Science and Technology of Weft and Warp Knitting
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Module - 5
Lecture - 21
Fabric Design - Float and Tuck Formation

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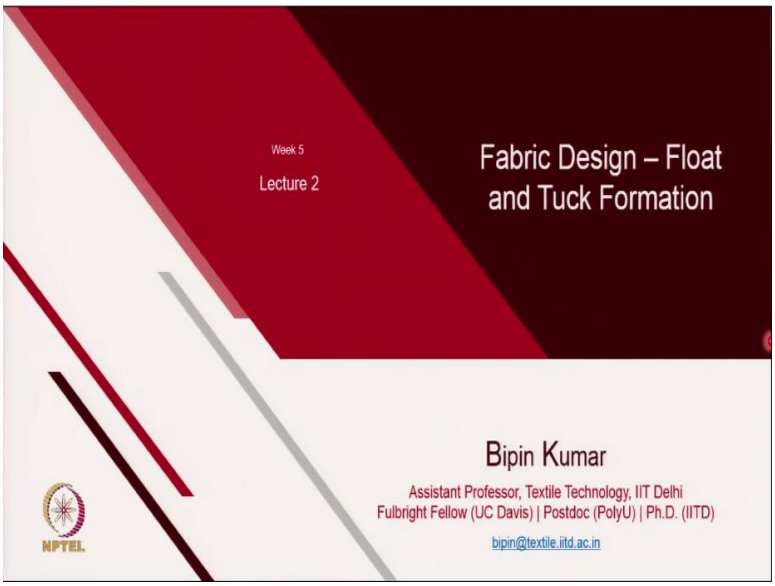

Welcome participants, to lecture number 2. In this particular lecture, I am going to introduce you fabric designing. And I am going to show you some of the fabric samples, where there are float and tuck stitches is present in the fabric structure.

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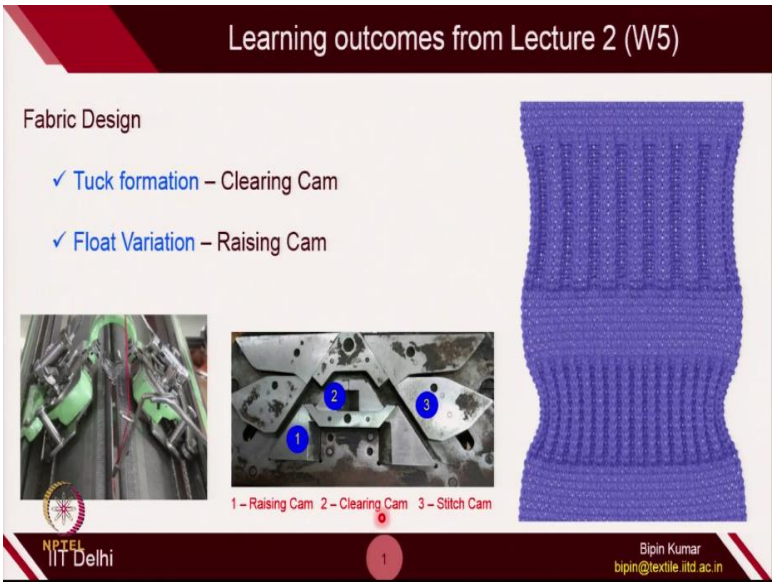

So, just a quick recap, what we are going to learn in this particular lecture. So, in this particular lecture, you are going to learn how you can make the tuck loop with the help of clearing cam in the fabric structure. And also, how you can make the float loop with the help of raising cam and introduce floats in the fabric structure. The machines which I am going to use is V-bed machines where you have 2 beds, front bed and back bed.

So, these are the fabrics which will looks like when you change the stitches. So, at this segment, the stitches are different. In this segment, the stitches are different. And you can see how the fabric nature is changing depending on the stitches that is present on the fabric surface. So now, let's first understand how we make tuck and float. So, I have already given you a hint about tuck and float stitches in last week.

You need to play with the cam profile, especially raising cam and clearing cam is responsible for float and tuck stitches respectively. Stitch cam, I have already given you the indication; when you set the stitch cam, you can play the loop length. So, the last lecture is all about playing with the stitch cam setting. Now, today, the lecture is all about changing the raising cam setting and clearing cam setting; and changing the fabric design.

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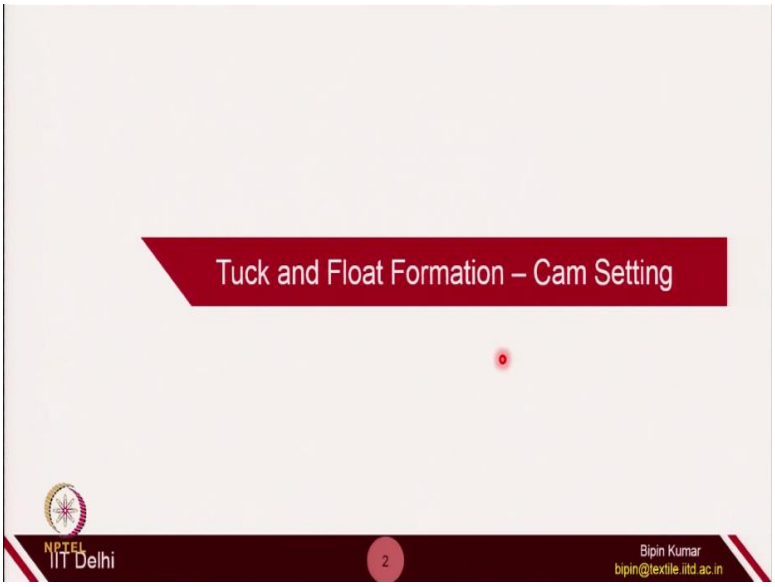

Just a quick recap. We have already done this. But I just want to quickly go through those slides where I was changing the tuck and float.

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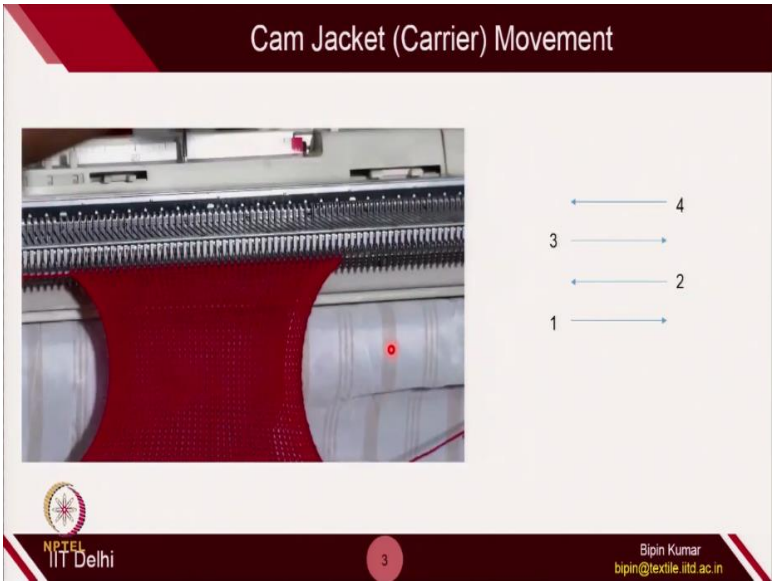

So, if you remember **(Video Starts: 02:24)** the cam jacket; the cam jacket on the machine is moving from left to right and right to left, to create a particular course. Okay. So, in the first course, the cam jacket is moving from left to right. In the second course, it is doing opposite, right to left. In third course, it is doing left to right. In fourth course, again doing left to right. So, for each direction of cam jacket, we have to specify whether it is making loop stitches, tuck stitches and float stitches on the machine.

So, now, in the fabric notation also, you have to carefully indicates the direction of carriage movement. So, this is the carriage which is moving, which is taking the cams from left to right or right to left. So, that direction of motion is also very, very important. You should indicate that as well. So, in the first course, it is moving left to right; second course, right to left. So, this is how the knitting takes place on the machine. **(Video Ends: 03:29)**

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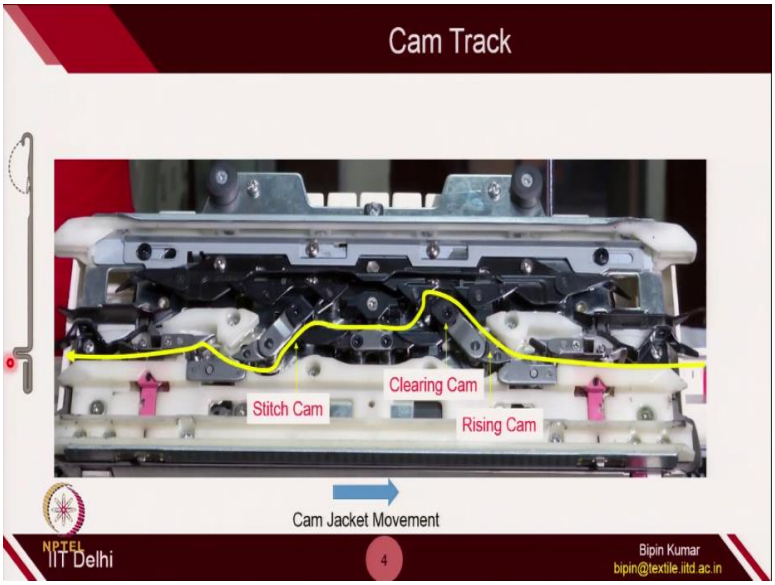

If you follow the cam track from week number 2, when the cam jacket moves from left to right, it will first interact the needle from right side. And the needle **(Video Starts: 03:42)** will first go, and then hit the raising cam, then clearing cam, then stitch cam and then upthrow cam; and finally descends **(Video Ends: 03:51)** from the opposite ends. So, this is the path which the needle will follow when the cam jacket moves from left to right.

So, these are the location of raising cam, clearing cam and stitch cam. But, when you reverse the movement of cam jacket from right to left, the needle will come on the left side when the cam jacket is moving in opposite direction.

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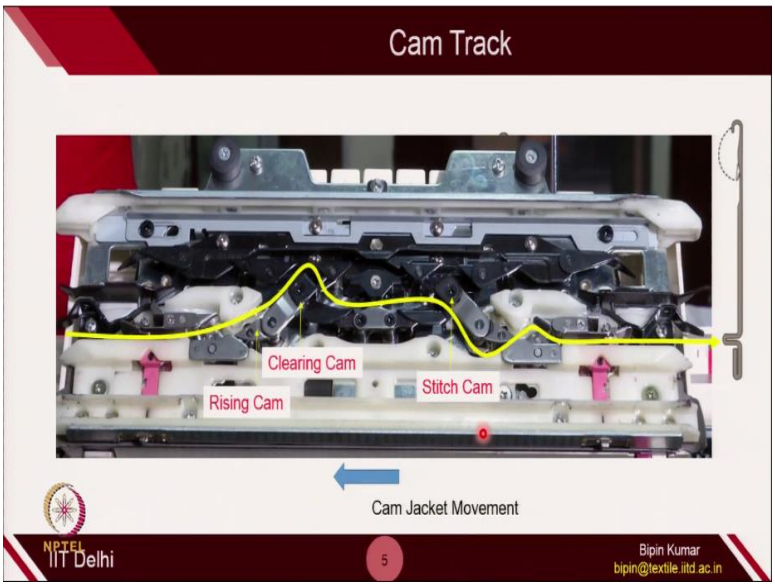

So, when the cam jacket moves from right to left, the needle will start from the left side with, relative to the cam jacket movement. And the needle will **(Video Starts: 04:27)** now follow

this path of cam profile. So, the stitch **(Video Ends: 04:36)** cam is now playing the role of clearing cam. From the previous slide, if you see. Now, this is the profile of the yarn path. So, it will first hit this raising cam, which was upthrow cam in the previous slide.

This was a stitch cam in the previous slide, but now this is clearing cam, because it is making the needle to rise. So, now this is raising cam, clearing cam and a stitching cam. So, depending on which direction the carrier is moving, the nature of these cams will change. So, it may act like a clearing cam and it may act like a stitching cam, which will depends on which direction the carrier is moving with respect to the needle bed. So, direction of carrier from left to right and right to left and specifying the relative cams is extremely important in fabric designing.

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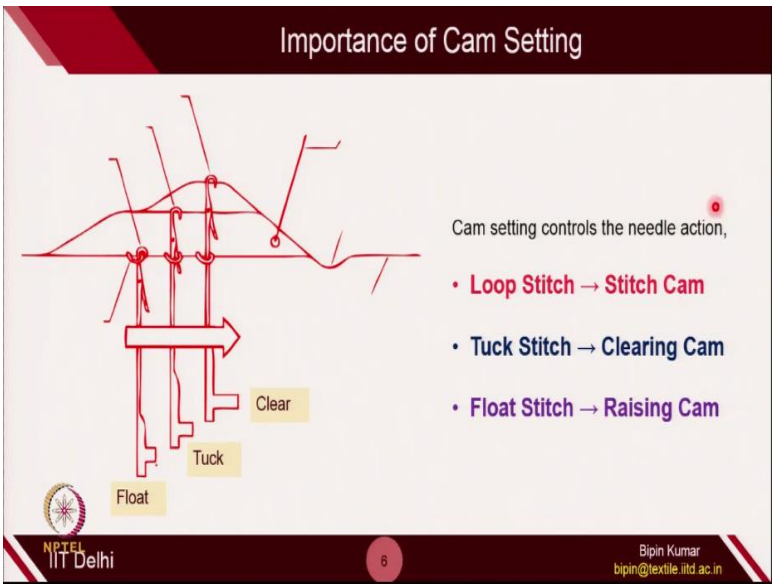

Cam setting: I have already given you sufficient information how we can make the float. So, in case of float, the needle just follow this path. It will not rise. It will just simply remain idle on the machine, catching its old yarn. For tuck, the needle rises, but it do not clear the old loop with the help of clearing cam. And then, it will catch the new yarn. This is the new yarn. And then, in the next course, it will releases both the tuck loop and held loop simultaneously.

For clear position; actually, when the needle rises up to this position, it, which is only possible when it hits the raising cam as well as clearing cam together in a sequence. Then it will make the normal loop stitch. This is the 3 position or 3 path which the needle will take. But that path will depends on, at how the cams has been set on the machine.

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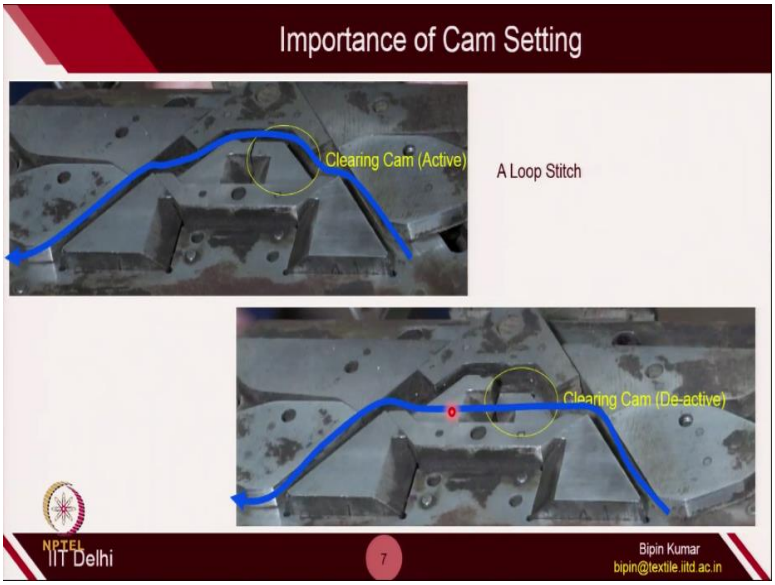

So, for example, this is the cam diagram for V-bed machine. So, this is the clearing cam. So, when the needle is starts rising from right side, from right to left; then, when clearing cam is not deactivated or it, when it is in active position, the needle will rise and clear the old loop. In this case, it will make the loop stitch. When the clearing cam is in deactivated position, it means it is, the metallic block is now suppressed inside the plate.

It is not hitting with the butt. So, in that case, it will move like this. It will rise, but it will not rise sufficiently to clear the old loop. And in that process, it will catch the new loop. And in this way, it will make the tuck stitch.

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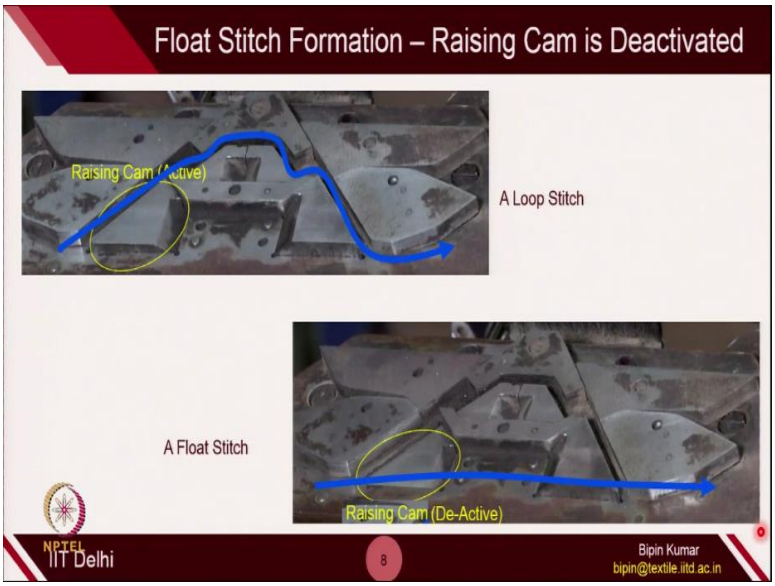

So, in case of float stitch, this is the raising cam. So, when the raising cam is in active position, it will hit the needle butt and the path will be like this. So, it will be a loop stitch.

When the raising cam is in deactivated position, it means it is suppressed inside the metallic platform in this cam platform. Then, the needle will not rise. The butt will simply move in a straight line. So, the needle will remain idle on the bed.

So, in this case, it will make a float stitch. So, depending on the direction of the movement, and depending on the setting of stitch cam, clearing cam and raising cam, a number of fabric designs can be created. But, direction is extremely important.

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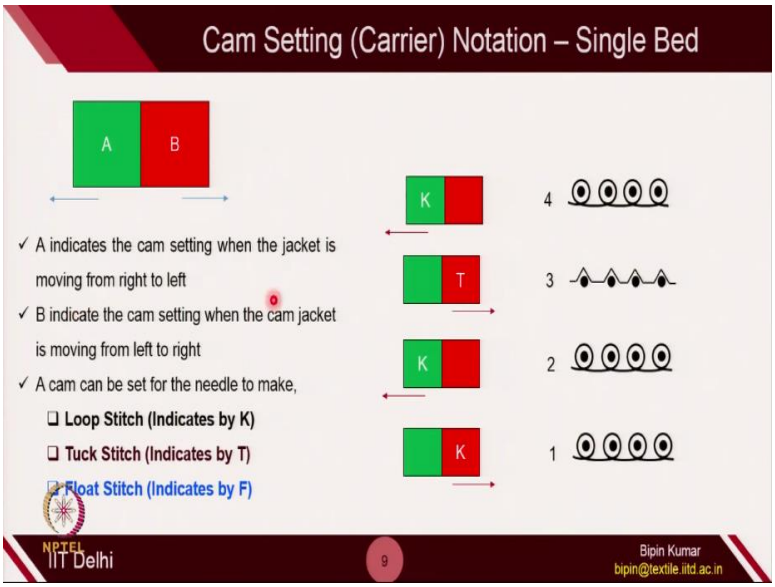

So, we are representing 2 blocks for each direction. So, the right block is representing when the cam is moving in the right direction, from left to right. And the left box is actually representing when the cam is moving from right to left directions. And A and B are the symbol which indicates whether, when this particular carrier is moving in right direction, then what type of loops is being created.

Whether it is a stitch loop; whether it is a tuck loop; whether it is a float loop. So, A indicates the cam setting when the jacket is moving from right to left. B indicates the cam setting when the cam jacket is moving from left to right. And A and B can be set into loop stitch, tuck stitch and float stitch depending on the user notation. So, loop stitch, you can indicate it by K. It means, the needle is actually knitting.

Tuck stitch, you can indicate by T. This is just the symbol which will very helpful in denoting the carrier movements and what the needle is doing when the carrier is moving in a particular course. And float stitches by F. So, the B could be K, T and F; any symbol can be there. So,

when the B is K, it means, when the cam jacket is moving from left to right it is making knit stitches or loop stitches.

When the B is T, it means the cam jacket is moving tuck stitches in all the needles, when needle is moving from left to right. When B is F, then it is making float stitches. For example, if this is the cam jacket and the cam is moving from left to right side; and it is set at K. Then, on the bed, it will be making all loops. Okay. So, all technical back loops. When it is moving in opposite direction and when it is set at K, again in the next course, it is again making loops.

Now, let's suppose, in third course, when the carrier is set or the cam is set at T, it means, all the needles now will engage in tuck position. And now, it will be creating tuck stitches, all the needles of that particular bed. When, again when, for the fourth course, when this cam jacket is set as knit position, then it will knit all the loops. So, this is how you can denote the carrier movement and decide in particular course what the needles should be doing. So, this notation of carrier is extremely important in fabric designing.

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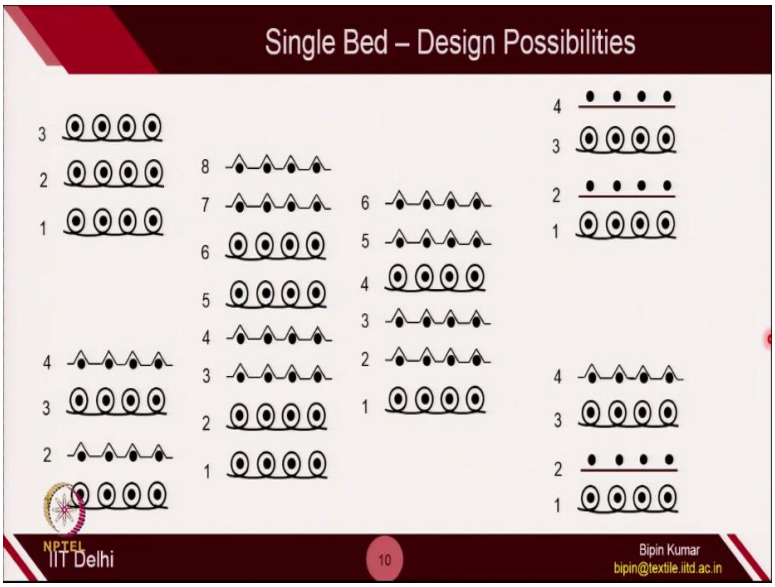

In single bed, especially the single flat bed which I showed you in week number 2, what are the design possibility? what we can create? So, we can created all loops in every courses. So, in first courses also, all needles are doing loop. Second course also, all loops. Third course also, all loops. But we can also decide depending on our design, we can introduce tuck in some of the courses.

For example, in second course and fourth course, we have introduced tuck in all the needles. Depending on designs, we can also change the position of tuck. We can have multiple tucks together. We can have multiple loops together in the course. So, in first course, loops; second course, loop; third, tuck; then fourth, all tuck; fifth, again loop; sixth, again loop. We can also play with different tuck and loop numbers.

So, there is only 2 courses of loops and 4 courses of tuck in the fabric design. We can also play with the float. So here, the first course is loop. Second course is all float. Third course is all loops. Fourth course is all float. Sometimes, we can also combine float and tuck in the same fabric. So, in single bed, by changing the carrier cam setting in a particular course, we can select what needles would be doing at a particular course.

So, these are some of the design possibilities. You can see, the designs are unlimited. I have a few fabric samples, where I have already set the machine in a certain sequence, which I am going to show you in couple of minutes. So, this is how we actually make designs on the fabric by setting the cam.

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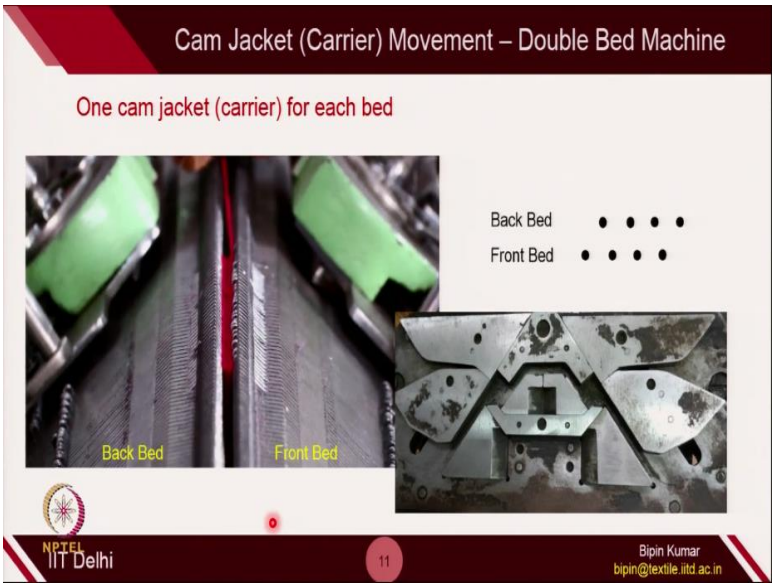

If you go for double bed machines, you basically had 2 beds. So naturally, for back bed you have different carrier; for front bed, you have different carrier. So, again, this carrier can be set at different location when it is moving from left to right and right to left. And back bed carrier can be also set at different setting when it is moving from left to right and right to left. So, there are 4 possibilities which you can do.

(Video Starts: 13:29) You can see, this is how you make the fabrics. So, you can select at every course, what front beds can be do; what back bed can be do. So, the design or the setting is completely up to the users who is running this machine. **(Video Ends: 13:47)**

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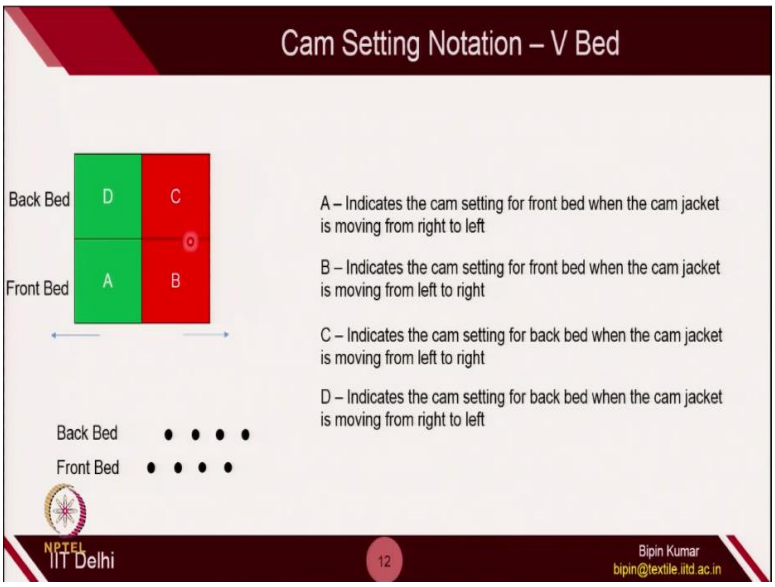

So, now, how we actually set the cam setting notation for V-bed. So again, you have 2 beds; so, 2 carriers. So, for front bed, it is shown by 2 boxes at the lower row. For back bed, 2 boxes on the upper row. A B C D is again the setting which is possible. A is the setting when the front carrier is moving from right to left. So, A indicates the cam setting when the front bed is moving from right to left.

B indicates the cam setting when front bed is moving from left to right. Similarly, C indicates the cam setting when the back bed is moving from left to right. And D indicates when the carrier is moving from right to left. And this is the front bed and back bed. So, this is how you denote the cam setting for V-bed. So, now let's see, when you have K, T and F at a particular location, in these carrier movement.

So, you have already seen, whenever we use V-bed machine, both the carriers of back bed and front bed, they move simultaneously. So, the setting has to be done for both the carriers at the same time. So, B and C has to set when the machine is moving from left to right. And A and D has to set when the carrier is moving from right to left.

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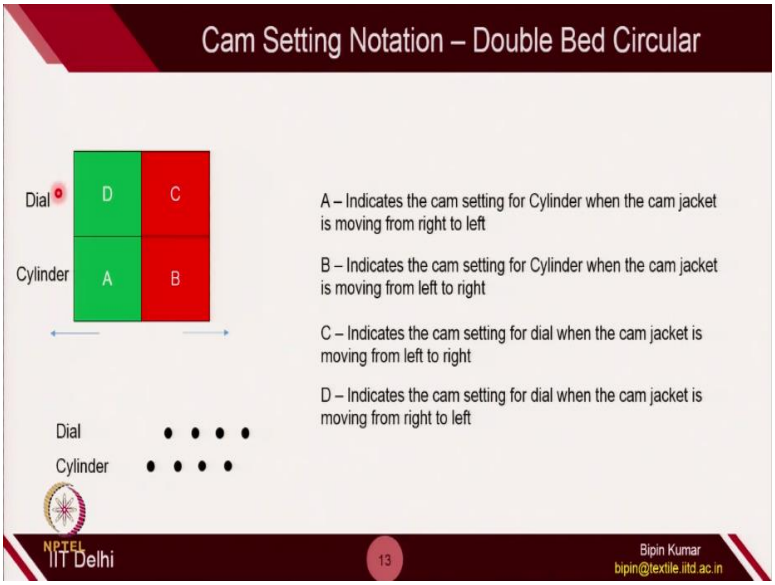

Similarly, in double bed cylinder also, for cylinder you can do the setting; for dial also you can do the setting.

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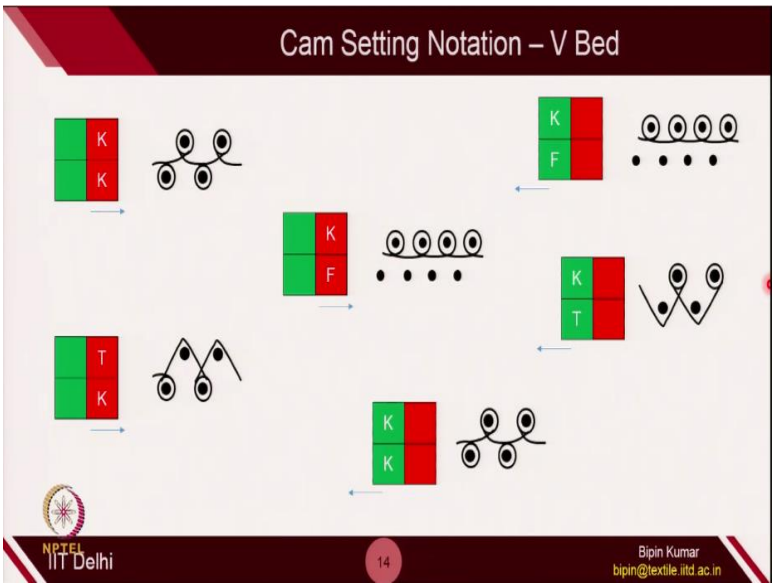

In V-bed, what the cam setting indicates? For example, if the front bed's carrier is at knit position, back bed carrier is knit position, it will be knitting loops in both the bed. So, in front beds also, you can see technical front loops are there. Back bed also, all the needles are doing technical back. Because, both the carrier, both the beds are selected at knit position. Now, if you see here, the front bed is set at knit position, back bed is set as tuck position.

So, that's why, front needle is making loops and back needles are making tuck. This is for V-bed. Again, if you see this one, the back bed is making loops, because it is set at K position. Front bed is making floats, because it is set at F position. Again, if you see here, when the

carrier is moving in opposite direction, from right to left. So, K K, it means indicating all the loops. T K, so here, the front bed is making tuck and back bed is making loops.

So, you can see here. If you, again if you see here; so, front bed is making floats, because it is indicated by F. So, front bed needles are not doing anything. Back bed needles is at the knit position. So, they are knitting the loops. So, again, the setting can be unlimited; designs can be unlimited.

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You can, depending on the setting, you can, anytime, you can set the carrier at different location and you can create multiple designs. Some of the designs are visible here. I have a few fabric samples, which I emphasize you to carefully observe. And I will give you the indications, how we created that fabric on that particular machines, so that, you can go on the machine and you can make your own fabric design.

So, let's have a look to some of the basic designs. **(Video Starts: 17:24)** Let's see this fabric. This is the first course which we created. After that, again from left to right, right to left. We keep doing it, doing it. And this is the last course we created on the machine. If you carefully see this fabric, you will be able to observe whether you have introduced any tuck stitches, float stitches.

So, let's first zoom this fabric, just to make sure whether we have introduced any tuck loop or float loop. So, if you see this fabric, this is the rib structure. I hope you have seen the fabric analysis of double jersey fabric. So, this is the rib structure. After making rib, you can see

here, there is much bigger loops are coming. If you see here, there is much bigger loops are coming compared to the bottom one.

So, you can clearly see, the appearance at this segment and this segment is different. Okay. If you reverse this fabric, again, the appearance is different and different. So, this fabric is created on the same machine, but setting must be different. That's why the looks are changed. So, now I am going you to give the indication what I have changed on the machine, so that this fabric looks like this.

So, if you see this particular section of the fabrics; so, the machine was set in the first course. The machine was set in loop condition, both front and back. Okay. Because, if you reverse it also, it looks like similar. So, this is naturally a perfect rib fabric. Because, on the both side, it looks similar. Now, we created multiple courses of such loops. So, in the second course also, again, all needles was knitting; and so on.

So, till here, we were following the knitting on both beds. So, only stitches. But now, let's see this segment. So, at this segment and this segment, you can clearly see, these 2 segments are different. So, there must be something comes in this segment. So, I will first give you what I have changed on the machine. Then I will also take out the yarn and help you to understand what actually I have created in every course in this particular section.

So, what actually I have changed on the machine? So, when I started making this fabric; so, I have made the setting that all front beds were doing the knitting in the first course and also back bed was doing knitting on the first course. But in the second course, I was making the back bed to do nothing. It means, back bed was set as float. So, in the second course, I was just knitting the front bed, not knitting the back bed.

So, this was the setting in the second course. In the third course, again, it was set at 1; and fourth course, it was set at, similar to course number 2. So, in this segment of the fabric, every alternating courses, we are changing the repeat design. So, first course, both bed loops; second course, only front bed are making loops; back bed is not doing. In the third course, again, both beds are knitting.

In fourth course, again, it is similar to course number 2. So, only front bed was knitting. So, I was introducing float in second course and fourth course in the back bed. That's why the structure was different. So here, in this particular segment of the fabric, both front and back bed was knitting. That's why both the surface was having similar nature. But here, only 1 bed was consecutively knitting, the other bed was knitting and making floats alternatively.

So, that's why the appearance was different. Okay. So, you can see. On one side, it has much bigger loops, which is nothing but the held loop. So here, the loops was held. Here, the yarn was not catched. So, this needle is basically making held loop in every alternating courses. So, 2 courses it is taking to make 1 held loop. So, that's why, on the back side, you are watching much bigger loops. Okay.

So, this is how you can see. So, this is the rib with float. If you take out the yarn from the last end, you can able to see whether both beds was knitting or not. So, if you see carefully, you can take out the loops; only the front bed loops are coming out. So, you can see here, only front bed loops are coming out. So, when it is making rib, the loops are engaged in both the needles. So, which you can see it now.

So, here you can see, first then; then front bed; then back bed; then front bed, back bed, front bed, back bed, front bed, back bed; then front bed, back bed, front bed, back bed. Let me zoom out for you. So, you can see here. Loops are being locked in both front bed and back bed. Can you see? The loops are coming out from both the sides. So, this is naturally a rib, where both the needles are making loops.

Now, let's go for the second course, where you will see only one side the needles are making loop, but other sides are not visible. So, here you can see, loops are only coming out from one of the bed. So, it means, only one set of the needles are making loop. Other set of needles are not doing anything; so, they are making float. Again, if you see the next course, again both beds are making loops.

You can see here. You can see, both beds are; loops are coming out from both the beds. Okay. Now, in the next course, only one bed, the loops are coming out; other beds are not doing, you can see here. Okay. So, this is how you can identify. Although, it will not look like from the surface, but if you carefully see the yarn movement, you can easily say, in one

of the course, both the loops were coming out; and in other course, only one of, set of the needles was making the loops.

This is how the fabric design was created for this fabric. Okay. The simplest one. So, the structure is different, yarn movement is different, also the properties will also change. So, if you see this rib fabric, you can stretch too much. But in this part where you have float and rib, you cannot stretch the fabric; too easy; so, much tighter. But if you see the rib part, much easy to make the stretching.

But in case of float part, float and rib consecutively, its very difficult. So, structure become tight. So, in next lecture, I am going to analyze the mechanical aspects of the fabric. But today, in this particular lecture, we are focusing only on design. So, let's focus only on the design part, just to make sure how you can play with the machine setting and create different nature of loops in the same fabric itself.

So, here I am showing you again a different fabric. Just giving you hint, how I created this fabric. Let's first look at the fabric. So, I created the fabric. This is the first course. Then, I created one section of the fabric. Then I created second section of the fabric. Then I created third section of the fabric. And then I created fourth section of the fabric. So, the number of needles was same, but you can see how the structure was changing.

If you carefully observe, here the width is increasing. Here, the width is, width of the fabric is less. You can see here, the width of the fabric is less; here, the width of the fabric is more. So naturally, at this point, the tuck has come. Because tuck actually increases the width of the fabric. So, this is again the bigger loops. You can see here. Opposite side, it is different. So naturally, both beds are not making loops.

So, it is obviously a kind of float type of arrangement. Again, if you go below; again, this loops are much much bigger, this loops are much smaller, opposite side is also different. If you further go below, if you see this part, again the structure looks different. Then this part, if you carefully see, so this part and this part is, the structure look different. So, definitely, the cam setting was different for both the beds.

And if you see the opposite side, the structure looks different, structure looks different. So, let's first, let me give you the hint, how I created this fabric. So, especially, in this segment, if you see the front side and the back side, they look similar. So, the moment you see front side and back side are look similar, it means, both front needle and back needles are doing the same thing.

So, I was creating loops on the front and back side. And I repeated this for multiple courses. And I keep repeating this, okay, for this much section of the fabric, for this much section. After that, in this segment, I changed the cam setting in the first course. If I start from the bottom, in the first course, I make the rib in the first course. In second course, again I make the rib. But in third course, I introduced floats on the back bed.

So, I introduce floats on the back bed. So, these are the floats on the; this is in the third course. In fourth course, again I introduce float on the back. So, 2 rib and 2 times float on the back bed. So, this is fourth course. In the fifth course, again I am repeating from the 1. So, this is my repeat units. So, every 4 courses, we are repeating the, in a sequence. So, fifth is again rib. Then sixth is again rib.

Seventh become float on the back. Eighth become float on the back. So, because of that, the nature of fabric is different from the rib one. So, you can see much bigger loops. And definitely, this is the held loop which is visible. So, if you see this side and this side, they both are different. So, if you see this one, the sides are different. And the reason being; if you see this particular loop, the needle is holding the loop.

Here, the needle has not cleared the old loop. Here, the needle has not cleared the old loop. So, the old loop is bigger. And in the fifth part, it is making the rib. So, every, after 2 courses, it is clearing the old loop. So, the old loop is bigger. So, which is visible on this side. Now, if you go for other designs. So, this was the design number 2. Now, if you see this part. So, this part and this part, again the fabric design was little bit different.

And how I created this? So, here I created 1 rib and 2 floats. So, in first course, I created like this. In second course, I created float on the back side. Okay. And in the third course, again I created floats. So, and then, I was repeating it. So, the fourth one is become similar to first

course. Then, fifth become similar to second course. Sixth become similar to third course. So, this is how I created this segments.

So, if you see this design number 3; this is the design number 2; and this is design number 1. So, if you see the second design and third designs, they are different, because every 2 rib, you have 2 floats on the back side. Here, you have just 1 rib and 2 floats. So, naturally, you are reducing the number of ribs in the structure. And that's why the structure looks different. Now, let's see the last part, which is the fourth part.

This is where the structure is extending, because the width is increasing. So, whenever width is increasing, you can easily identify this is a tuck design. So, in tuck designs, how I created this fabrics? So, first I created rib; in first course. In second course also, I created rib. In third course, actually I created tuck on the back side. And in fourth course, again I created tuck on the back side.

And then, I was repeating this design. So, if you see number 2 and number 4; after every 2 rib, I was having 2 floats in the fabric. But here, after 2 rib, you have next 2 courses with tuck loops in the fabric. So, if you, overall if you see in sequence, we started from here, rib design. Then 2 rib, 2 floats. Then 1 rib, 2 floats. Then 2 ribs and 2 tucks. And this is how the fabric will be different.

So here, the appearance are different. Then, here the appearance is different. And if you keep moving, again you can see, the appearance is changed. And finally, when the tuck has come, the fabric changes itself. This is all designing aspects on knitting. Naturally, when you take out the yarn, you can measure its loop length; you can measure the GSM of the fabric in a particular area; you can also check the thread densities.

So, all these will have significant influence on the fabric performance. So, in next lecture, actually, I will select a few tuck based design on V-bed and few float based design on V-bed. And I will do the analysis of its structural characteristics. **(Video Ends: 35:59)** Stay tuned. In next class, we will continue with the analysis of tuck and float design. So, this lecture was all about designing on the fabric by changing the cam setting on front bed carrier and back bed carrier. So, if you have V-bed machine in your university or in your company, you can please go and create different designs of the fabrics. So, enjoy knitting. Thank you very much.