each other. So mostly, the tricks are actually displayed, so that both the needle set should not face each other. Because, while doing the movement, if they face each other, **(Video Ends: 07:23)** then the head may collide with the other needle's bed.

So, in that case, the needle may break. So naturally, the position of slot on the cylinder and the dial is shifted, so that they should not collide during knitting action. So, the idea here is, the cylinder needles, where each vertical bars, you can say they represent the needles; they are actually laterally shifted from the dial needle; so that, when the dial do any kind of reciprocative movements, they can do in between cylinder needles.

And similar arguments can be made for the cylinder needles also. They also do, the reciprocative movements in between dial needles. So, this is how they are placed on the needle bed.

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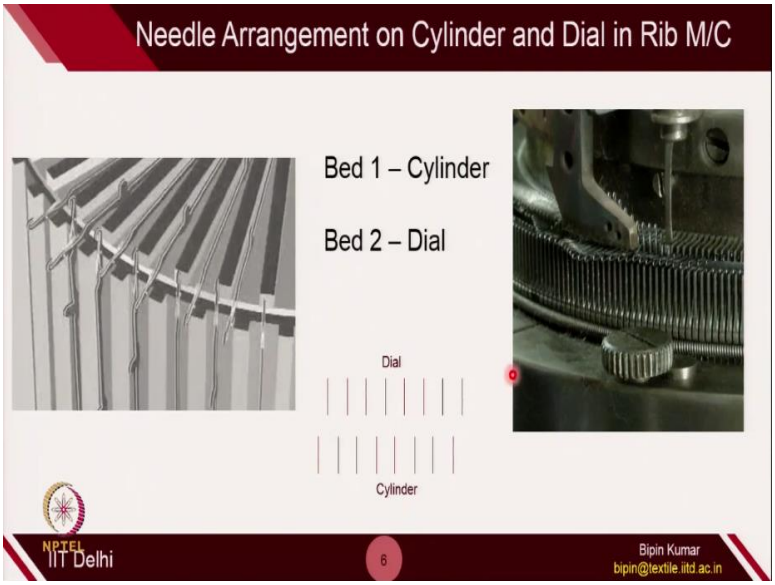

Here, you can see the actual picture of the machines. And, in the clearing position or in the active position, you can see the dial needle is coming out along radius direction. And you can also see the vertical set of the needles which belongs to cylinder. And they are doing vertical reciprocations. And the sufficient gaps are there, so that they can do the reciprocative movements in between opposite needles. So, the needles are not facing each other. So, one set of needles are displaced laterally by half pitch. They can smoothly do the knitting action.

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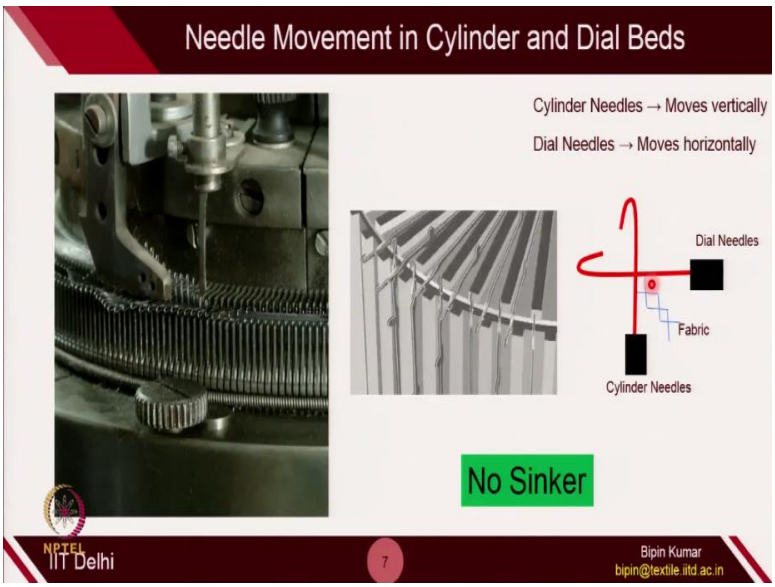

Here, this is the actual running of the machines. **(Video Starts: 08:53)** You can see how this running is taking place. So, the cam is somewhere here, which is forcing cylinder needles to go up and down. And the separate cam is there for dial needles to make it reciprocation along radial directions. **(Video Ends: 09:10)** So, the cylinder needles actually moves vertically. So, this is the cylinder needles, they do the reciprocation vertically.

And dial needles do the reciprocation horizontally along radial directions. So, the directions of reciprocation is entirely different. And the fabric is again being produced at 45 degree angle with either cylinder or dial. The loops which is being generated, they are released from the machine at 45 degree. This is actually similar to the V-bed machine. If you remember, there was a 2 bed.

So, it, both the beds were creating the loops. And the fabric was being pulled from the bottom side. Okay. So, the angle of fabric pulling was actually 45 degree with both the beds. So, similar type of arrangements is also there. And the fabric is being pulled from the inner diameter or inner side of the circular bed, which is not visible here. If you open this machine, you can see, the fabric is being generated in the inside.

Key takeaway from here is, if you see most of the circular bed, if you remember in week 2, when we have the circular bed machines, there was a additional elements which was sinker. But herein, you cannot see any sinker element in fabric formation. Because, if you remember, the sinker was responsible for fabric hold up, for fabric pulling; or to provide support for loop formation by the needles.

So, the sinker belly was doing all those function and sinker throat was also pulling the fabric when the needle was rising. But herein, since, whenever one set of needles is doing action, the stem of other needles are providing the such support. So, let's suppose, when dial needle is moving forward, the loops are connected with, still with the stem of cylinder needles. Stem of these needles are actually doing the function of sinkers.

So, there was no requirement for the sinker elements, especially in case of double bed knitting machines, which is the most fundamental difference compared to single bed circular knitting machine and double bed circular knitting machines. Because, the opposite set of the needles are actually doing the role of sinker in loop formation or fabric hold up or fabric take up. Okay. So, there is no sinker in case of double bed knitting machine, especially in this category.

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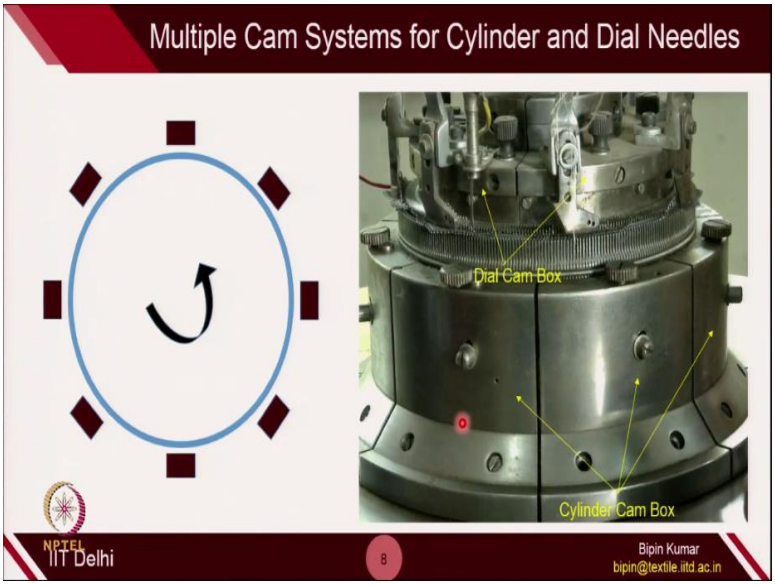

We have also seen multi-feeder machine. So, herein also, you have multiple cams which are being placed along the circumference, so that, at a same rotation, in the same rotation, a single needle can create multiple number of loops. Obviously, this is done to increase the productivity on this particular machine. Compared to flat bed, where you have to first complete the entire reciprocation; and then you have to return to make the second course.

Here, you can simultaneously create multiple number of course in one rotation. This is the beauty. And that is done because of the placement of multiple number of cams along the circumference. So, here you can see, these are the cylinder cams, these are the box. When you open it, you will easily see the track. So, the moment the cylinder is rotating, it will first interact with this cam, the moment it finished doing knitting, it will automatically will be interacting with the next cam; and then, next cam; and so on.

So, in this way, multiple number of loops are created on a single rotation. Similarly, on the top side, because you have the dial needles which is doing reciprocation in the horizontal plane, you have that dial cam box which gives the cam track for dial needles. And for each cylinder cam box, there is a dial cam box available on the top side, so that, both the needles can do the reciprocating simultaneously. Okay. So, we are going to see now, how these cam box are placed on this machine. And we are also going to analyze what are the nature of cam track especially in this particular machine.

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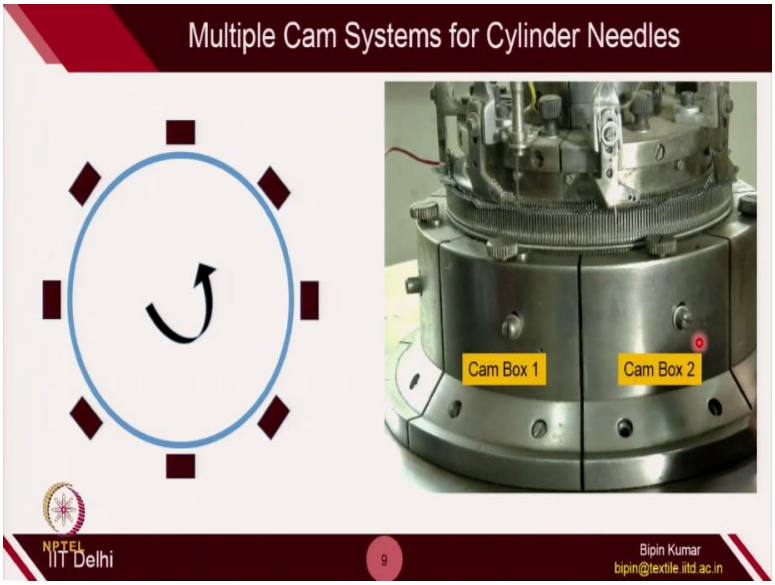

So, let's first focus on the cam system for cylinder needles. So, as you know, the cylinder needles are placed vertically on the cylinder tricks. So, I am going to now open one of the cam box. So, in each cam box, there is a track which is designed, so that the needle butt can engage with that track; and it can do the reciprocation in vertical direction. This is the similar way, because we need to do the knitting; for that, we need to provide reciprocation.

And that is done by the cam. So, cam is one of the integral part which we already know. So, now I am going to open this, one of this cam box, so that you can see how this tracks is designed.

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So, let's see this video. **(Video Starts: 14:15)** So, you can see here, I opened one of the cam box; and you can follow the track. So here, the needle butt; so, these are the needle butts. The

moment the needle butts is actually interacting with this cam track and it is forced to follow the reciprocative movement. So, the needle butts actually enters from here. And then, it has to rise. You can also fix this **(Video Ends: 14:41)** particular cam box on the machine. This is how the cams are located along the circumference for the cylinder bed.

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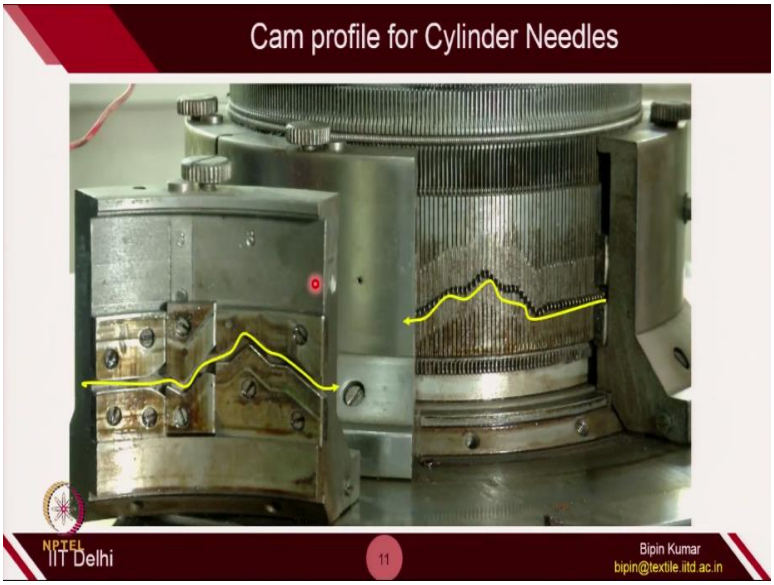

So here, let's see the cam track. So, this is how the needles do the movement. So, you have the needle butt. The needle butt get engaged with this track; and then it rises. Then, at this position, it is doing the clearing. And then, it is doing the stitching with, by, with the help of stitch cam. So, the stitch cam is somewhere here. This is the raising cam and this is the clearing cam.

And this is the location of the butt, which you can see. So, at this point which is the maximum height; this is the clearing position. And after that, it is descending. This is the stitch position. And here you can see, at this position, the needle starts rising. So obviously, it is interacting with the raising cam. This is the track which the needle but follows especially on the cylinder bed.

You can fix this block inside. So, then, the needle butt actually follow this path. So here, the cylinder is actually rotating and cam is fixed. So, we have also seen the categories of circular machines. Where in one case, cylinder is rotating, cam is fixed. And other case, cam is rotating and cylinder is fixed. So, this type of machines especially double bed machines, you will see mostly, the cam is fixed and cylinder is rotating.

So, once cylinder is rotating, if you fix more number of cams; then naturally, you can make sure the needle do the multiple knitting action in one revolution. And this is what is happening. So, once the needle completes the reciprocating movements for this cam box, then it is interacting with the second cam box. Then, third, fourth, fifth. So, in this particular machines, there are actually 6 cam box. So, it is making 6 loops in 1 rotation, each needle.

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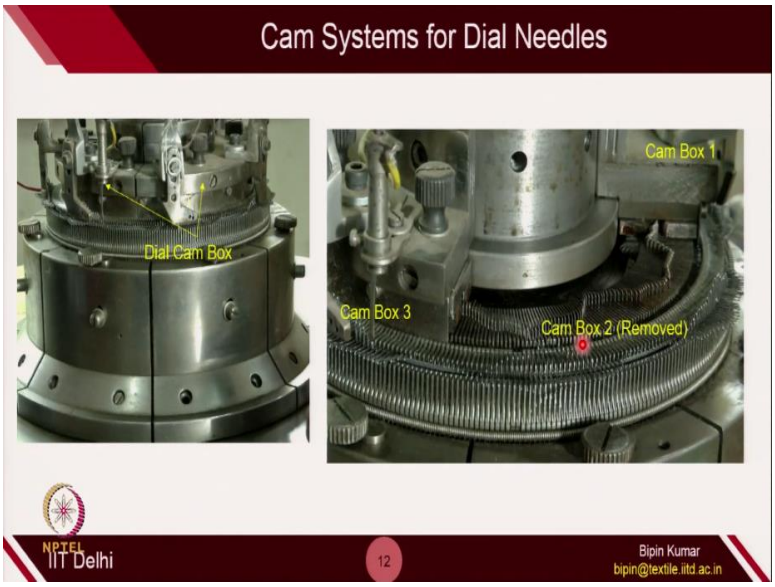

Now, let's see the position of dial cam box. On the top side, you have the dial disc on which the needles, dial needles are placed in a radial directions. And to make sure the reciprocative movement is done by the dial needles. You have the dial cam box also present. So here, I am showing you, the 2 dial cam box. So, if you enlarge this, it will look like this. So here, again, because the dial needles also have to do the reciprocation exactly at the same time when the cylinder needles is doing in the opposite bed; multiple number of dial box is present.

So here, I have removed one of the dial box, so that you can see the clearing and stitching position. So, here you can see, the butt is fastest from the center. So, the center is somewhere here. And the butt position is located fastest along the radius. So, this is actually the clearing position. And this is at most closest to the center point. So, this is actually the stitching position. So, the butt here, starts interacting.

Then it is going to the clearing position. And then, it is going to the stitching position to complete the knitting action. So, these are the 3 cam box. One of the cam box, I have removed, so that you can see the location of butt. This is actually the running condition; how

this butts of dial needles changes its course depending on the interaction with a particular dial cam box.

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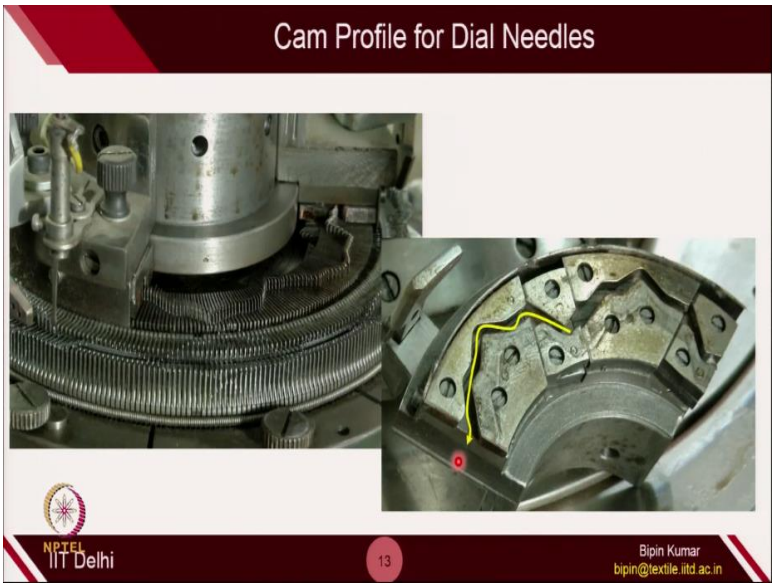

This is how, you can see, if you remove this; actually, there are 2 dial cam track. So, first it completes this. And then, it is interacting with the another cam track. So, here basically, the 2 loops are being created. So, this is particularly the resting position. And then it is rising. Then this is clearing. Then it is doing stitching; and again going back to resting position. So, again from here, it is rising; then doing clearing; then doing stitching; and then, going back to its resting position.

So, 1 cam box, actually you created 2 cam tracks. The needles can do; if the needle goes from this point to other point, it actually makes 2 loops. So, this is how dial cam box are placed on, for the dial bed.

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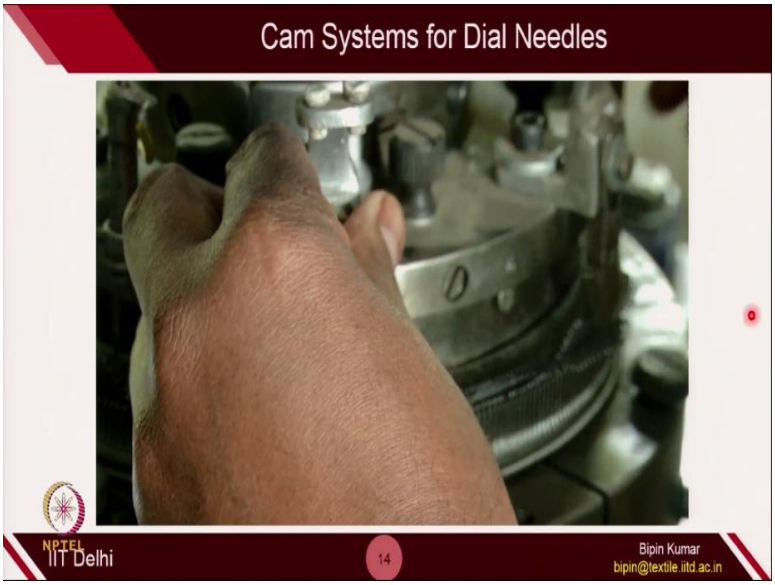

So, here you can see how I can locate this dial box on the machine. So, this is the; I have removed this dial cam. **(Video Starts: 19:25)** And then, you can fix this dial cam box on the machine. **(Video Ends: 19:33)** So, this is how you fix the machines. So, this is the arrangement of cam system for 2 different beds. So, you have cylinder cam system which is fixed on the curved part of the cylinder. And you have the dial cam box which is fixed on the top of the dial bed. They help in reciprocating movement of the cylinder and dial needles respectively.

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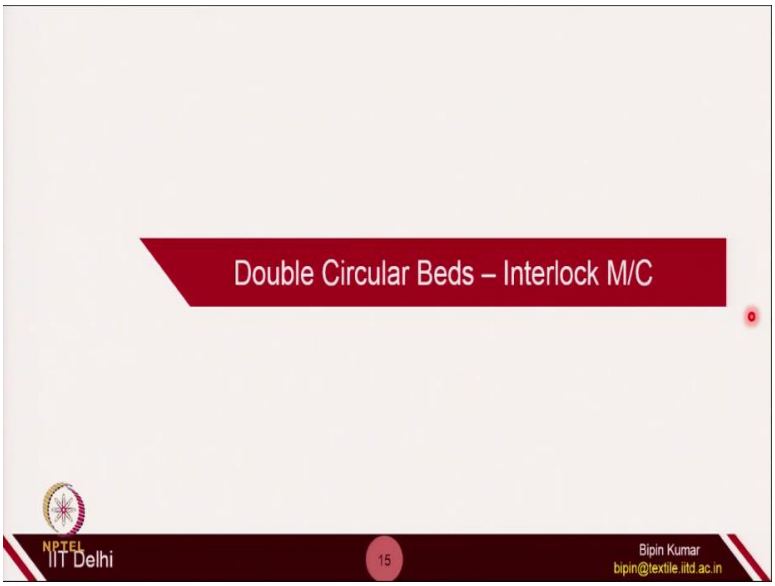

Now, we are going to move in another categories of a circular bed machine, which is called interlock machine. So, this is also very, very popular. And interlock fabrics are being used in t-shirts, in undergarments, in pressure garments. So, this beds is also very, very popular. The nature of this bed is looks similar to rib machine, rib circular knitting machine.

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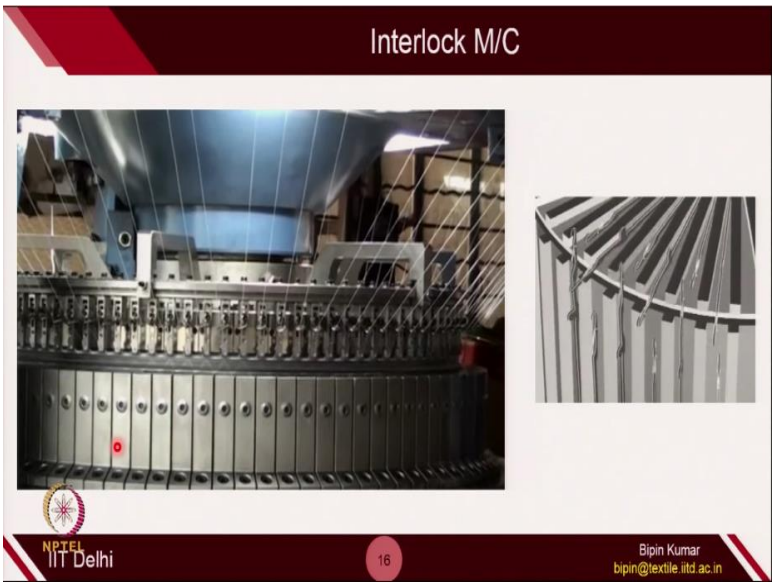

But, there is certain difference between these 2 types of machines. We are going to understand these 2 machines. So, if you look at the interlock machine, it will again have 2 different beds; one is cylinder and the other one is dial. So naturally, the name of these 2 beds remain same, compared to the rib knitting machine. The only difference is the placement of needles and the type of needles which is used in interlock machines.

So here, you can see, there are multiple cam box which is placed on the cylinder bed. So, you can count how many cams are there. So, this is actually having 36 feeders. So, you can imagine, there are 36 cam box are placed in on a big cylinder. Here, you can't able to see the dial disc. Naturally, you have multiple cams for dial bed as well. Now, let's see how interlock machines is different from a rib machine. Because, it has again the cylinder and dial itself. But, the positioning of needles on these 2 categories of machines are completely different.

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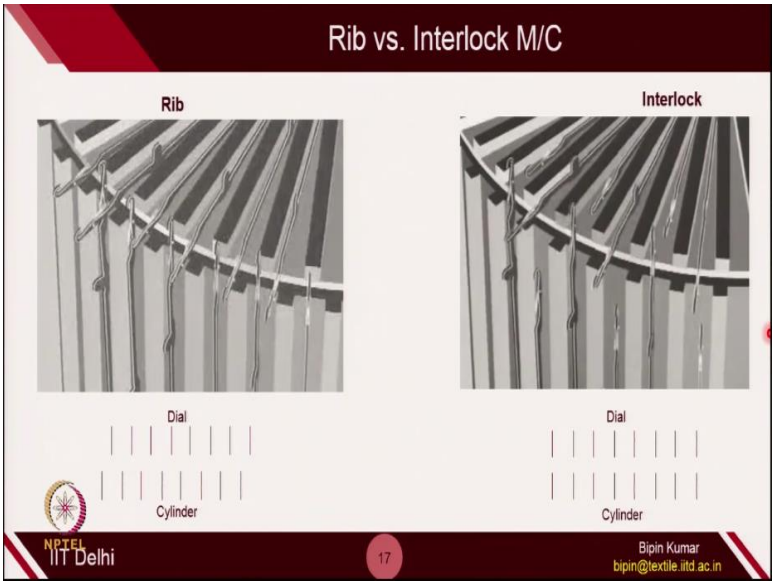

So, in case of rib machine, it has 2 bed: cylinder and dial. And the needles on these 2 beds are placed in such a way that they do not face each other. You can see here, dial is coming out from the bed. It is not facing with the cylinder needles. So, cylinder and dial are not facing each other. The bed are actually laterally shifted by half pitch with the opposite bed. But in case of interlock machine, both dial and cylinder are facing each other.

So, you can see here, when this cylinder needles is going top, the dial is actually not doing anything. So, this is some of the subtle difference between these 2 types of machine. The first difference is: the positioning of needles of cylinder and dial is not facing each other in case of rib knitting machine. But in case of interlock machine, they are facing each other. The second difference which you can observe here is: all the needles are actively participating in the knitting process.

But here, when the cylinder needle is riding, then dial is not doing anything. Dial needles opposite to that is not doing anything. And when dial is doing a active movement, then cylinder is resting on the cylinder bed. In this particular machine, at a particular location, only half of needles are active. And the reason behind, because these 2 needle beds are actually facing each other.

So, if cylinder and dial, if they are active at the same location, they can hit each other. The machine take cares of this, so that, whenever the cylinder needles is taking part, dial is resting; or when dial is taking part, cylinder is resting. So, these are the 2 basic difference

between these 2 types of machine. And because of this 2 difference, you are actually creating a different kind of fabric structure.

So, in next week, when we will see the different fabric structure in weft knitting, then you will realize, in rib category, you create a double jersey fabrics which has a different property, but in interlock machines, you again create a different kind of fabrics which has different property compared to double jersey fabrics which is created on rib knitting machine. So, the fabric which is produced by these 2 machines are completely different. And that we will look in next week. Let's see positioning of these needles.

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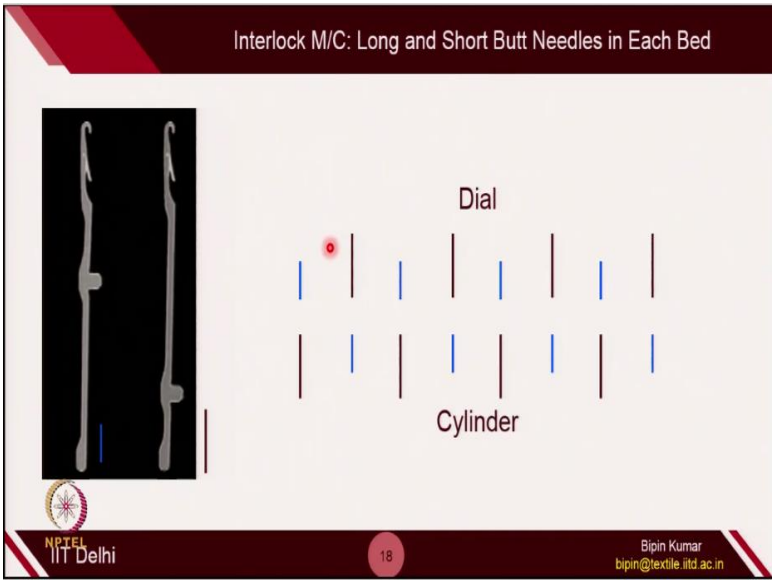

The another difference which you will find in interlock machine is, they have both 2 sets of needles on the same bed. So, on same bed, you will have long butt and short butt needle. Here, there is a 2 needles. In one case, the butt is at the highest position. And in other case, the butt is at the lowest position. So, this particular needle is called long butt needles, because the butt is at the lowest most position.

And here, the butt is closest to the head, so it is short butt needles. And these 2 needles are placed alternatively on each of these bed. So, here, the blue is representing the short butt needles. Here, the height is also short. So, you can see here, this is, the blue one is representing the short butt needle. The other color needles which is shown in red, which is the long butt needles, this is placed on the same bed.

So, you can see, long butt and short butt, they are placed alternatively in cylinder bed as well as dial bed. The other key point you can understand here is, whenever cylinder long butt is facing, it is having short butt needles from the dial bed. The dial short butt is facing cylinder long butt needles. And cylinder short butt needles is facing dial's long butt needles. So, this is how the placement is done in a interlock machine. Now, let's see the cam tracks and the arrangement and the movement of these type of needles on interlock machine.

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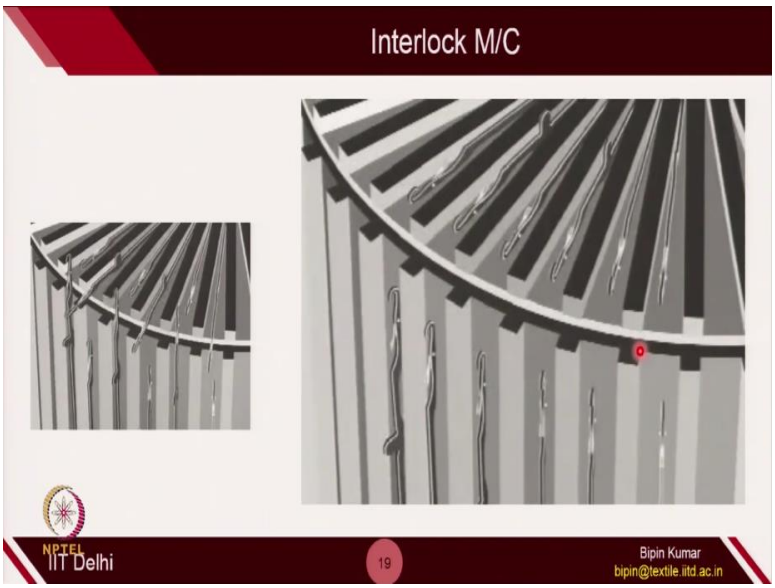

So, here I have a small animations through which you will be able to see how this needles are taking part in **(Video Starts: 26:19)** knitting action. You can see here. So, the tricks are actually facing each other. So, each needles are facing each other on both the beds. So, it is not possible if they do the knitting action simultaneously. So, that's why alternating needles are selected from each of the bed.

So, when dial needles are active, the corresponding opposite cylinder needle is inactive and vice versa, so that they should not hit during the knitting actions. So, you can see here. **(Video Ends: 26:57)** So, this is how the interlock needle arrangement is different from a rib needle arrangement.

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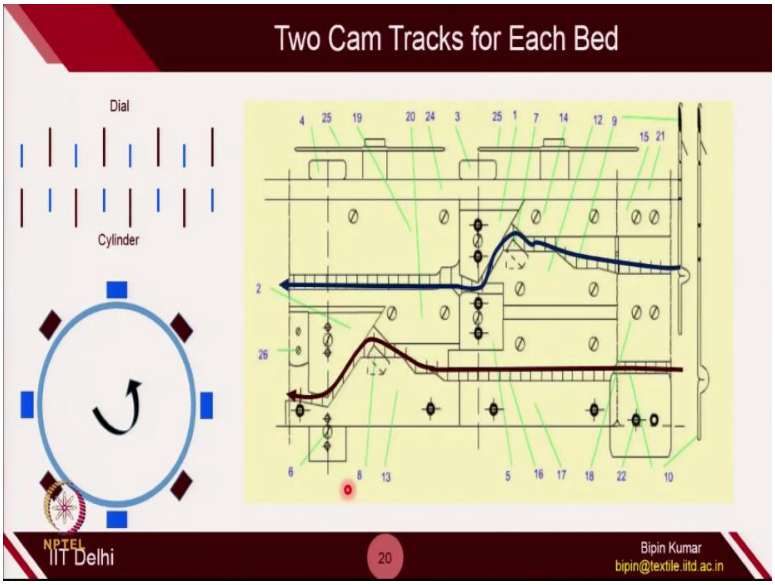

In, especially, since you have 2 butt of 2 needle size, one is long butt, another one is short butt. So naturally, you have 2 cam tracks for short needle and long needles. So here, you can see, this is the long needles, where the butt is at the fastest position. So, it has this track which is shown here. And the another track is created at the upper position of the cam box, which you can see here.

This is for short butt needles. So, this is the track for short butt needles; and this is the track for long butt needles. So, when the long butt needles are following this track; so, whenever this long butt needles is at this particular location in a cam box, at that moment, the cylinder needle or the long butt needles is resting, because you can see, the, it is not rising. It starts rising from somewhere here.

But in case of short butt needles, when cylinder needles is resting, short butt needle is engaged in knitting action. And when short butt needle is resting, the cylinder needle is active in knitting. So, this is how the timing is set, so that both long as well as short butt needles take part in knitting alternatively. And this is done to avoid collision with the dial needle. Similar type of cam arrangements or cam track is provided for dial needles also; 2 track for dial needles, so that you can create some kind of timing difference to avoid collision with the cylinder needles.

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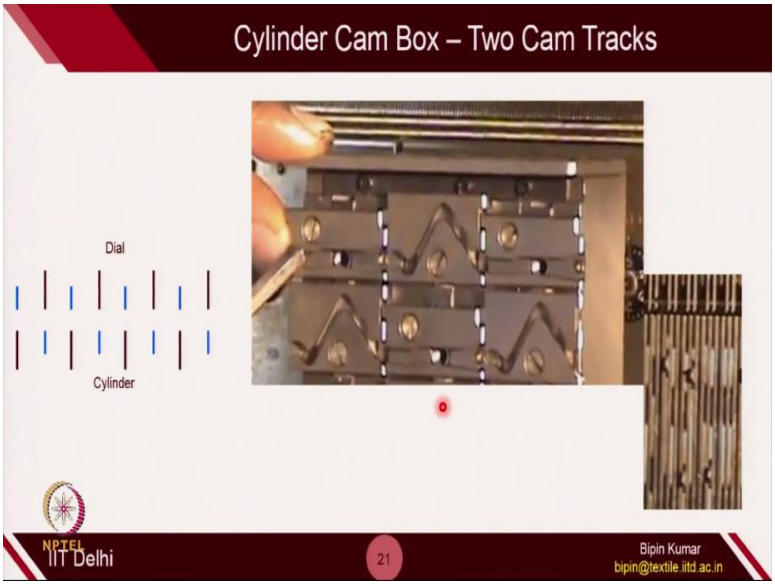

This is the track, you can see here. So, this is for short butt needles which is at the top position. So, here the butt of the short needles interacts. It goes up, do the knitting, again it is resting. When the short butt needle is resting, here you can see, the long butt needles is doing the knitting. Because, it is rising; then releasing the loop; and then it is doing the stitching. And when this short butt needles is doing the knitting, you can see, the long butt needle is resting.

So, this is how, whenever at a particular locations, short but needle is active; then naturally, the long butt needle of that particular bed will be inactive position. This is done to avoid collision. And this type of cam arrangement is there for both dial as well as cylinder bed.

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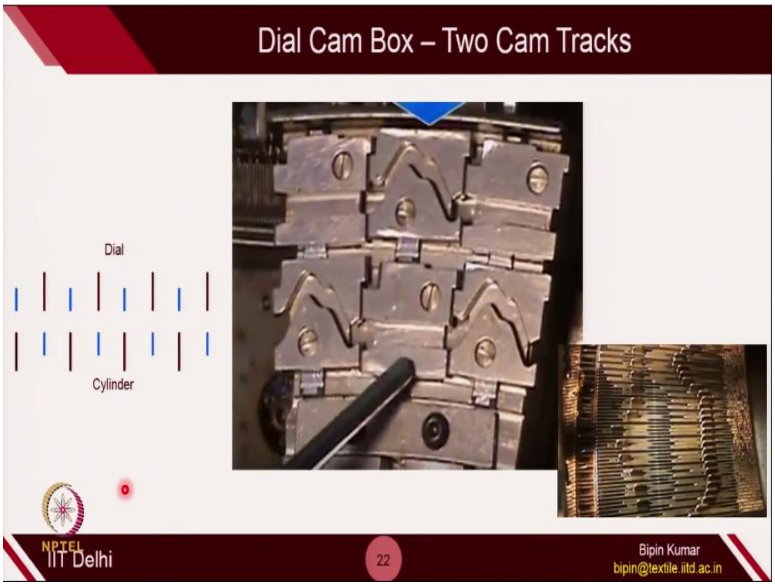

This is the dial cam box. Again, you can see the short butt needle. This is for short butt needle position. So here, it is first resting; and then it is doing knitting; then again resting. But, when dial short butt needles is resting, then you can see, long butt needle is in active position. So, when dial short butt needle is active here, then dial long butt needle is resting. So, this is how the timing and the sequence of needle movement on each of the bed is decided. Okay. So, now let's see the yarn feeder selections.

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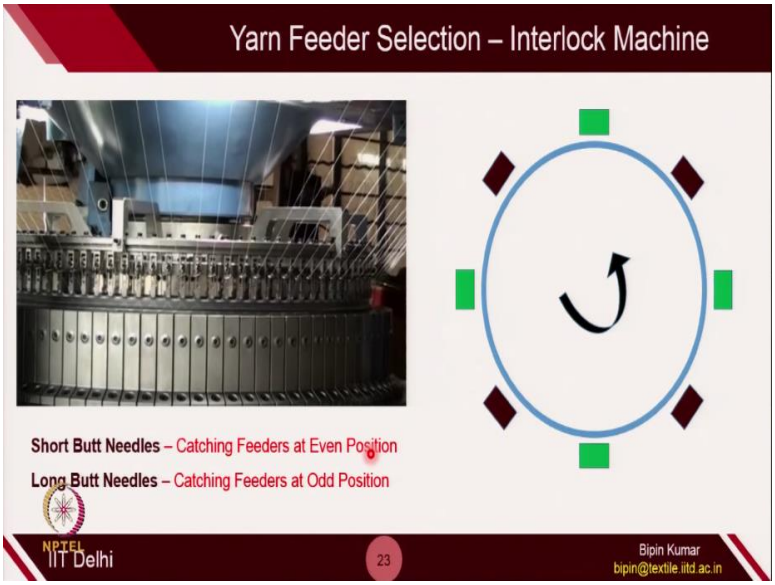

Because, you have the different cam tracks for short butt needles and long butt needles. So, naturally, whenever you take a snapshot, only at a particular location, one kind of needles will be active. So, in each of these cam box, you will realize, at certain moments short butt needles is active. So, in that particular cam box, it will be catching that particular feeder. But in other cam box, when long butt needle is active, then it will be catching different feeder.

The catching of the feeder, which, each feeder is providing one of the yarn. So, with the cam, one feeder is provided. Alternatively, the long butt needles and short butt needles will be catching its feeders. Here, you can see, there are 4 cams which is actually making long butt needles in active positions. They are catching the feeders only in these 4 positions. When a long butt needles is active here, it is inactive in at green cam box.

So, at this feeder, the long butt needle is not catching the yarn. It is actually catching the yarn in alternative feeder positions. So, you can call this as a even position or a odd position. When short butt needles is catching even position feeder, then long butt needles will be catching only odd position feeders, because of the nature of cam track.

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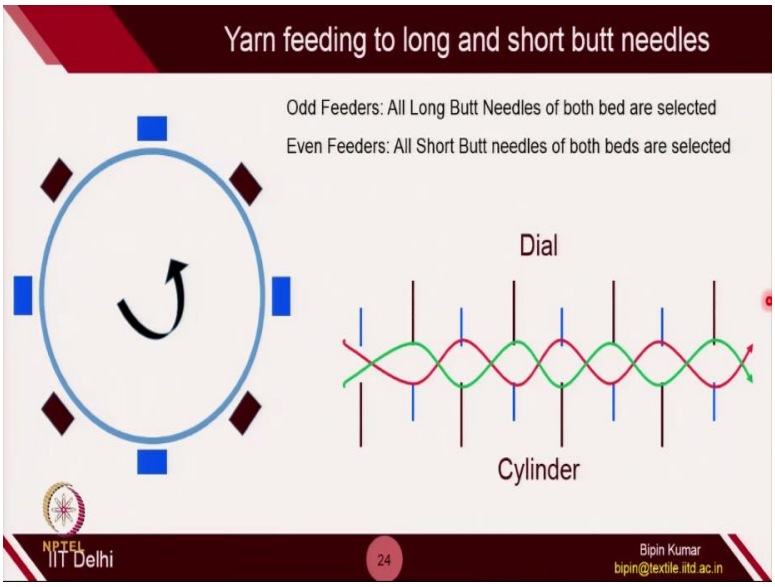

This is how things are done. So, you can see the blue one which is representing the short butt needles, they are catching feeders alternatively. So, it first catches here. After 90 degree turn, it is catching the feeder here. Again, after 90 degree turn, it is catching. So, it is leaving the feeder alternatively. Odd feeders: all long butt needles of both beds are selected. So, here, only the long bed needles are selecting the odd number of feeders. And even feeders are selected by short butt needles. So, this is how the feeding is done to both the needles of a single bed. This is applicable to dial bed as well as cylinder bed.

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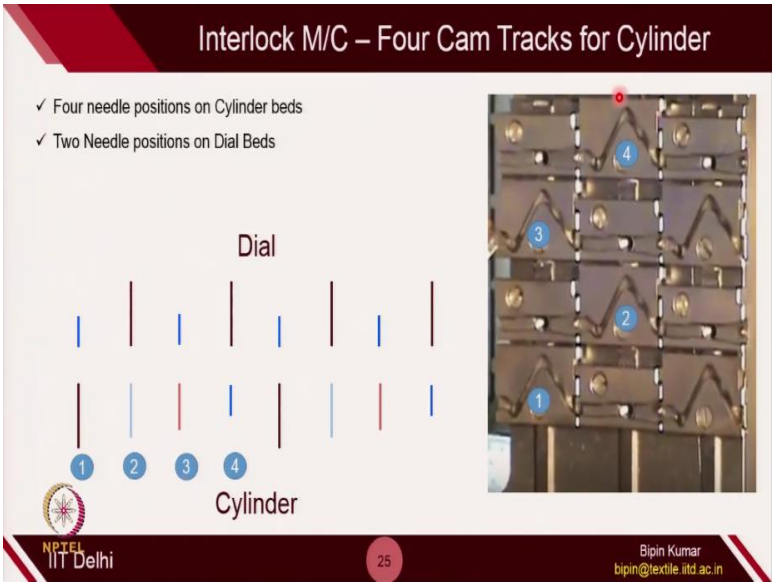

In interlock machines, we can have multiple position of needle butt. Sometimes, on the same machines, we do not have long butt needles and short butt needles. The same needles, only the positioning of butt can be shifted. So, this is similar to the working position and non-

working position on a single flat bed machine. So, to make sure that the butt is engaged, we were actually shifting the butt of a flat bed with the help of jack and making it in a active position.

The same thing you can do here, where you can select and decide 4 cam position, or 4 active position for the needles. In this particular interlock machines, you have 4 cam track. And each cam track, the positioning is different. So, if the needle butt is at this position, it will follow this cam track. If the needle butt is at this position, it will follow this cam track. If the needle butt is position at here, it will follow this cam track.

On the cylinder, instead of having 4 different size of the needles, the positions can be shifted, so that it can follow different cam track. Here, this is the 4 position of the needles which is indicating by; the bigger position is actually indicating here. The butt is at the fast most position from the top. The second position actually is indicating here, which is the second fastest from the top.

And the fourth position is actually from the, closest from the top of the cylinder. So, this 4 needles is actually having 4 different track position. The fourth one which is the smaller butt position, from the top, it is following this cam track. The third one, it is following this cam track. The second one, it is following this cam track. And the first one, it is following this cam track.

Dial is still having only 2 sets of the needles. So naturally, 2 cam track. But in this particular machine, there are 4 cam tracks. So, 4 position for cylinder needles. At a particular instant, you can see, fourth and 2 are active simultaneously. And 1 and 3 are active simultaneously. So, this is how they are doing the knitting. When the first needle is start rising, the third needle also start rising. So, naturally, these 2 needles are in active position. And again, when second needles is rising, then fourth needle is also rising in the active positions.

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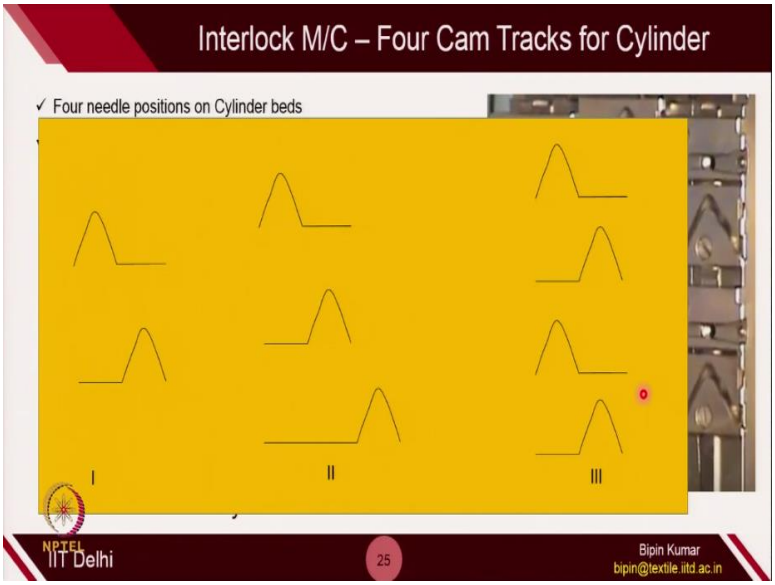

So, you can have different cam tracks for a interlock machines. You can have only 2 cam tracks; one for short needles, one is for long butt needles. You can have 3 cam tracks depending on 3 types of needle butt positions. You can have 4 cam tracks depending on 4 needle positions. And sometimes 2 needle butt can do the same type of knitting actions at the same location, as well as; the arrangements is unlimited and depends on the nature of the fabrics which is being created. These are some of the examples for deciding the cam track for a particular interlock machine.

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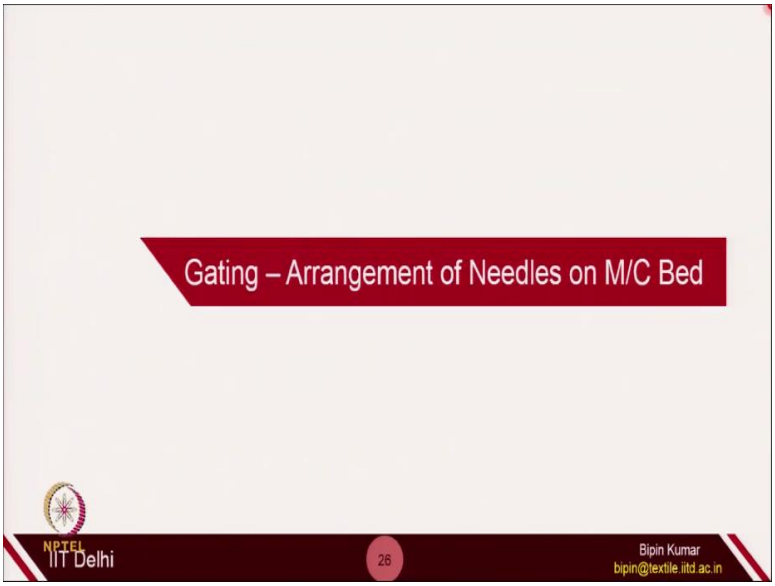

Now, you have seen, because the needle arrangement on a circular beds are extremely important; so, that's why, in common term which is used in knitting is called gating. Gating is nothing but the arrangement of needles on machine bed. I want to summarize all the needle

bed arrangements for so many beds which we have covered in last 2 weeks, so that you should be able to understand how the needles are placed for different types of machines.

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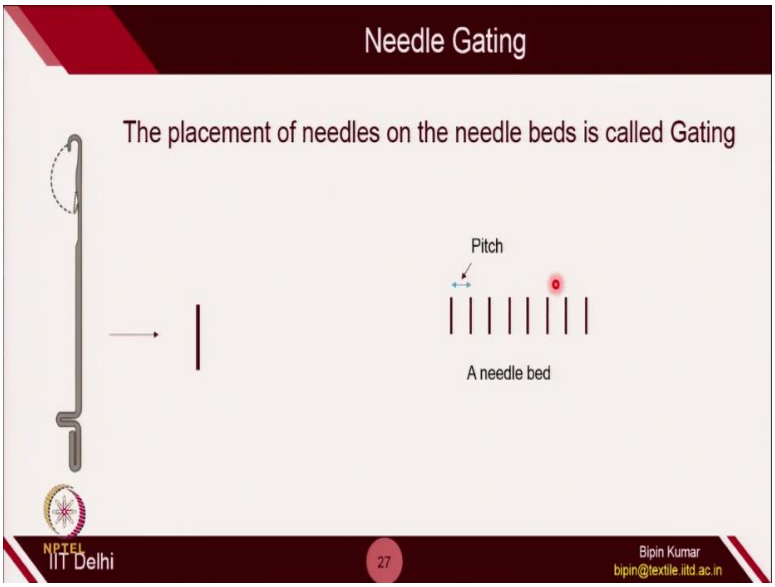

Needles are generally represented by a straight bar. So, one needle is actually represents; so here, this bar is representing a needle. So, the gating is nothing but the placement of needles on a particular bed is called gating. So, if it has 2 beds, how you are placing that needles, whether it, these 2 needles are facing each other, or whether they are shifted with relative to each other, it all depends on the machine type and the type of fabric which you want to create.

So, here you can see, this is one of the bed where all the needles placed in a series. So, this series of bars actually represent a bed. And distance between 2 bars is actually nothing but the pitch of the machines which we already know this.

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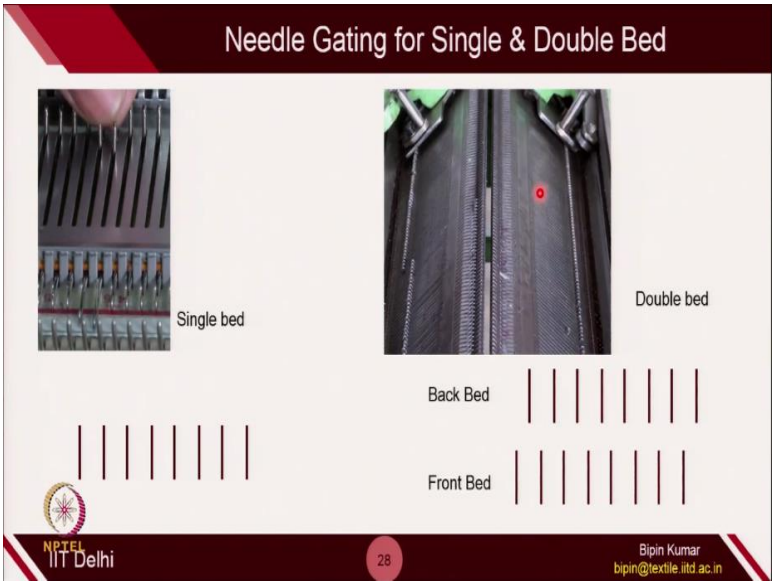

So, needle gating for single and double bed. So, for single bed, you can simply represent all the needles. And these needles are placed parallel to each other for a bed. This is how they are located on the machines. And between these 2 needles, the distance decides what type of yarn count you want to use on this particular machine. For double bed, since it has 2 beds, so you need to give the notation for 2 different needle bars.

So, the first bed which is called the front bed, which is this side, denoted by a series of parallel bars. And the back bed, which is decided by a series of back bars. And they are not facing each other, you can see easily, so that they do not collide. So, this is basically the gating for V-bed machine, which you can easily observe. So, this is how the needles are placed on a V-bed machine.

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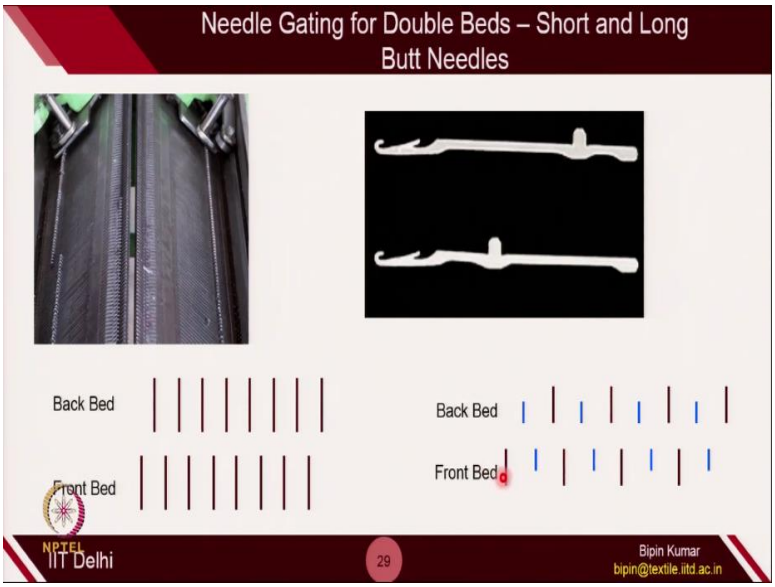

On a V-bed also, there are 2 possibilities might happen. There are some machines where you can find long butt needles as well as short butt needles on the same bed. So, again, the placement of these needles will not be facing each others. So, each bed is not facing each other. Here you can see, both long and short butt needles are present on the same bed. So, such machines are also there.

Depending on what type of complexities or what type of fabric structures you want to generate, you prefer either same set of needles or long and short butt needles on the same bed. But the for, especially with the, on flat bed double bed machines, you usually observe, the needles are not facing each other. They are actually shifted by half pitch.

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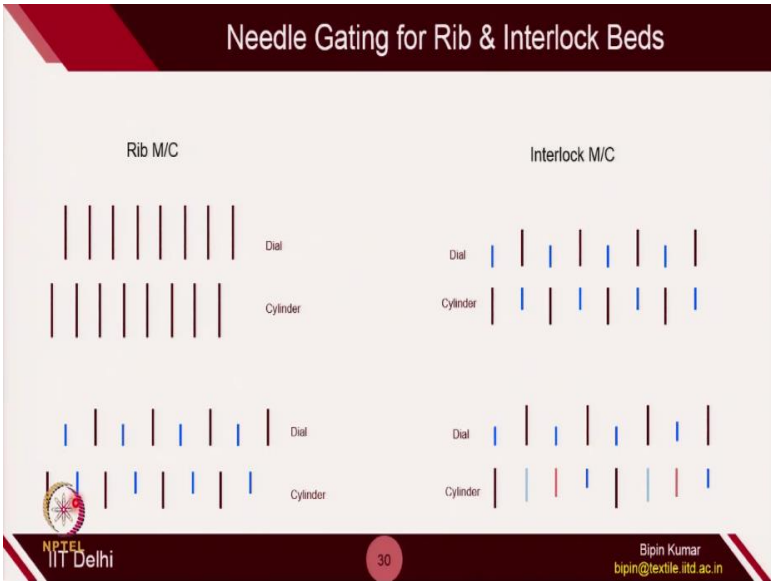

Now, if you see rib machine and interlock machines. Again, in rib machines, it, the gating, especially in case of cylinder, one gating is done for cylinder beds, another one is done for dial beds; and they are not facing each other. They are shifted by half pitch. In each of the bed also, in rib categories, you can have long butt needles and short butt needles depending on fabric complexities.

Because, once you have long butt and short butt needles, you can easily, it will actually help you in selecting these type of needles. So, sometimes you can select all the long butt needles of one bed. Sometimes you can select all the short butt needles of one bed. These type of selection actually helps you in designing. So, once we will start the designing in next week, you will see how important is the needle selection on a particular bed, because this gives you a lot of flexibility in fabric design.

In interlock machines, you can see, the dial bed needles and the cylinder bed needles are facing each other. And in each of the bed, you have both long butt needles and short butt needles. Sometimes, you can have 4 position or 4 butt position of the needles which I already discussed in one of the slides. So, this is how the gating is defined. Gating, actually by looking to the needle arrangement, you can at least guess what type of knitting technologies we are covering.

Whether it is a single bed, then only one set of parallel bars will be shown. When you are dealing with double beds, then 2 set of bars will be shown. When you are dealing with rib machines or V-bed machines, you will realize they are not facing each other. Whenever you are dealing with interlock machines, you will realize they will be facing each other. So, this is how the gating is done. And gating is so important in knitting technologies.

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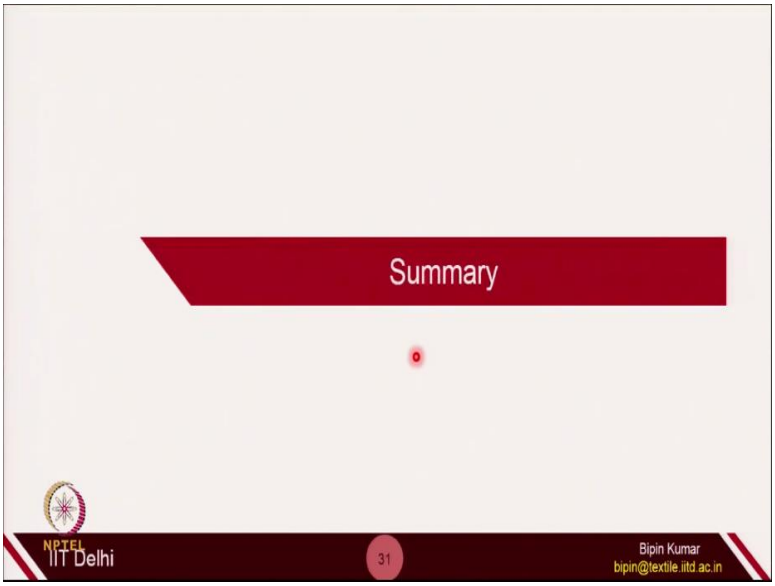

Now, I am going to do the summary of what we have covered in this particular lecture. So, basically we finished double circular knitting technologies.

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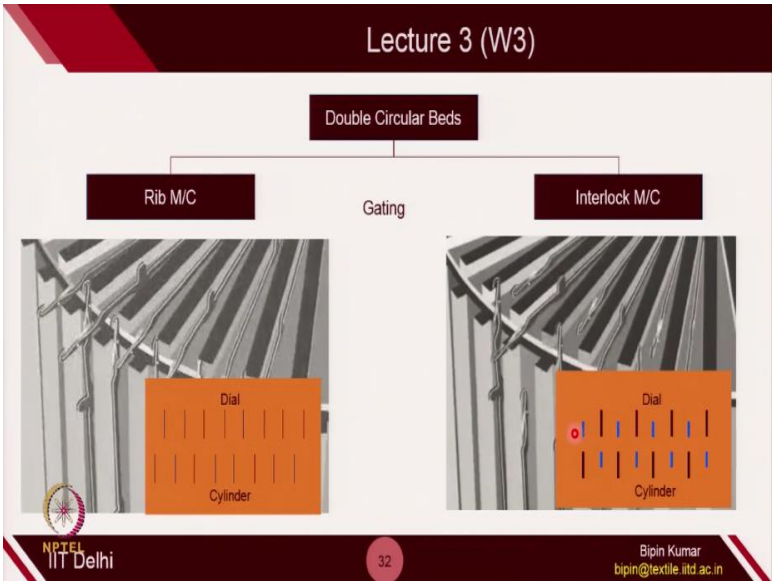

One categories of double circular bed is rib knitting, where the gating of needles are done in such a way they are not facing each others. So, in rib machines, they are one cylinder bed and another dial bed. And the second category of double circular machine is interlock machines, where the gating is done in such a way that they are facing each other. In interlock machines, in general, you have both long butt and short butt needles.

So, in interlock machines, when short butt needles are active, then long butt needles are resting; and when long butt needles are active, then short butt needles are resting at that particular locations. So, this how these technologies are defined in circular beds. So, so far, if you see week 2 and week 3, we were only covering the technologies related to knitting. So, we started with single bed, then we categorized single bed into flat and circular. Then we, in week 3, we categorized double beds in flat beds and circular bed.

So, in flat beds, we covered V-bed and purl. And in circular beds, we covered rib and interlock. So, this is overall. In weft knitting, this is all the technologies which is used especially in the market. From next week, we will see what type of fabrics we actually create on these type of machines; what are their nature; how they are different. And also, we are going to see, on each of these machines, there are a lot of flexibility in controlling the loop structure; from fabric design point of view, especially for designers and for engineers.

Next few lectures will be extremely important, because you will be able to analyze the fabric structures; how loops decides the fabric properties. So, stay tuned. Thank you for listening. Thank you very much.