Science and Technology of Weft and Warp Knitting
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Module - 10
Lecture - 43
Double Bar Warp Knit Constructions

Welcome participants. Now, we are moving to lecture number 3 in week 10. In this particular lecture, I have chosen a topic to discuss more about double bar warp knit construction. So, double bar means, you are using 2 different guide bar for making the warp knit structure. Just a quick recap of single guide bar structure.

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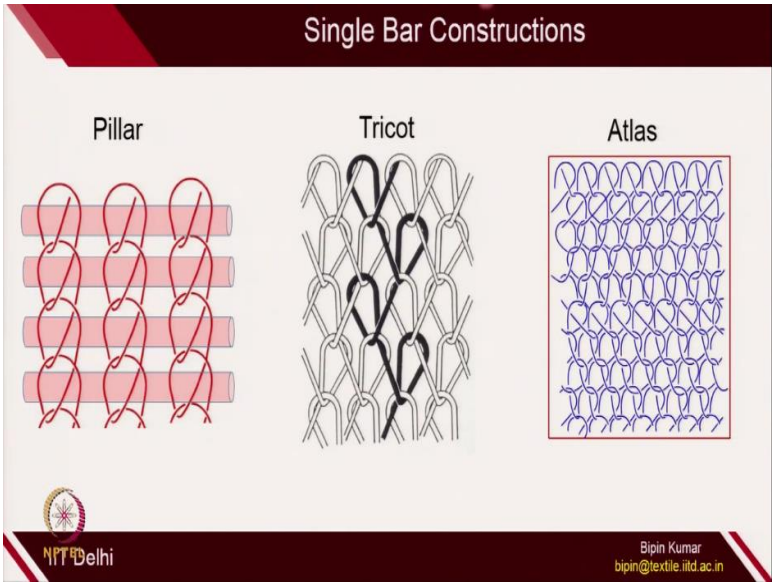

In the last class, we talked about 3 categories of single bar construction, where single guide bar was used. First was pillar, where there was no connections between the wales. So, pillar was usually; the fabric is created with the help of weft inlays. Or sometimes, pillar are used in double bar constructions to give support. The second structure is tricot which is the most simple one and widely used structure in warp knitted category.

Tricot as a single bar structure; here, you can have the guide bar shifting from one needle to its alternate column or alternate needle. Or sometimes, the guide bar will be shifting from one needle to second needle, third needle or fourth needle, depending on the construction. So, in tricot category, we talked about 1 cross 1 tricot. We talked about 2 cross 1 tricot; 3 cross 1 tricot; 4 cross 1 tricot.

So, in tricot, the overlap will always be 1, but underlap can keep on changing. So, you were basically changing the floating length. This is also very, very popular in single bar construction. The third categories of single bar construction was atlas. So, in atlas we have seen how the combination of closed loop and open loop were produced in the same structure. So, this all categories of single bar constructions can also be used in double bar constructions.

So, you can have 2 guide bar. One can be set as a pillar or another can be set as a tricot construction. So, once you combine any these 2, then it will become a double bar construction. So, we will see some examples of how you can combine pillar and tricot and create a composite fabric of these 2 construction. Similarly, you can combine atlas or pillar; atlas or tricot.

So, the combinations you can see is infinite. And in 2 bar constructions there are lot of possibilities are there. In literatures, you can also find 5 bar construction, 6 bar construction, 8 bar construction. So the, depending on the technology's capability of your machine, you can go for different design of the fabric. What is another important thing which we covered in the last week was closed loop and open loop.

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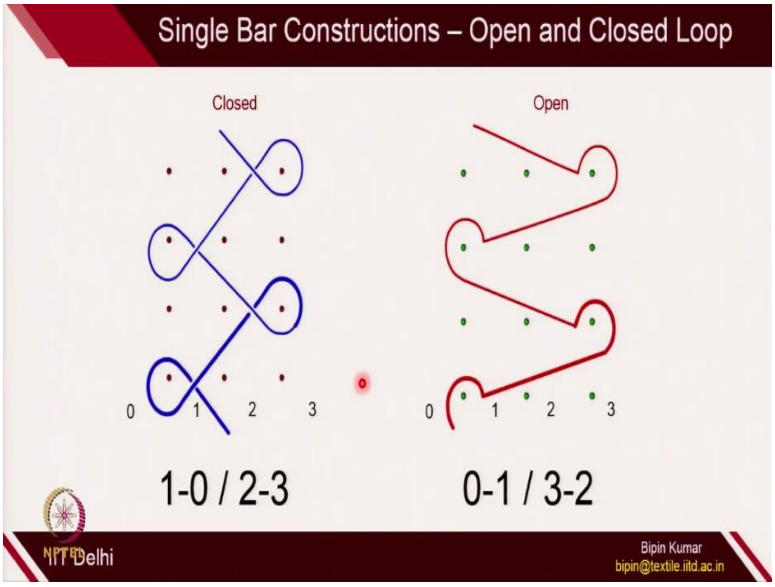

So, in closed and open loop construction, we have seen how the direction of overlap and underlap can be changed and we can get different types of fabric structure. For example, if you see closed loop construction; so, in the same course, the direction of overlap is 1 to 0; and direction of underlap is from 0 to 2. Okay. So, which is in opposite direction. Similarly, in open categories, the direction of overlap is 0 to 1.

And underlap is also in the same direction, which is 1 to 3. So, in this way, closed construction and open constructions are different. In this, if you carefully see, both the overlap and underlap has same amount; overlap is 1 pitch and underlap is 2 pitch. So, in both the construction, the amount of overlap is same; amount of underlap is same. But the only difference here is, they are in opposite direction.

So, once you have different opposite direction, the nature of loop in the fabric will be different. Especially, the open loop construction is highly unstable, distorted. The fabric is more wider, the GSM is lower. So, there are lot of properties can be altered only by changing the direction of overlap and underlap in the same course. So, this is what we covered in the last classes. And we mainly focused on single bar construction.

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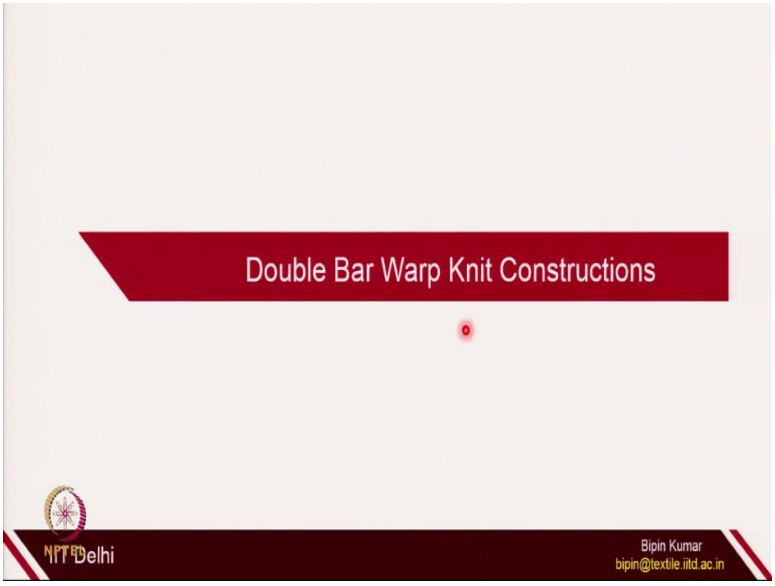

Now, let's move to double bar warp knit construction. So, first of all, what do you mean by double bar construction?

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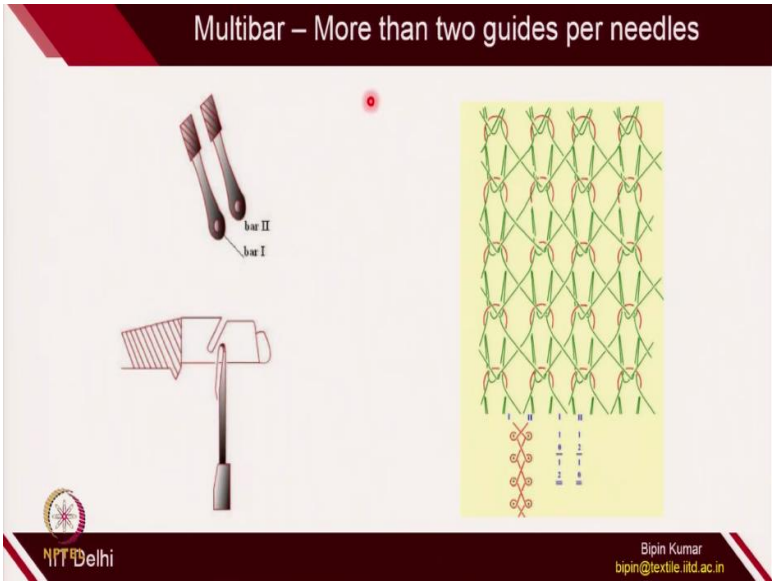

So, in double bar construction, each needle will get chance to interact with 2 guides and each individual guides will be connected to different bars. So, for example, if you see this guide is connected with bar 1. So, this is the bar. And the second guide is connected with different bar. So, you can think for the plan, for bar 1 as a tricot or atlas or pillar. Similarly, for bar 2, you can think for any combination for guide movement.

So, in this way, the 2 combination of guide's movement are combined together and in different type of fabric structure can be generated. So, as a 2 bar construction or multi-bar construction, you need to give the lapping diagram and plan for 2 different guides. So, for each guide, you need to draw the lapping diagram; for each guide, you need to draw the lapping plan.

So, this is the only difference in single bar and double bar construction. When you have 6 bar construction, bar 1, bar 2, bar 3, bar 4, bar 6. In that case, you need to provide lapping plan for all the 6 bars; and also lapping diagram for all the 6 bars. So, in today's lecture, we are going to focus mainly on double bar constructions where we are focusing on 2 bars. So, if you understand 2 bars; 3 bar and 4 bar, it is just the generalization of the principles used in 2 bar construction.

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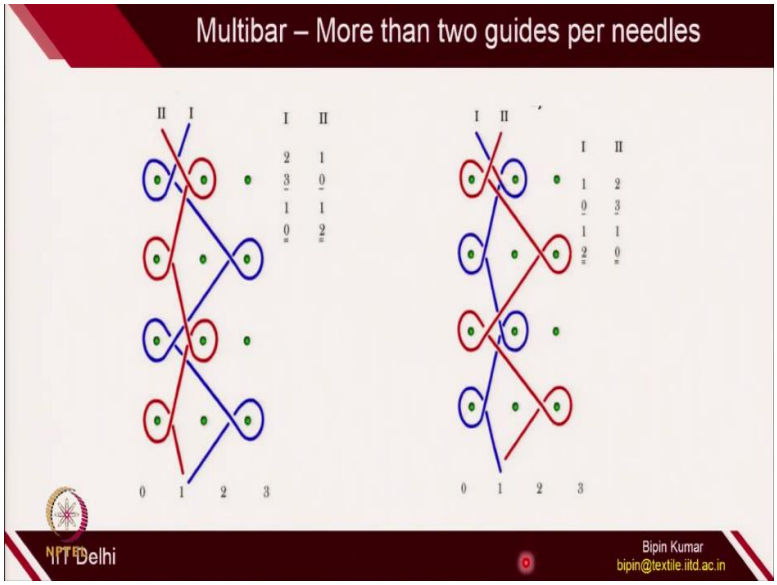

So, here I am giving you just a quick example of 2 bar construction. So, the blue one, if you see the left lapping diagram. So, the blue one is having different lapping plan and the red one which is the guide bar 2 has different amount of lapping movement during course formation. So, definitely, these 2 guides must be attached with different guide bars. So, we need to provide the movement of both the guide bars as a separate column.

If you see the second photo, they look similar to the first one, but the only difference here is, we have altered the position of 1 to 2 and 2 to 1. So, we have swapped the position. So here, the 2 become 1. So, here the red was denoted by second guide bar; here the blue is denoted by first guide bar. So, the only difference is, we have shifted the position of guides with respect to needles.

So, it means, what was initially set to bar 1 movement; now, the bar 1 movement is changed to bar 2 movement; and bar 2 movement is changed to bar 1 movement. So, obviously, when you change the relative position of these bars, obviously, you will get a different types of structures. So, even though the lapping plan of these 2 bars are same, but relative positioning with respect to the needle will also play a important role here. So, let me explain you how, when you change the position of bar 1 and bar 2 how the fabric will change.

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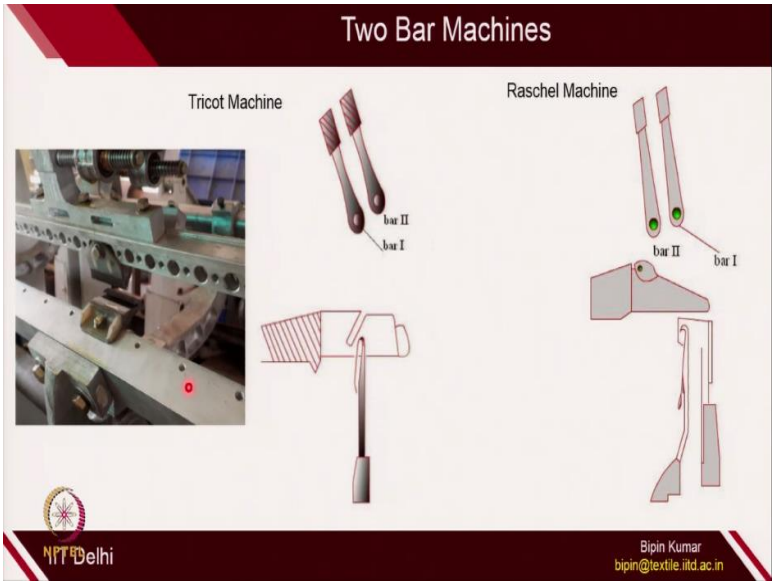

So, first of all, here is the 2 technologies which is quite popular in 2 bar machines. So, first one is tricot machines, widely popular for agro nets; for simple mesh fabric; for mosquito net fabrics. So, single bed machines are very, very popular. And this is, this machine I also demonstrated in week number 8; how we fix sinker; how we fix bar; how we fix needle; everything was shown to you as a lab demonstration.

So, in tricot machine also, you can see, if you see the **(Video Starts: 09:31)** video carefully, there are 2 guides. So, one is this one and another one is at the back side. And this is the needle which is rising. So, you can see it here. So, this is the needle and there are 2 guides which is attached on the top. So, one is visible. So, the bar 1 is visible to you; bar 2 is at the back side of this bar. Okay.

Similarly, on the raschel machine also. Raschel machine also, the role of sinker is not that prominent, because there is a verge on the needle bed itself. So, the pulling of fabric is very, very easy. So, in raschel knitting machine also, we can have 2 guide bar which will be providing yarn to the individual needles. Okay. **(Video Ends: 10:16)**

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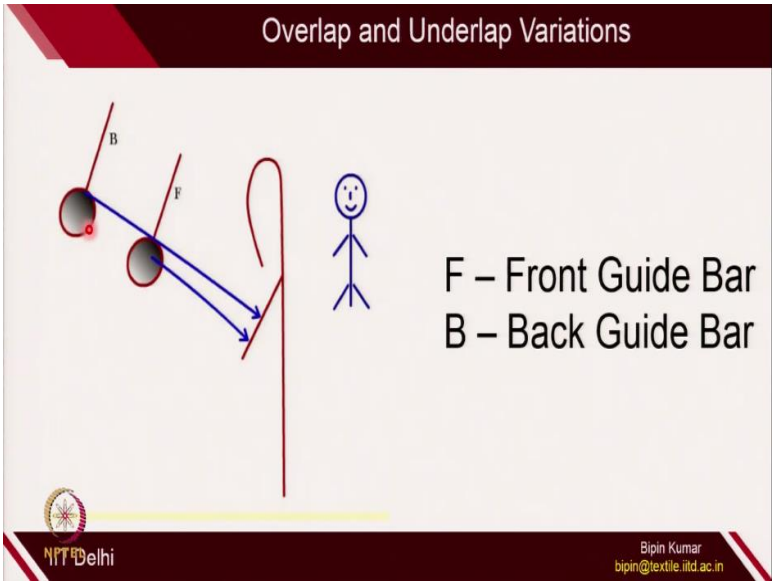

So, the positioning of 2 guides is very, very important, because it will decides which yarn is actually being interacted by the needle first. So, usually, we have the front guide bar and back guide bar, which is presented to the needle. So, we define front guide bar as the guide bar which connects or which is nearest to the needle. That is called front guide bar. The second one is the back guide bar which is fastest from the needle.

So, F and B are denoted as per the relative positioning of those guides in the front side of the needle. So, those who is very next to the needle, that is attached with the front guide bar. And those who is fastest to the needle, it is called back guide bar. We can also name this guide bar 1 or guide bar 2.

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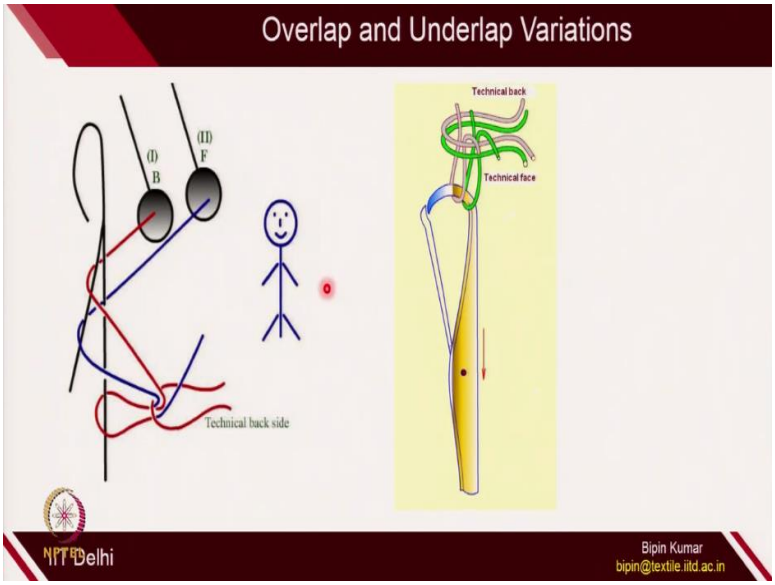

So, if you see here, why this position is very, very important; because once the guide bar swings from front side to back side, naturally, the yarn which is attached to back guide bar will come on the top of the surface, when you are looking the fabric, on technical back side. So, on the technical back side, the yarn which is attached with tech, with the guide bar B or the back guide bar, that will be visible to the user.

So, you can see it here. So, depending on which yarn or which color you are attaching with individual guide bar, that will decide how the fabric will look on the surface. So, if the yarn is attached with the back guide bar, that will come on the back side of the fabric. And those which is connected with front guide bar, that will come on the technical front side of the fabric.

So, it is similar to weft knitted constructions, where we have the technical front and technical back. So, here the technical back side, the guide bar which is technical back, those yarns will be visible. On technical front side of the fabric, yarn which is attached with the technical front side or front guide bar will be visible. And this is shown in the needle also. So, you can see the technical face side; yarn from front guide bar is visible.

On technical back side, yarn from back guide bar is visible. And front and back, we denote with respect to the needle position. So, those which is very next to the needle is called front. Those which is fastest from the needle is called back, on the front side. But, on the opposite side, if you see on the back side, the back guide bar is very near to the needle and front guide bar is very far to the needle.

So, obviously, the denotation of front and back is defined with respect to the front side, not at the back side. And positioning of yarn on individual guides will change the appearance of the fabric. So, although overlap and underlap variations are important, but positioning of these guide bars is also important with respect to needle. Now, let’s see some of the combination of the fabric which can be generated.

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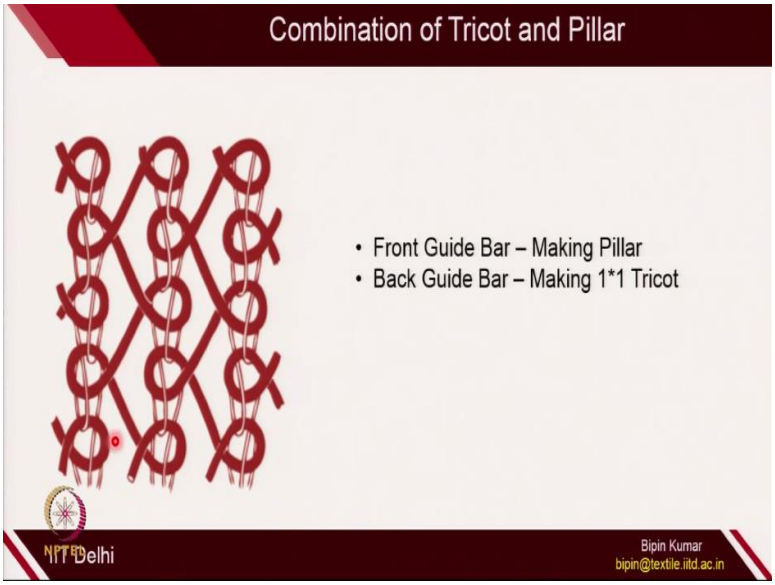

So, if you see here, there are 2 guide bars which is providing the yarn to individual needle. So, first one is actually front guide bar is making pillar construction. So, I already explained you different types of pillar construction in the previous lecture. And back guide bar is making 1 cross 1 tricot. So, this is the one of the simple 2 bar constructions, where you are combining tricot and pillar together.

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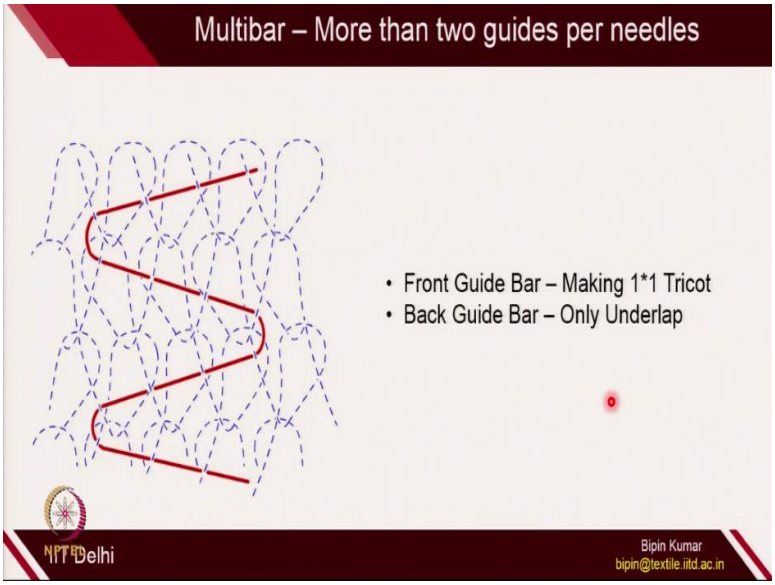

So, if you see another constructions, here also 2 bar construction. Front guide bar is making 1 cross 1 tricot; and back guide bar is doing just underlap. So, it is just shifting the position, not giving yarn to the needle. So, that is also possible in the fabric construction.

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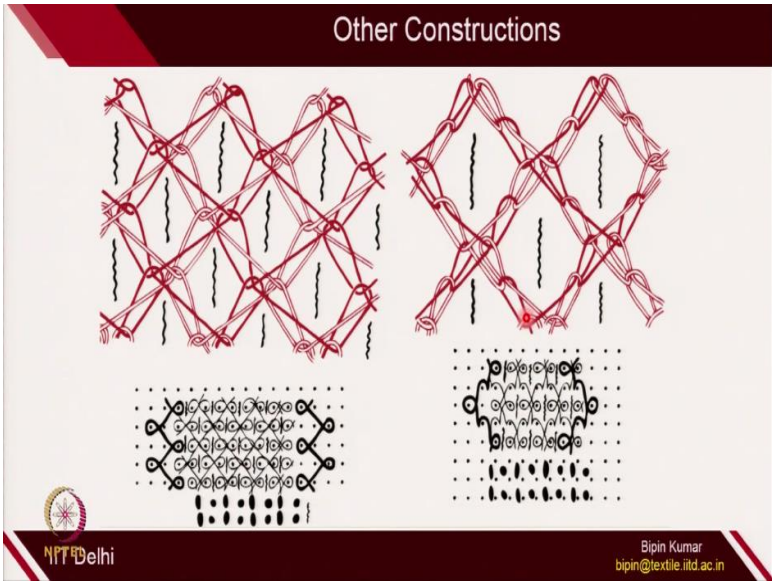

Other complicated constructions could be; so, here is the lapping plan for 2 bar constructions, where you can get mesh, different types of meshes. And these meshes is very, very important, because that will decide the size of the pores. So, for mosquito fabric development also, size is very, very important. If you go for tissue engineering, where you have to develop cell on the surface; there also, pore size is very, very important.

And you can change the dimensions of pores depending on the lapping plan of 2 different bars. So, I have some fabric with me. So, I am going to explain for 1 or 2, 2 bar constructions, how they are designed and what was the lapping plan and diagram for individual guides. So, that will be sufficient for you to at least guess how a double bar construction is defined or generated.

So, let me show you the first construction. **(Video Starts: 15:48)** So, this is your first construction. So, if you carefully see the fabric, the similar fabric is, if you want to see the color mode, this is the fabric. So, if you see this type of fabric; so, one is made from the black yarn, which if you, if I zoom it more for you. So, one is made from the black yarn and the other is the green yarn which is traveling.

So, definitely, if you see the column which is created by the black yarn, is nothing but the pillar construction. Because, the pillar, it is moving in one direction. It is not connecting with adjacent columns of pillar. So, definitely this 2 bar fabric is having 1 pillar. And the other combination is the green yarn which is actually combining these 2 pillars and placing them in the right position in the fabric.

Similarly, in the white fabric, both the yarns are same; so, it's very difficult to differentiate. But the same construction. And here you can able to understand more closely. So, let me explain for you. So, you can see the construction here. So, this is the construction. And the pillar, if you start pulling it, this is a open loop pillar construction. If you start pulling it, it is just coming out from the fabric, which is not the case with closed loop pillar.

So, if you want to see the difference between closed loop pillar and open loop pillar, you can see it here. The pillar, loops in the pillar is coming out. So, all the loops which is being formed in the pillar is just coming out, because it's a open loop construction. So, the middle one. So, this one. So, let me zoom for you. Okay. So, this is the loops. So, this is the pillar loops.

So, you can see it here. So, it is just coming out. So, that's the problem with open loop construction. Okay. And, on the side, you can see, there is a another guide bar which is actually connecting 2 pillars. Okay. So, which is connecting 2 pillars together. **(Video Ends: 18:35)**

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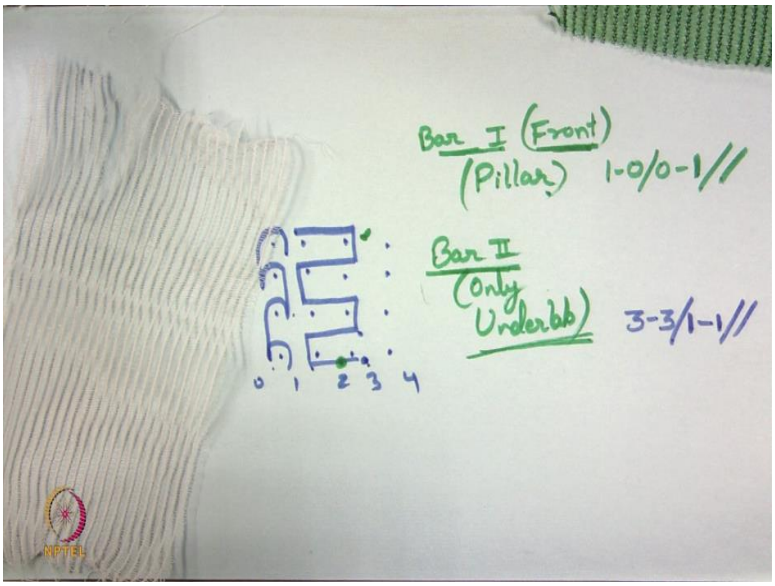

So, in simple terms, if you want to express this fabric. So, if you want to express this fabric, the first guide bar is actually making pillar in open loop construction. Okay. This is the open loop construction. And the other guide bar is actually just providing yarn to 2 columns, only doing underlap. So, this is what is happening exactly in this fabric. Okay. So, the first guide bar which is the front guide bar is making the pillar.

And back guide bar is actually making up the only underlaps. So, the first guide bar, bar 1, which is the front one, it is actually making pillar. Okay. So, you can note down the lapping plan for the pillar construction. This is 1 to 0. Then, 0 to 0, because there is no underlap. And then, 0 to 1. So, this is the, for pillar construction, open loop. So, 1 to 0; 0 to 0 is the underlap; and then, 0 to 1.

So, this is what is denoted here. And this bar, 1, which is a, next, very next to the needle is attached with the, the yarn is attached with the front bar. Then, there is second bar 2, which is just giving the underlaps. Okay. So, that is also only underlap. So, if you recollect the lecture number 1, it is the combination of 2 different types of overlap and underlap variations, by using 2 bar.

So, here if you see, 3 to 3; 3 to 3 is the overlap. After that, 3 to 1 is the underlap. Then, 1 to 1 is again overlap. And then, it is moving back to third position. So, this is how 2 bars are connected together. So, 3 to 3, 1 to 1. If you see second construction, which looks like slightly mesh type fabric. **(Video Starts: 21:27)** If you see, this is a kind of mesh which has been created. **(Video Ends: 21:32)**

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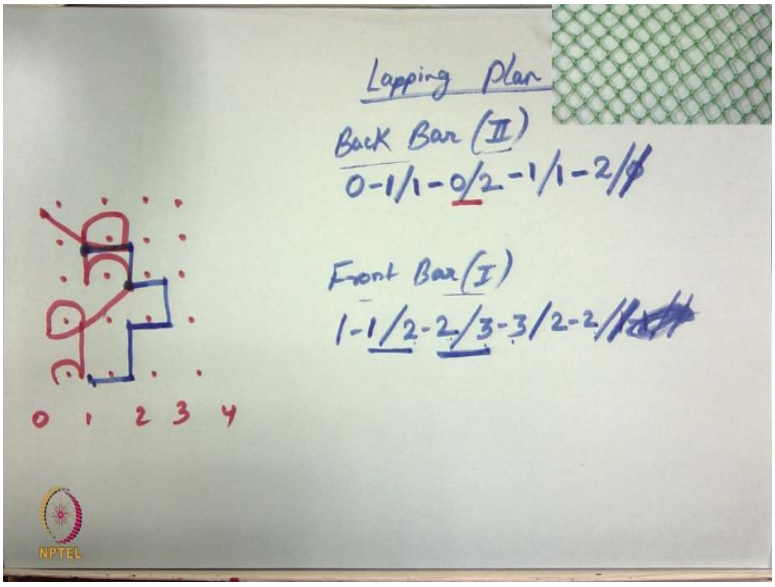

So, if you want to see the construction for this fabric, the lapping plan for back bar which is 2 and front bar which is number 1, is like this. Because, that it is very difficult to observe even in microscope. So, once you are developing this fabric; and the way you design the pattern drum and pattern disc, which I will be covering in the next class. Based on that, I am just explaining what is the lapping plan for this particular fabrics.

So, this particular fabric is having the lapping plan of 0 to 1; then 1 to 1; then 1 to 0; then 0 to 2; then 2 to 1; then 1 to 1; then 2; then. So, this is, after that, it is repeating. So, this is the lapping plan for back guide bar. For lapping plan for front guide bar is 1 to 1; 2 to 2; then 3 to 3; then 2 to 2; then 1 to 1. And after that, it reach back to its original position. So, basically up to here.

After that, it is repeating. So, this is for back guide bar and front guide bar. If you want to draw the lapping diagram; 1, 2, 3, 4. So, 0 to 1 on the front side; 1 to 1 is this, this one. And then, from 1 to 0, again on the front side. And then, 0 to 2. So, this is the second position 0 to 2. And then, from 2 to 1, on the front side, this is the overlap. And then, 1 to 1 is again, underlap is 0.

Then 1 to 2. So, after this, 1 to 2. And after 2, then this is 0. So, 1, 2, 3, 4; after 4 courses; we started from here, we reached here. And this is the lapping diagram for back bar 2. Now, let's see the lapping diagram for front bar. So, for front bar. You have 1 cross 1. So, I am using the different color, so that you can differentiate. So, 1 to 1 is overlap. So, overlap is nothing. After that, 1 to 2.

This is the underlap, 1 to 2. And after that, 2 to 3. 2 to 2 is again overlap which is nothing, just swinging. After that, then this is 3; 2 to 3. This is underlap. From 3 to 3 is again nothing. Then 3 to 2 is underlap. Then 2 to 2 swinging. Then, after 2 to 2, this is 2 to 1, overlap. So, we started from here; we finished here for the next course. So, this is how it is happening. So, the front guide bar is just doing underlaps; and back bar is basically a atlas construction, because it has open as well as closed loop.

So, this is closed loop and this is open loop. So, this is how this particular fabric is created. So, this particular fabric is basically created using this. So, there are different types of fabrics are there. Some fabrics, you can easily observe with the help of microscope; and some fabrics are very, very complicated.

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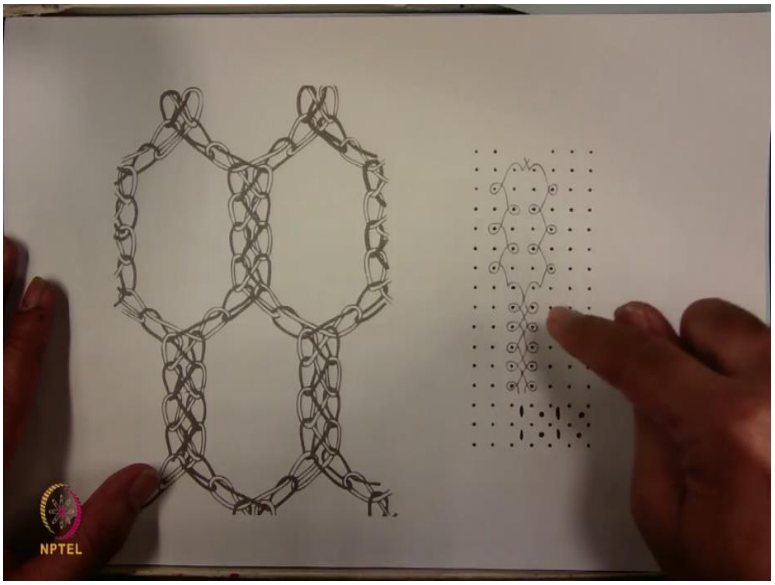

So, you cannot actually guess how the fabric will look. It is very, very difficult from engineering point of view to guess the design of the fabric before making it. So, there are lot of hit and trials. You have to do it. You need to understand how the sinker loops is actually pulling the loops and how the mesh can be created. So, this is a hexagonal mesh which can be created if we follow the lapping plan according to this particular lapping diagram.

So, obviously, you will get this fabric. So, in literature, there are so many examples are given. So, I just expect you to keep following different types of examples and try to understand double bar construction. So, with this, we are finishing the warp knitting structural design possibilities. In the next class, I will take you to the lab where how we actually make or change the lapping plan on the machine, so that you can create different types of structures.

So, for this particular week, I expect all of you to please do as many practice. Try to understand warp knitted structure. I can understand the structure is very, very complicated. But, a lot of practice and experience has to come. And you need to keep doing a number of practices. So, in the quizzes also, I will incorporate many types of questions, where you can make the practice and try to be comfortable with this type of topic.

So, from next class, we will be discussing more of technology related thing and the machine, on the machine, how we actually design these fabrics. So, with this, thank you very much. See you soon in the next week. Thank you.