Science and Technology of Weft and Warp Knitting
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Module - 1
Lecture - 3
Loop Formation in Weft Knitting

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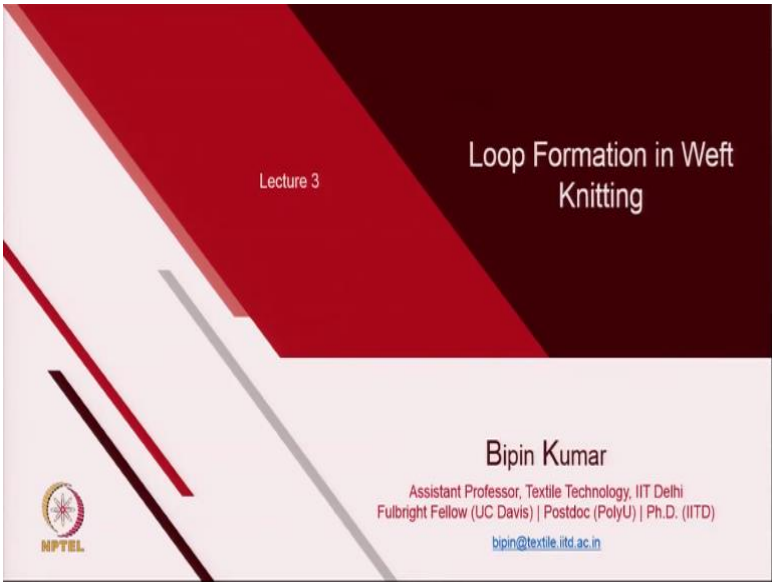

Welcome back participants. Now, we are going to move in lecture number 3 which is loop formation in weft knitting.

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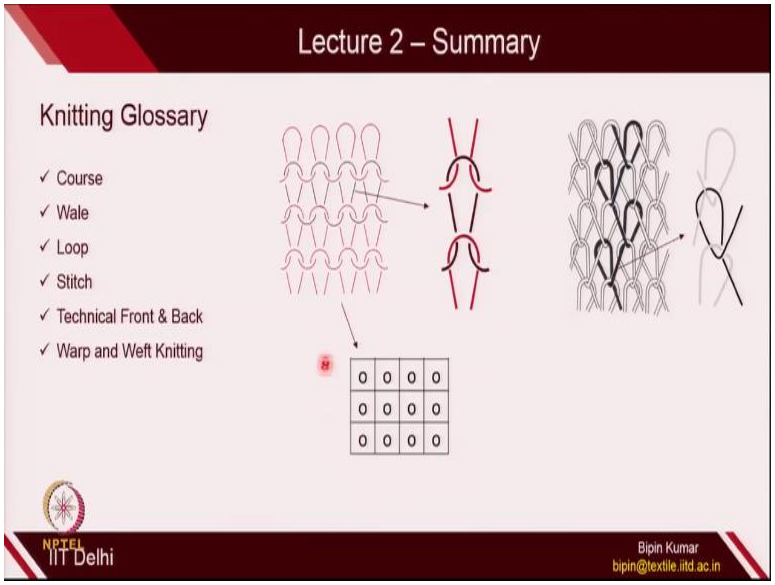

Before we move, let's see what we have covered so far. In lecture number 2, we covered about different knitting terms which is quite popular to describe a knitted structure. One is course,

which is the rows of loops. Second is wale, which is a column of loops. Loop is the fundamental block of a knitted structure. Stitch is also called loop when it has 4 intermeshing points. So, you have, you can see this loop which has 4 intermeshing points.

We call that as a stitch. We also define technical front and back. Depending on how you look at the surface, we can see some part of a loop. For example, herein, you are able to see only the head and the sinker part, which is called technical back. We also looked at 2 different types of knitting which is warp and weft knitting. So, in weft knitting, the movement of yarn is from left to right which is along the weft direction or fabric width direction.

While in case of warp knitting, the movement of yarn is along the length direction, which is similar to the warp direction in a woven fabric. So, depending on the movement of yarn, we differentiate these 2 fabric structure, warp knitting and weft knitting. And loop network, you can see also, this looks quite stable in a weft knitting. But in, if you see the loop architecture in a warp knitting, it is completely different, because of the nature of intermeshing.

We also tried to look at how we can better represent this fabric structure by simple box diagram. For example, we can represent this fabric by simple 0 and cross, by filling 0 and cross in boxes of a table. So, this is very useful when we go for very complicated design of knit structure. This type of diagrams are very useful in understanding whether each loop is technical back or front.

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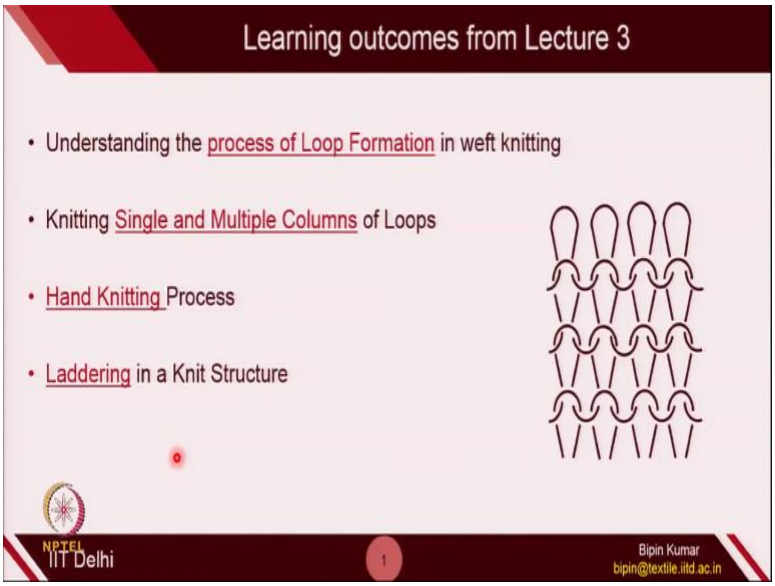

Now, let's move to this lecture, what we are going to learn in this lecture. First thing you are going to learn in this lecture is, how we actually create a loop in a weft knit. Second thing which you are going to learn is how we create a single column or multiple columns of loops. After that, after understanding of these 2, we will go and jump on hand knitting process which is very popular in India.

Most of the household, they do the hand knitting by simple 2 bars. And also, we are going to see what happen if any loop inside a fabric structure is missed or breaks. Then there exist a case of laddering. So, we will try to understand, during fabric formation, if you miss something, what exactly will happen inside a fabric structure. So, let's move to the course.

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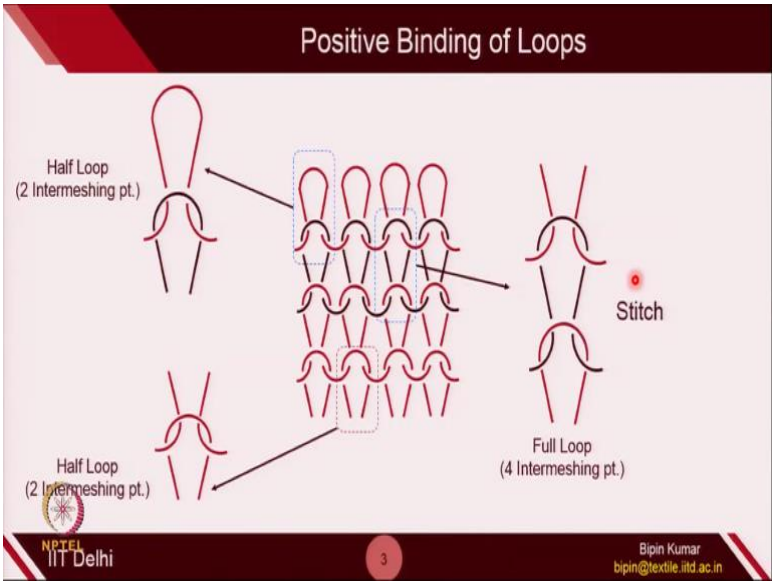

So, we have the yarn to create a knit structure, we have to make sure, whatever we, loop we create, it has to be positively binded by other loops. For example, we describe this in the lecture 2 also. The black loop has to be intermeshed or connected with top loop and bottom loops at 4 points, okay, 2 at the bottom and 2 at the top. Okay. So, there are 4 intermeshing points for a stable loops, 2 at foot and 2 at head.

We also look that, the different possibility of intermeshing that can exist in different loops inside a fabric structure. We can have half loops. So, especially on the top or the top loops, we have only 2 intermeshing points. If you look at the bottom loops, again we have 2 intermeshing points. And rest all other loops looks like 4 intermeshing points. And we call that as a stitch.

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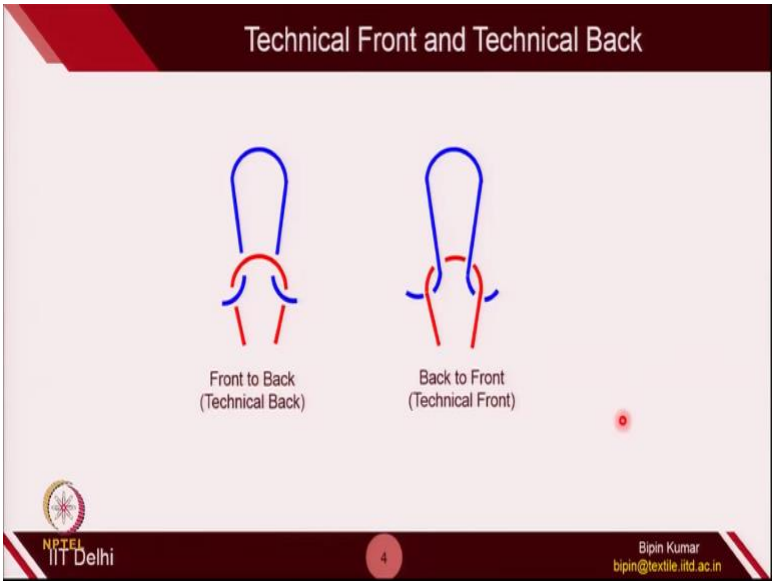

We also looked at the possibilities of how a loop can look inside a fabric structure. Is either it will look at the technical back side, we have seen this blue one. It looks that the loop has been formed on the backside. If you see this loop, it looks like the blue one is formed on the front side. So, we differentiate these 2 which is technical back and technical front. Depending on how we pull the yarn inside the previous loop, it will decide whether we are making technical back loops or technical front loops.

So, these are some of the basics. We must keep it in mind before we go to understand the loop formation in a fabric structure.

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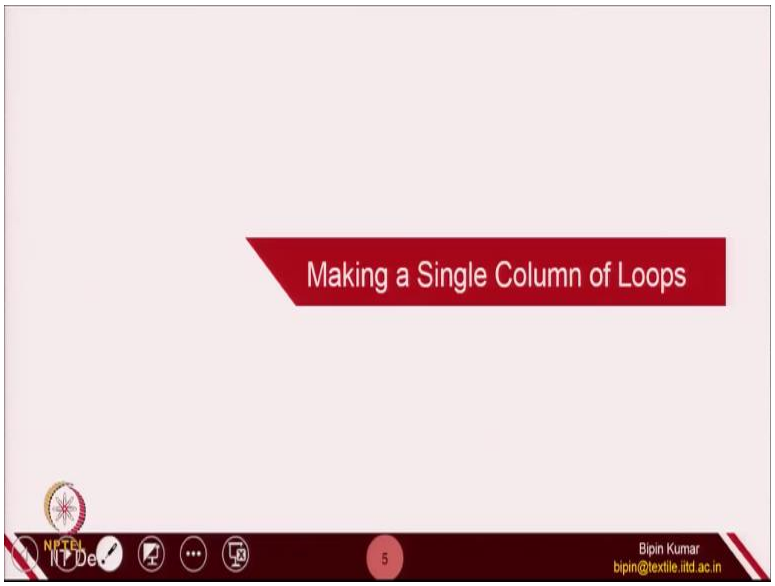

Now, let's move to the simple segment which is how we can make a single column of loops. So, in reality, when you pick any yarn, it is in a straight form.

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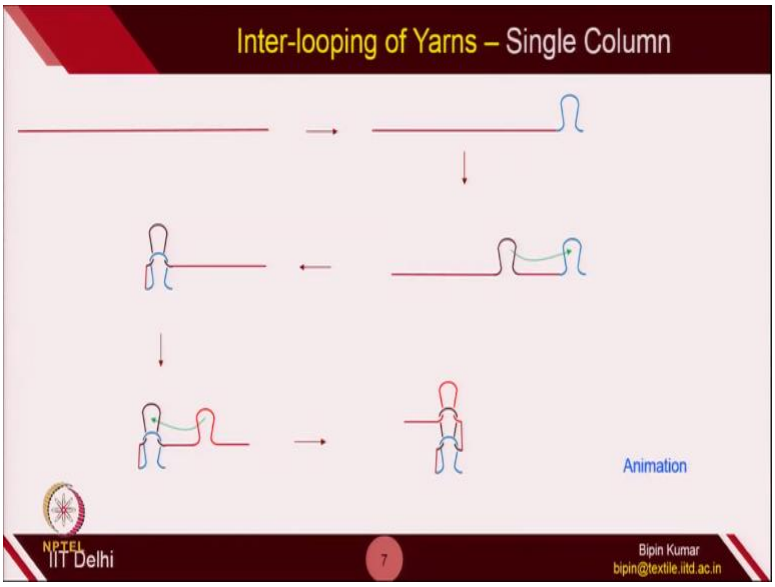

So, naturally, the first process which is required to make a knitted fabric is to make a loop. And how we can make a loop? We can apply force in certain segments and we can bend the yarn. For example, here. From one side, for example, in the, in one side, we make this yarn to be bend in the loop shape, for example. Now, the next step, if I have to create a loop on the top of this loop, we have to make another loop.

And from where we can provide the yarns for that another loop? We still have the yarn segment. So, to make a loop in the column of this loop, in the blue one, in the same column, we have to first create a second loop. Okay. Once this second loop is created, naturally, to make a column, we have to pull this loop and pass it through the old loop. Which is the, blue one is the first one and the black one is the new one.

So, we have to pass the new one through the old loop. Here is the point which will decide whether you want to pull this loop to the technical front or to the technical back. Okay. So, let's, we pull this loop in technical backside. So, once you take this loop, catch this loop and pass it through this old loop; naturally, you will create a loop structure. Okay. So, we have created 2 loops.

After that, we can again create the third loop which is the red one and we can make this loop pass through the old one. With this time, the old loop is black one. And we are passing the red one which is the new loop towards the back of black loop. So, in this way, we created the third

loop in this column. So, this process, we can keep repeating till we can achieve the sufficient number of loops in a column.

We have the animation through which you can able to see the animation, how we create a column of loops. **(Video Starts: 08:25)** So, you can see, the needle is moving. It is catching the loop and passing through the back side of the needle loop. So, we can see the animation once more. So, we have a needle. It is passing, catching the yarn, making the loop and pulling that loop on the backside. So, in this way, we usually **(Video Ends: 08:51)** create a column of loops.

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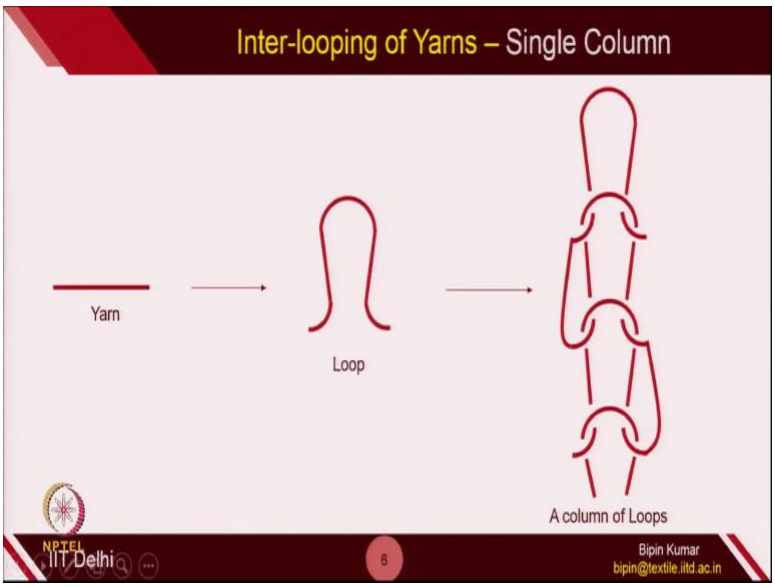

So, we take the straight yarn, we keep making loops and we keep creating intermeshing points to make a column of loops.

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We also have the videos of the real yarn, how we can make a column of loops. We have the Manjit Singh in our lab, Technical Superintendent at IIT, Delhi. He is going to explain you how we can, going to create a column of loops. So, let's see the movement of yarn. **(Video Starts: 09:22)** So, we have the yarn which you can see in his hand. We have the needle. And we are going to first create the first loop. Okay.

So, this is how we created the first loop. Okay. Next, we are again going through the old loop. We are going through the old loop. And now, we are going to catch a new yarn. And we are now going to bend the yarn in the form of loop. And now, this time, in this, at this moment, we are passing the new loop through the old loop. Again, we are doing the same process. We are catching yarn, bending the loop and passing through the old loop.

In this way, we can create a, you can see, we can create a long column of loops. Okay. **(Video Ends: 10:44)** So, let's try to understand what were the basic steps to make or add a loop in the column.

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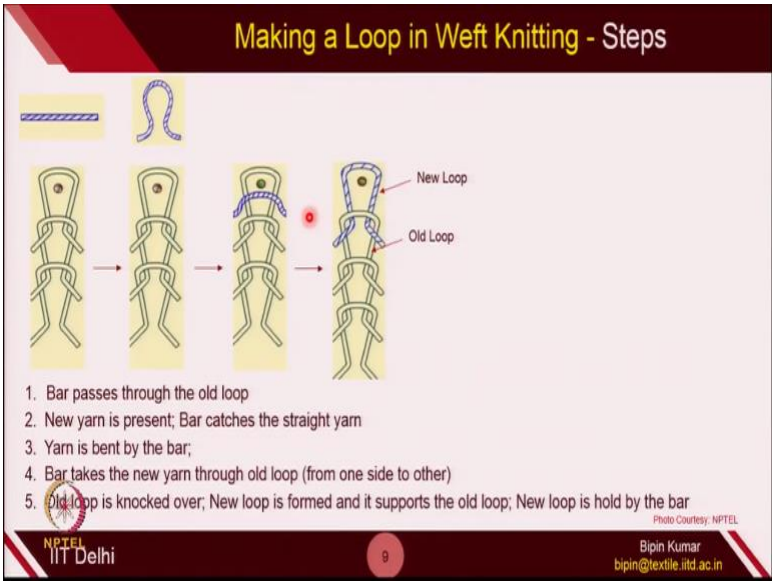

So, for example, you have 3 loops in this column and we are going to add a new loop which is shown by the blue segments in the same column. So, the first process is, we have the bar or needle which we have shown in the previous animations and in the real video also. We have the needle which passes through the old loop. So, we are taking the needle from one side to the other side of the old loop.

On the other side, we, the yarn is being present to that needle. Okay. And this new yarn is present to the bar which is moved to the other side. And that bar actually catches the yarn, straight yarn and try to pull that straight yarn in the bent form. So, the next step, after catching the straight segment, that straight segment is bent in the form of loop by the same bar, which is this bar on the other side.

Once that bent yarn is been formed, that bend yarn is then tried to pass through this old loop, which is being hold by the needle or bar. So, what we do? We actually catch this new yarn, blue yarn. We then take this blue yarn from one side to the other side. This process is called either technical front or technical back. But, for this figure, we can say it, this is a technical back side.

So, bar take the new yarn through the old loop from one side to other. It could be technical front or it could be technical back. Or finally, in the process, it releases the old loop. So, old loop is knocked over. So, as soon as the old loop is knocked over, new yarn or new loops are already there, which is holding the old loop through its feet. Okay. So, new loop is being formed

and it is supporting the old loop. So, in this way, the process keeps on going. And we keep adding the new loops.

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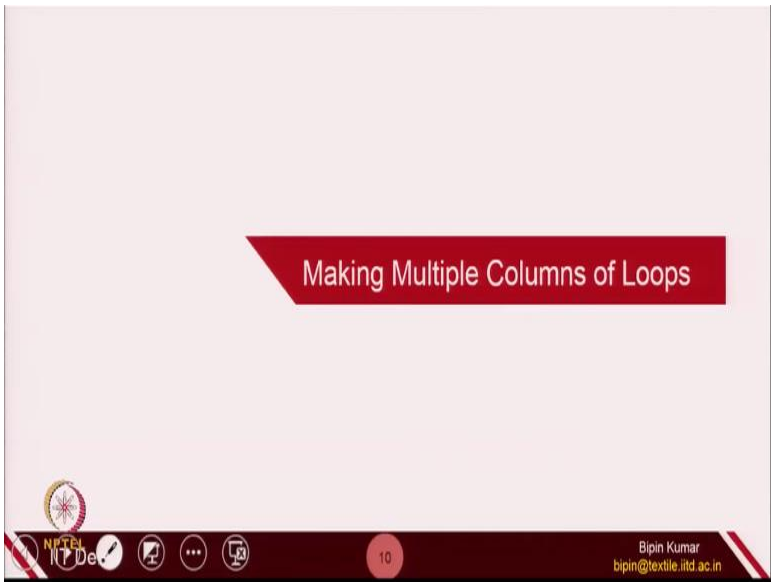

Now, let's look at the multiple column of loops; how we can create multiple columns. Right now, we have just seen one column. But how we can create multiple columns? And these columns, how we can connect these columns as well? So, again we can start from a straight segment.

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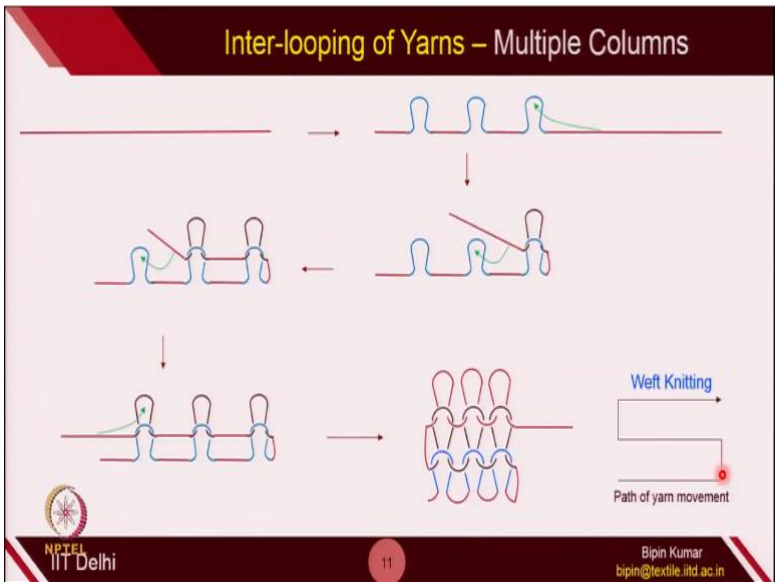

Because, since we have to create multiple columns; so, we have to first decide how many columns we want to make. So, naturally, we can make the first loop of each column. For example, here I want to create, let's suppose 3 columns. So, we make 3 loops. Okay. And after

that, from the remaining yarn segment, I have to make loop and I have to pass that loop through the first column. Okay.

So, I have to make the loop with this straight segment and that new loop has to pass through this old loop. Okay. So, here you can see, we have added a loop in the first column. Again, we still have the straight segment. We can again create a loop for the second column and take that loop from one side to other. So, in this process, we can create the second loop. Again, we have the yarn segment straight left with us.

We can again create a new loop and we can pass it through the third column. Okay. So, in this way, we create a loops in each column along the course. So, the ideally speaking, if you try to understand this, we are adding loop one by one along the row for each column. Okay. Similarly, we keep repeating this process and we can add, keep adding loops for each columns. So, the movement of yarn, if you try to observe here, what we are doing is, the movement is of, the yarn in the form of loop is moving either from left to right or right to left.

So, you can see here. Here we creating the loop from left to right and again from, for the second course, we are creating the loop from right to left and then left to right. So here, the movement is either left to right or right to left. So, that's why this process of knitting is called weft knitting, because we are moving along the fabric width direction and weft direction. So, depending on how many columns are there, you can decide the width of the fabric with the same yarn. Okay.

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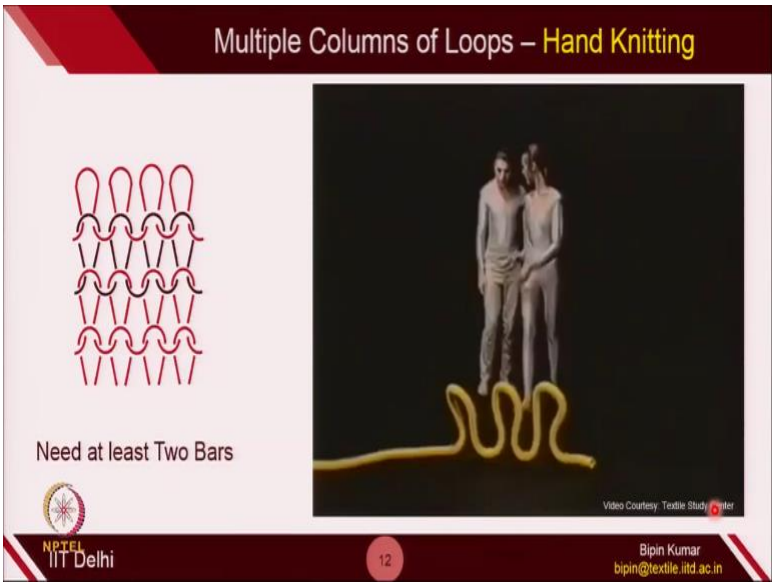

Let's see the real animation video. It is a very good video I observed from one of the textile study centers, which very much able to explain how we actually create this loops in each column. The most fundamental difference here for creating multiple columns is; during the process, we always need 2 components, a two-support system to create loops in each column. Let's see how.

So, we need at least 2 bars. One bar for holding the loops and other bar for creating the loops. **(Video Starts: 16:47)** So, let's see the video. So, here you have 3 rows of loops, 3 loops in a same row. We created the first loop in the first column. Then second loop in the second column. And then, third loop in the third column. And the other guy is actually helping in holding the new loop.

So, new loop is always has to be hold. Otherwise, it will just fall off. So, again, we are making a new loop on the third column, then second column; and again, then, first column. So, you can see, in this way, the process can be repeated. So, always the new loops has to be hold. Otherwise, the fabric can fall. And the old loop is already supported by new loops in the columns. **(Video Ends: 17:42)** Okay.

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So, hand knitting is also a process similar to what we have seen in this video, where;

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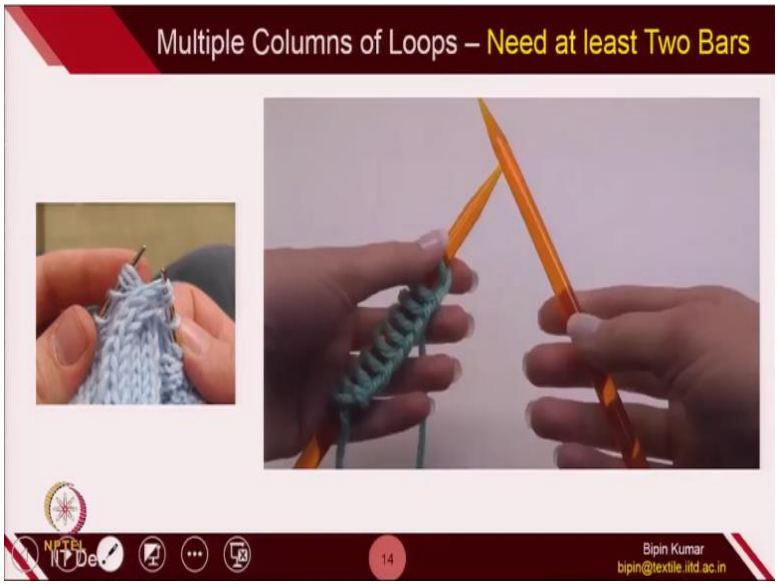

You actually take the 2 bar and one bar actually supports the old loop and the other bar creates the new loop and take the old loop. So, the first bar actually holds the loop and the second bar actually creates the new loop and we keep transferring the old loop from one bar to other bar. Let's see this video, which, through which you would be able to **(Video Starts: 18:25)** understand carefully.

So, we, you have the old loop supported by bar 1. You can see, this bar. And now, this new bar is moving through the old loop and it is now, you are making the loop. It is just, you are bending the yarn in the form of loop. And now, this second bar will take that loop through the old loop from one side to other side. And once new loop is being formed, then we need not to support the old loop.

We can simply knock over the old loop. So here, this is the place of knocking over. Because new loop is being formed in that column. And that could support the old loop. Again, you can see the process. You have the old loop. And the second bar go through from one side to other side. Okay. And then, this bar catches the yarn on the other side. And then, it pulls that yarn in the form of loop from the back side to the front side of the old loop.

So, now the old loop which was there in the bar 1, it has been knocked off. And this process is repeated again and again. And we can create series of loops. And we can create multiple columns. **(Video Ends: 20:18)** Okay. So, for creating multiple columns, one thing is for sure that we need to support;

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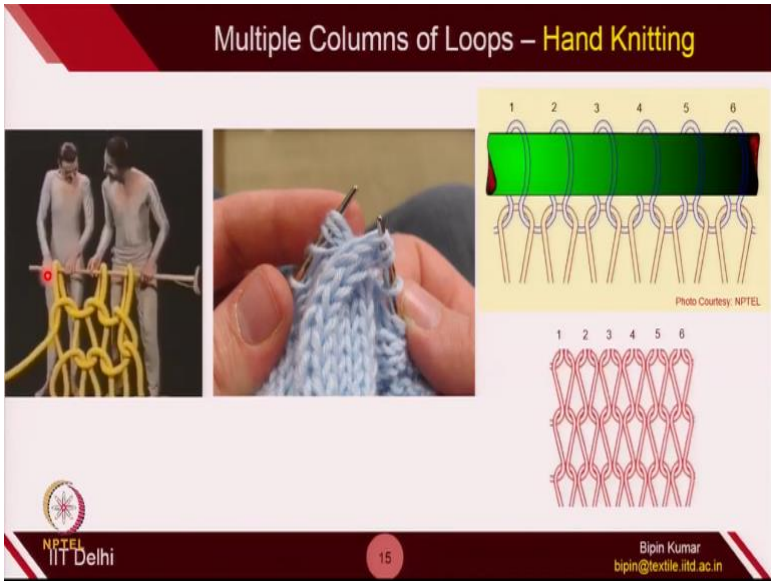

We always need to support the new loops in a particular course. And all the old loops will automatically be supported by the new loops. Okay.

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So, this is how we create normal loops in a fabric structure, in a knit structure. Now, let's see, how loops are stable in a fabric structure. What will happen if you miss any particular new loops in a particular column.

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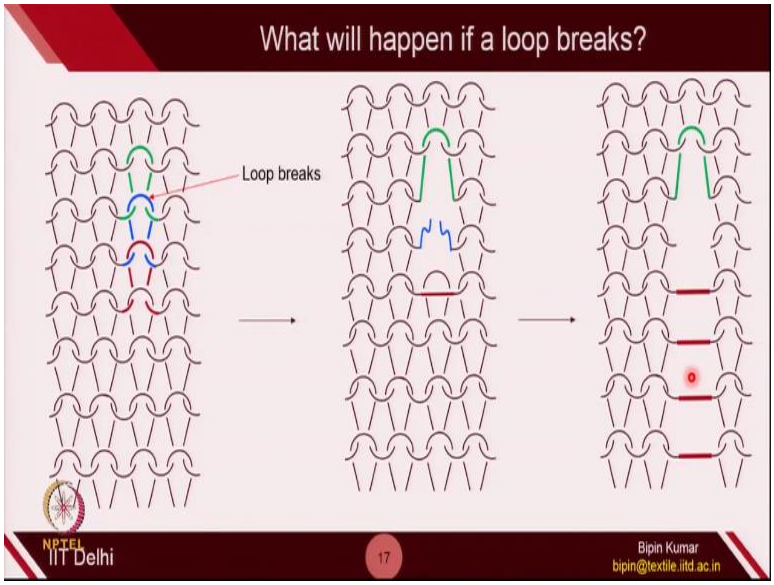

For example, let's suppose, you have 4 columns of fabric. Okay. And accidentally, let suppose, the blue one; I have shown 3 loops in a same column. And accidentally, let suppose, if we cut the blue one, what will happen. Fundamentally, to make this structure stable or coherent, every single loop has its route. If any of the loop breaks, it is going to affect the behavior of loops in the surroundings.

So, the moment the blue one breaks, it will going to affect the green loop and the red one, the below one. Because, the blue one is already intermeshed with top loops and bottom loops. But unfortunately, blue one is breaks, then no one is there to hold the legs of green one. So automatically, in the structure, the legs of green one will be open up, because there is no blue loops which is there to hold the legs in the position.

Apart from disturbing the old, new loop or top loop, the blue one is also disturbing the below one. Since the loop does not exist, automatically the head of the red one will be free. And if the head of the red one will be free, this loop, the red one will be pulled by the fabric. And the segment of the yarn will become straight. The moment this loop become straight, it is going to disturb the below loops in the columns.

And in that fashion, all the loops in the same column will be disturbed. And immediately, you will observe that the fabric will be completely open or porous, because one of the column is missing. And the reason being, breaking of just one loop can disturb the structure completely. So, it is extremely important to take extra precautions in creating intermeshing points for each old loop.

If any loops miss, then it is going to affect the loops in the same column. I have a fabric structure with me where are you would be able to actually see how the appearance of the fabric will change in a fabric structure.

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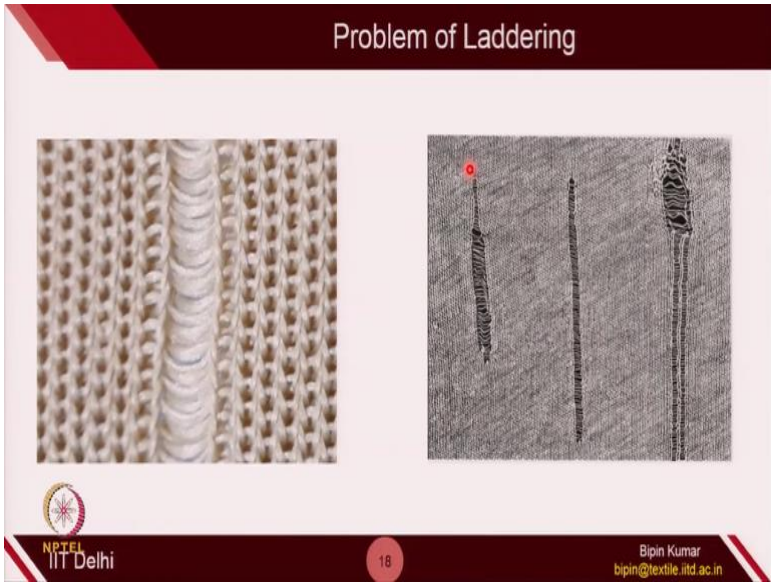

So, here you can see, one of the loops was missing and this is why all the loops become straight. It is just like a straight segment. This is some kind of problem in a fabric structures. You can see how the fabric structure has been laddered. This defect is called laddering of loops in a knit structures. We have one fabric also with me, through which you would be able to see how it can affect the fabric structure.

(Video Starts: 24:34) So, let's see here. So, this is what will happen if any of the loops; so, this loops in this column, one of the loop got breaken. So, all the loops which is below in that column just become a straight because of tensioning in the yarn. Because there was no new loop was there for each of these loops in the column which was supporting its head. So, once any heads break, all the heads in the same column will just become straight.

So, that is the big problem. So, if you cut any loop, if you, let's suppose cut any loop, you will find out it will become like this throughout. And above this column, since the new loops was supporting the heads, so the structure was not open. Okay. So, only from the broken part, below, in the same column, all the loops will just open out. So, this is the problem of laddering **(Video Ends: 25:42)** which is one of the fabric defect. Okay. So, let's summarize lecture 3.

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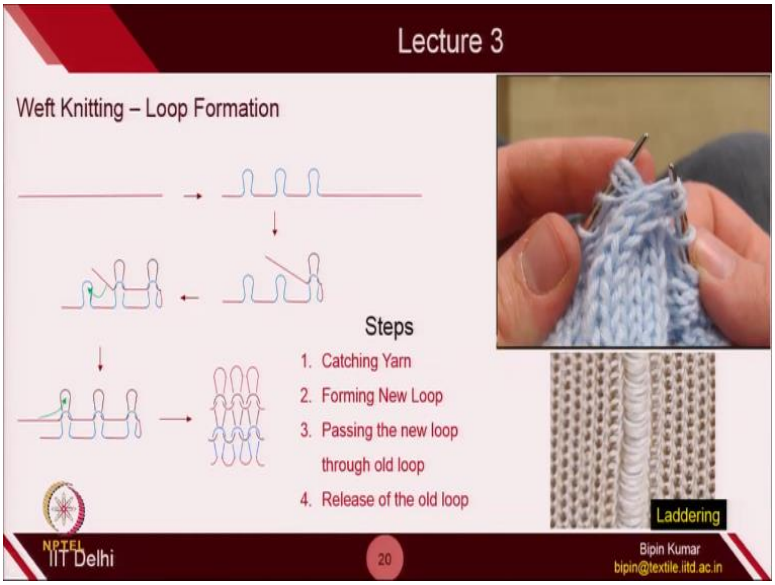

So, in this particular lecture, we learned about 3 major important thing. First, how to create loops, single column and multiple columns. So, here you can see from the same yarn, you can keep **(Video Starts: 26:05)** creating loops. Okay. And then, you can keep adding loop for each of the columns. And you can create multiple columns of loops. So, basic steps which is involved and which is shown in the figure also.

So, the first thing which in the figure you can see after creating a series of loops it is first creating loop passing through the other side and then releasing the old one. So, here you can see it is passing through the old loop and then releasing the old one. So, once it created the new loop, old loop is released. **(Video Ends: 26:47)** So, this is the same process which is happening in the case of fabric made by hand knitting.

So, we catch the yarn, we form new loop, we pass the new loop through old loop and finally we release the old loop. If any of the loop is by accidentally missed in the fabric structure, any of the loop by accidentally missed, then automatically, all the loops in that column will open and yarn will become straight. This problem is called laddering. So, we have to take utmost care in making loops and connecting these loops with other loops on the same column.

So, this is all about introduction of knitting in this week. From next week, we are going to learn about the technologies and how the process of loop formation can be automated with the help of knitting machine. So, in next class, we are going to look at the technologies, hand knitting and circular knitting which is being used, which do the exactly same process what we have

learned so far of creating multiple column of loops. For the time being, thank you everyone. So, we catch you in next lecture. Thank you.