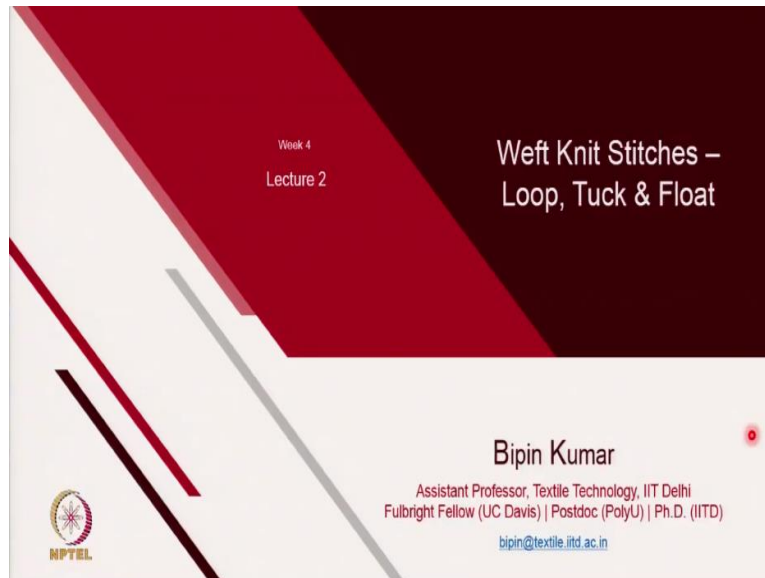**Science and Technology of Weft and Warp Knitting**
Prof. Dr. Bipin Kumar
Department of Textile Technology
**Indian Institute of Technology - Delhi**

Module - 4
Lecture - 17
Weft Knit Stitches - Loop, Tuck and Float

(Refer Slide Time: 00:17)

Welcome participants, to lecture number 2 in week 4. Today the topic I have chosen is, to introduce you loop, tuck and float. These are the 3 basic structural element in most of the weft knitted constructions. So, today's lecture is actually very, very important because, if you understand these loop, tuck and float stitches, you would be able to express all weft knitted structure that is available to you. So, let's look at these stitches. Before we move, in the last class, I have introduced you 4 structural platform on which you can create these type of stitches: loop, tuck and float.

(Refer Slide Time: 00:58)

Summary_Lecture 1(W4)
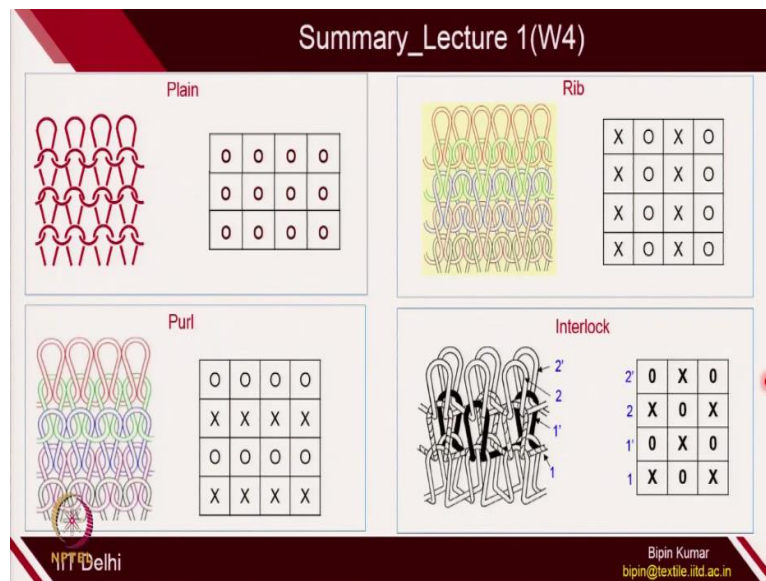
So, those 4 platform which is popular in weft knitting category is plain, where you have either technical front or technical back loops on the surface. The second structure is rib, which belongs to double jersey structure, where, in a course, you can find technical front and back loops alternatively. The other 2 double jersey structure was purl and interlock. So, in purl, alternating courses are technical front and back.

In interlock, actually it is made from intermeshing of 2 ribs. So, basically, there is 2 feeder system. One feeder system make 1 rib structure. And the other feeder system actually creates other rib structure. And these 2 rib structure are combined in the same course, which is shown here. All the technologies for making these fabric structures are different. Plain fabric, we usually make it on single bed machine.

These 3 structures, rib, purl and interlock, we usually create on double bed machines. In double bed machines, rib is widely popular in V-bed machines, where you can create rib structure. In rib knitting machine, in circular category also, you can create rib structure. Purl, you have to have different mechanism, where needle has to transfer. So, either you have purl knitting machines, where needle is transferred from one bed to other; or you can have the loop transfer mechanism in the V-bed machine itself.

So, that is also possible. In interlock machines, you have 2 sets of long butt needles and short butt needles on the 2 different beds. Usually, it is found in interlock circular double bed machines. The beauty of these 4 structural platform is, they have different characteristics. So,

if you see plain, this is highly unstable. It curl, it can be unravelled for both the ends. If you see rib, you can only open it from the ends.

The first course will not allow you to take out the yarn. Also, if you see rib, purl and interlock, they are quite stable structure. They do not curl. So, that's why, sometimes, most of these structures are preferred on the edges of the garments. So, this is what we have learned. There are lot of structural differences and the properties are also different. So, depending on what type of property you want to achieve from a garment, you choose one of these structural platform at different sections. Okay.

Now, let's move to the next part, which is to create stitches on each of these platforms. So, when you see any of these platforms, we can change the nature of stitches.

(Refer Slide Time: 04:01)
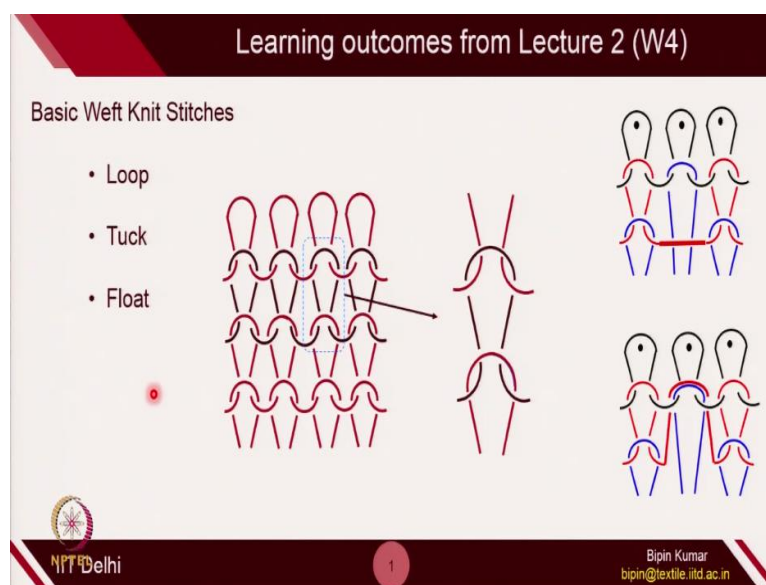
So, in this particular lecture, you are going to learn about the basic fundamental of stitches, where we control the intermeshing points. So, for example, if you see, this particular stitches, it has 4 intermeshing points. If you see this particular stitch, it has no intermeshing points. If you see this one, it has only 2 intermeshing points. So, these 3 stitches are basically loop, tuck and float, which we are going to explain you in detail.

And how we are making these type of stitches on the machine; what sort of cam track we have to change for the needle, so that the needles can create these type of stitches. So, the whole lecture is devoted to let you know about loop, tuck and float. These 3 elements of a structure are extremely important from weft knitting point of view, because this is the basis.

So, once you know the potential of each of these structural elements, you can design n number of fabrics with different properties.

So, from engineering point of view, from research point of view, you need to understand this loop stitches, their properties, their influence on the structure. From design point of view, also it make a huge difference. If you play with these type of elements, you can come up with very, very beautiful designs. So, for the design students as well as engineering students, this lecture is very, very important. So, I expect you to be pay attention, especially in this particular lecture. So, let's move to the first stitch.

(Refer Slide Time: 05:34)

We call it loop. So, we have seen this word so many times in last 3 to 4 weeks. But fundamentally, loop and stitch are 2 different terms. In reality, we sometimes exchange these words and we frequently use in knitting. But, in reality, in scientific way, these 2 terms are completely different.
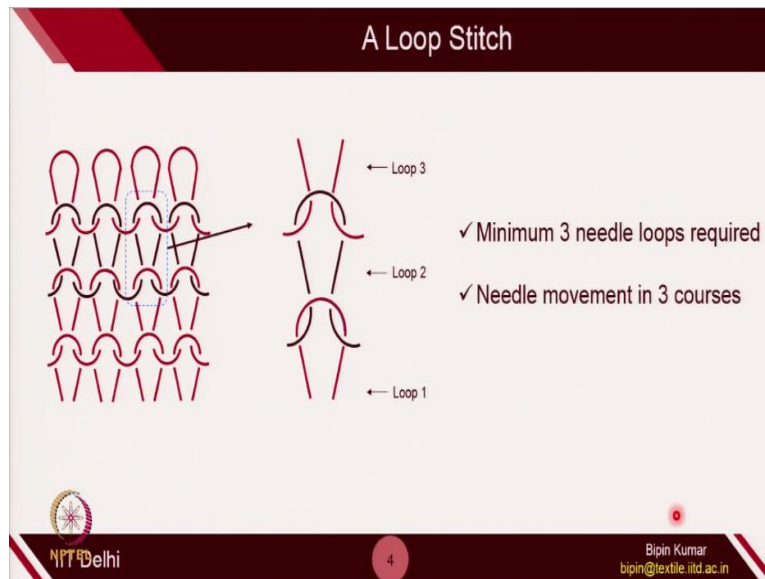
(Refer Slide Time: 05:56)
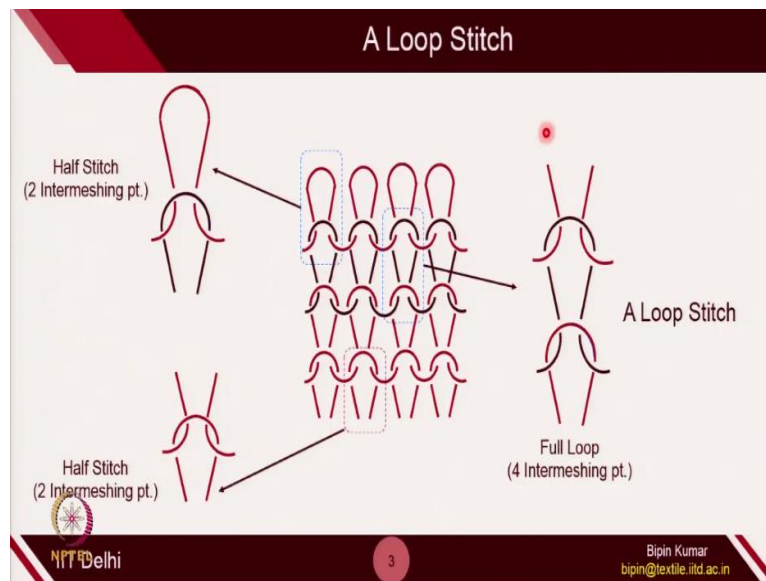
So, a loop stitch: In the first lecture itself, I introduced to you some of the basic fundamentals about intermeshing points. So, if you see any basic knit structures, each loop is intermeshing with top and bottom loops. So, if you see the top loop, the red one, it is intermeshing with the black one at 2 locations. Okay. But if you see the bottom loop, here, the bottom loop is intermeshing with, at 2 points with the top loops.

So naturally, not all the loops has similar nature of intermeshing points. So, in some sense, these loops are different. If you see the middle loop at the center, you can have 4 intermeshing points: 1, 2, 3 and 4. So, this is actually the full loop. We call this as a full loop, because this loop is actually perfectly stable, because it is being hold across all the legs and head parts. So, this we call at loop stitch.

So, now you can understand how a particular loop stitch is different from a normal loop. A loop can be very confusing words. It can be having 2 intermeshing points, it can have 4 intermeshing points; but a loop stitch means, it, we must have 4 intermeshing points. So, the main element of most of the plain jersey structure is the loop stitch, if you exclude the top loops and bottom loops. So, if you exclude the bottom loops and top loops, most of the loops are a perfect loop stitch.
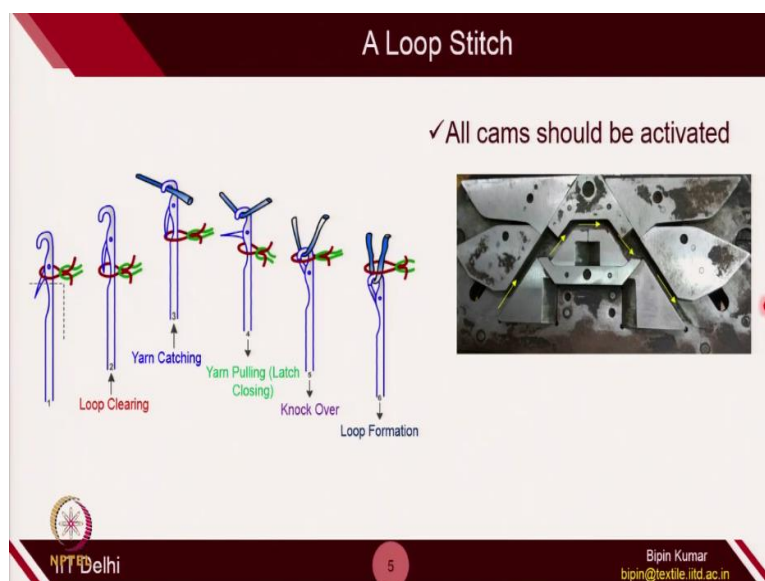
(Refer Slide Time: 07:37)

A Loop Stitch

- ← Loop 3
- ← Loop 2
- ← Loop 1

✓ Minimum 3 needle loops required

✓ Needle movement in 3 courses

If you see this particular loop stitch, it actually being created by 3 needle loops. So, to create loop number 2, you need to create the bottom loops, which is the loop number 1. And also, to provide intermeshing points at the head, you need to create the new loop which is loop number 3, so that, the loop 2 can acquire 4 intermeshing points. So naturally, to create a loop stitch, we need to create 3 needle loops in a course.

So basically, you have to run the machine at least 3 course to create 1 perfect loop stitch. Along the wale, you have to first create loop number 1, then loop number 2 and then loop number 3. So, loop number 2 will actually will become the loop stitch. Because, then only you can get 4 intermeshing points. So, needle, to create loop number 2, at least run for 3 courses on the machines. Then only, you would be able to create a loop stitch.

(Refer Slide Time: 08:41)

A Loop Stitch

✓ All cams should be activated

Yarn Catching
Yarn Pulling (Latch Closing)
Loop Clearing
Knock Over
Loop Formation

So, to create a loop stitch, the normal sequence of loop formation must be followed. So, the needles must clear the old loop; then catch the new yarn; then pull the yarn; and then knock out the old loop; and then loop is, should be formed. So, all these 3 loops should be created in a perfect sequence of loop formation. So, if you miss any one of the processing; either if you miss clearing, then you cannot be able to get 4 intermeshing points.

So, to get 4 intermeshing points, in the 3 courses, the needle should perform exactly the same nature of movement. So, this is how the needle should move. So, needle should hit the rise cam; then it should hit the clearing cam; then, at this moment, the old loop should be cleared; and then, while descending, it is catching the yarn, it is pulling the yarn, then it is hitting the stitch loop; and in this way, it is creating the loop stitch.

If you see the notation, because in the subsequent lecture, more and more complicated structure of knitting will come. So naturally, to describe those structure, we cannot all the time will be designing the fabric with loops. Rather, we will give some kind of notation to the fabric, because this will help you in understanding the complicated structure. We have seen the technical back and technical front loops.

(Refer Slide Time: 10:06)
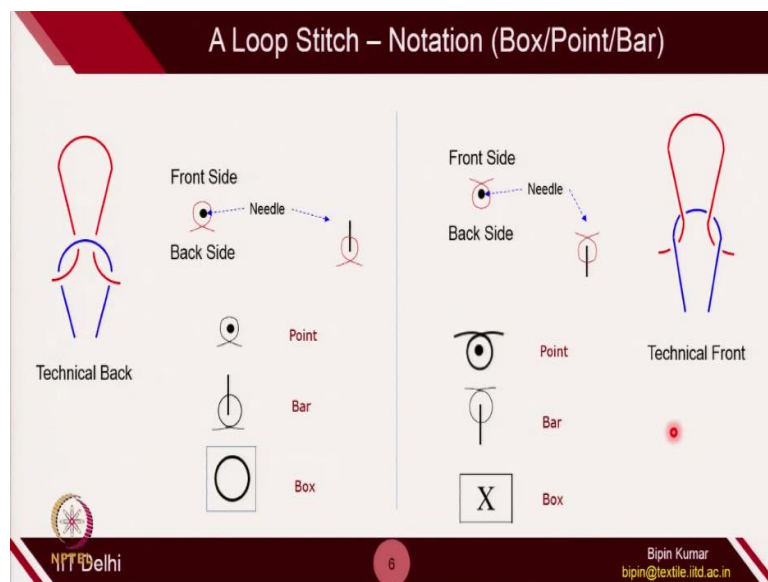
We represent this technical back by 0 in a box. But, there are some other notations which you can found in the literatures. So, I am going to introduce you other 2 types of notations, especially the point notation and bar notation. So, box notation, I have already introduced to you in week number 1, but in most of the research articles or in normal practice, you will find

most of the designers, they use point notation or bar notations in describing the fabric structure.

So, if you see technical back loops, it is being created; obviously, a needle is the hard core of knitting. So, to make or represent a particular loop, we must introduce needle as well. For example, the needle head can be represented by dot. So, this dot actually indicates the needles. And to create this particular loop, you can see, the yarn has been pulled from the top of the screen towards the bottom.

So, you can say, from the front side, it is going towards the back side. So, we can say, the needle has 2 sides, the front side and the back side. And if you see the movement of yarn, actually, the yarn first moves from back to front side, it means the needle actually moves from back side of the loop towards the front side of the fabric. On the front side of the fabric, it is actually catching the yarn and bringing that loops towards the back side. Okay.

From back side, it is coming out of the plane, where it is catching the yarn and then it is going inside. So, this is how; so, from back side, it is going to front side. And then, from front side, it is coming to back side. So, this is how you actually denote the loop of technical back. So, this notation, not only gives you the symbol of technical back, but also it will help you to understand how the yarn is actually moving.

So, if you follow the yarn path, the yarn is moving from back side to front side and then from front to back side. So, this is actually the point notation. Sometimes we also denote by bar notation. So, bar is also helpful in representing the needles. So, if you remember the lecture of needle gating, where we will representing all the needles of a bed by bars arranged in a parallel sequence.

So, sometimes instead of dot, we represent needle by a bar. The nature will again remain same. It is going from back side towards front side; and then from front side to back side. So, these are the 3 notation for technical back loops. 0 for box representation. For bar, we represent like this. For point, we represent like this. This type of notation is extremely useful when we are explaining the fabric structures.

I expect you all to learn these type of notations, because it will help you in fabric understanding. So, now, let's see the front part. So, in technical front loop, you can see the red loop is coming towards the front side; front side, it means, out of the plane. So, you can expect, there is something going inside the plane. From that side, it is catching the yarn and it is pulling that yarn from the back of the plane towards the front side of the plane.

This is how the technical front loops is created. So, again, you have the front side and back side. Here, the movement starts from the front side; then going back side; and then from back side to front side. So, here the movement starts from here. From front side, it is going towards back side. And then, from back side it is going towards front side. So, this is how the representation is opposite, compared to the technical back side.

So, if you take the mirror image along vertical plane, you will get this type of representation. In bar notation again, the same nature, instead of dot, you represent bar for the needle. So, this is how the technical front loops is represented in point form and in bar form. And this is the box representation. So, point and bar form is quite popular because, it is not only giving you the indication of technical back and front, but also it is it is giving you the nature of needles, how they are placed on the machines.

Also, it is giving the movement of yarn from front to back side of the needle. So, this is how these 2 types of notations is quite popular in weft knitting. So now, let's move to the next stitch, which is the tuck loop.
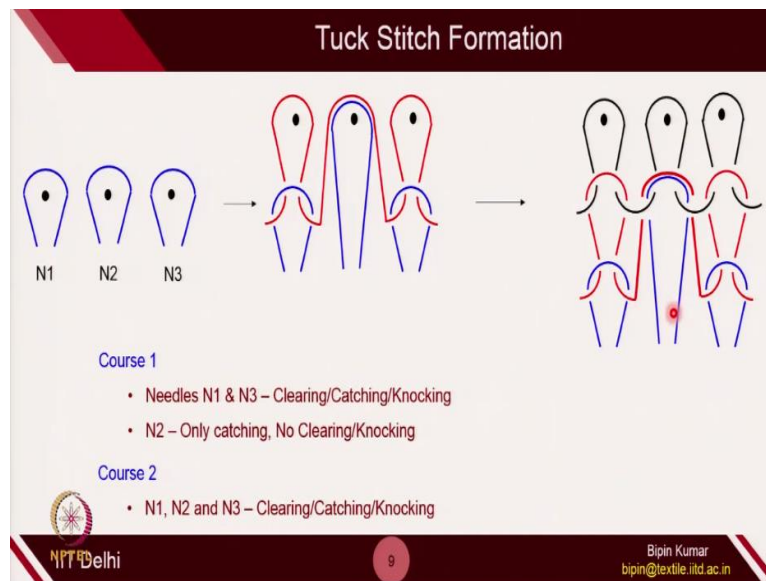
(Refer Slide Time: 14:51)
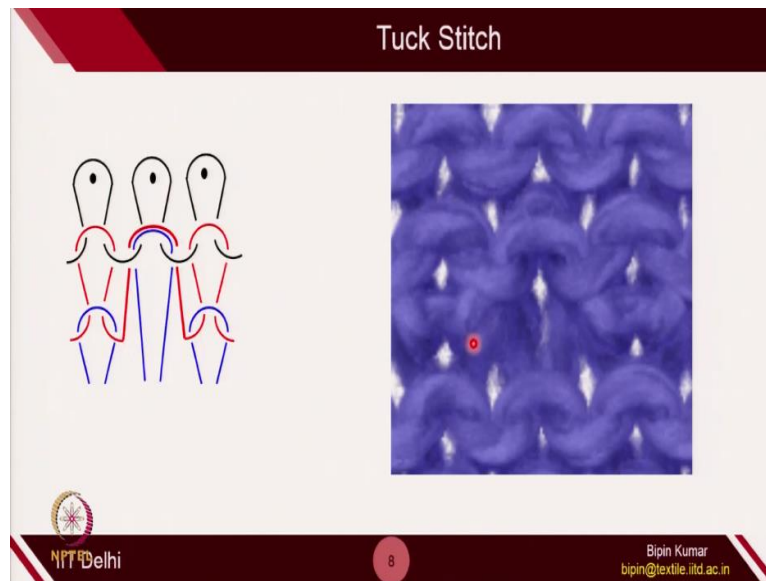
So, this is the next important **(Video Starts: 14:55)** structural element, you will find most of the weft knitted structures, where you will see that, the loop has actually only 2 intermeshing points. Here, you can see, especially this red loop, the legs are actually become open. And this is open because, the foot is not intermeshing with the below loops. So, here, the most fundamental difference you can observe here is, from the first column and second column where 3 loops are created in a sequence in 3 courses.

But in the second column, you can see, the old loop, which is the blue one, which was supposed to be knocked out, **(Video Ends: 15:38)** but it is still holded by the second loop. So, the head in this particular column, in the second course, the head of the needle is having 2 loops being hold at this location. And the foot of this red loop is missing, because it is not being created, because this old loop is not fixing the foot part.

This is why legs of the loop become open. So, this is the fundamental difference in the structural part of tuck and loop stitch. So, you can see here, the legs become open. So, there is basically, the sinker part is somehow missing for this particular loop. Okay. So, the sinker part become miss. So, this is the sinker part, but unfortunately for this loop, the sinker part is not available. And you can see, the legs are actually spread. So, let's see how we actually create this type of stitch on the machine.

(Refer Slide Time: 16:45)

Tuck Stitch Formation

Course 1
- Needles N1 & N3 – Clearing/Catching/Knocking
- N2 – Only catching, No Clearing/Knocking

Course 2
- N1, N2 and N3 – Clearing/Catching/Knocking

NIT Delhi

9

Bipin Kumar
bipin@textile.iitd.ac.in

So, for example, let's suppose, if you want to create a tuck stitch on needle number 2. So, this dots indicates the needle. This is how the needles are carrying the needle loop at a particular moment on the machine. So, to create tuck stitch, you have to follow certain sequence. So, in next course, needles N1 and N3 are clearing the old loop, which is the blue one. And then, it is catching the new loop.

This should be the sequence it should be following. So, needle number 1 and 3, needle 1 and 3, it has actually cleared the old loop; and it has catched the new yarn which is the red loop; and it has knocked the old loop on the new loop, which is the red yarn. So, both N1 and N3 are actually following the normal sequence of loop formation. So, the loops are been formed in a normal sequence.

But the needle number 2; actually, it does the catching, but it does not clear the blue loops. So, it means, it does the catching of new yarn, but it has not cleared the old loop from its head and latch. So, this is how the old loop is still being carried by the needle and needle also catches the new yarn from the machine. In the next course, basically, the needle then releases all the loops from its head.

So, both N1 and N3 are doing all its knitting action. So, it has cleared the old loop. So, when N2 is clearing its old loop, it is clearing the blue loop as well as the red loop; and it is catching the yarn which is shown in the black color. So, this is how a sequence, if you change for a particular needle, you are actually losing some of intermeshing points. So, for example,

the N2 has not done the clearing of old loop. This is why, 2 of the intermeshing points has been lost in the loop which is being created in course number 1.
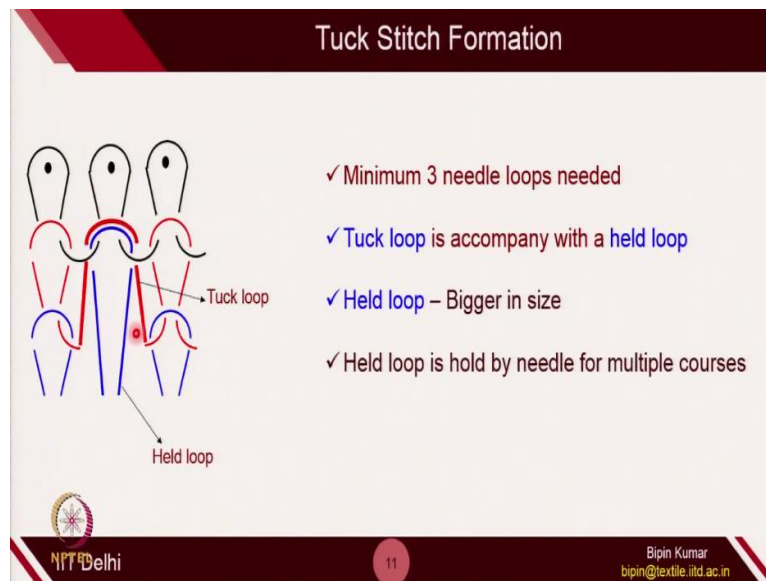
(Refer Slide Time: 19:08)
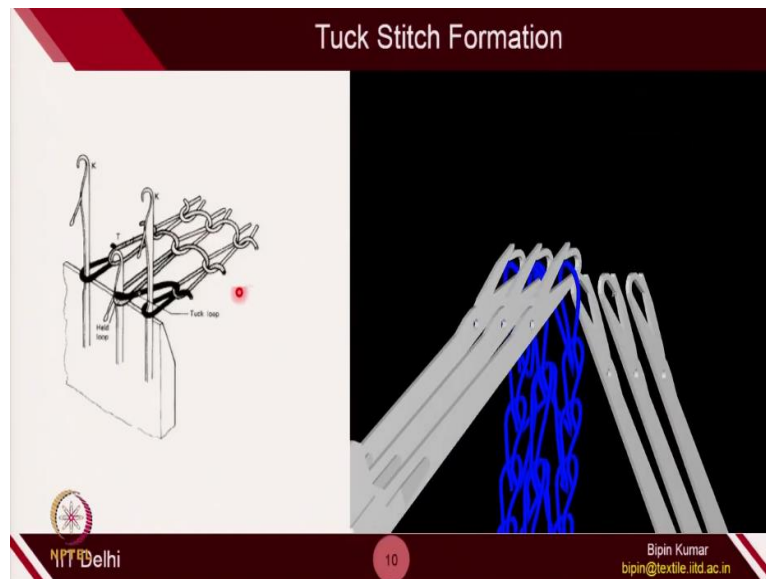
(Video Starts: 19:08) So, here is a animations through which you can understand how old loop was not being released in tuck formation and new yarn is being catched. So, this is the position where old loop is still under the influence of head and latch. And the needle is not released this old loop and it actually catches both the yarn. So, it catches the new loop and it has not released the old loop.

In the next sequence, it catches the yarn and it is releasing both the old loop and the tuck loop simultaneously. So, this is how you form a tuck stitch on the machine. **(Video Ends: 19:50)** Let's see again. If you carefully analyze this element;

(Refer Slide Time: 19:57)

Tuck Stitch Formation

- Minimum 3 needle loops needed
- Tuck loop is accompany with a held loop
- Held loop – Bigger in size
- Held loop is hold by needle for multiple courses

Whenever you make tuck loop, there is additional bigger loop which is hold by the needle at this particular position. So, tuck loop is always associated with a held loop. So, tuck loop is always associated with held loop. Also, you need 3 needles loop. So, 3 times, needles should be acting to create tuck loop. This is obvious. If you see the held loop, this held loop is actually bigger in size, because it has been hold by the needle for multiple courses.

So, if you see this particular hold loop, this is present in this course as well as in this course. Because of that, the length of that loop will increase. Since this held loop, the leg is becoming more, so it actually starts pulling the fabric in length directions. So, because of that, you will observe some kind of shrinkage along the length direction. Also, if you see this tuck loop, which is this red one, highlighted in bold, the legs are actually open.

So, if legs are open, it means it is allowing the fabric to relax in width directions. So, because of that, the fabric width along the course direction will increase. So, this is some of the fundamental aspects, how tuck loop will influence the fabric structure. So, how we actually create this tuck loop?

(Refer Slide Time: 21:37)

Tuck Stitch Formation – Clearing Cam is Deactivated
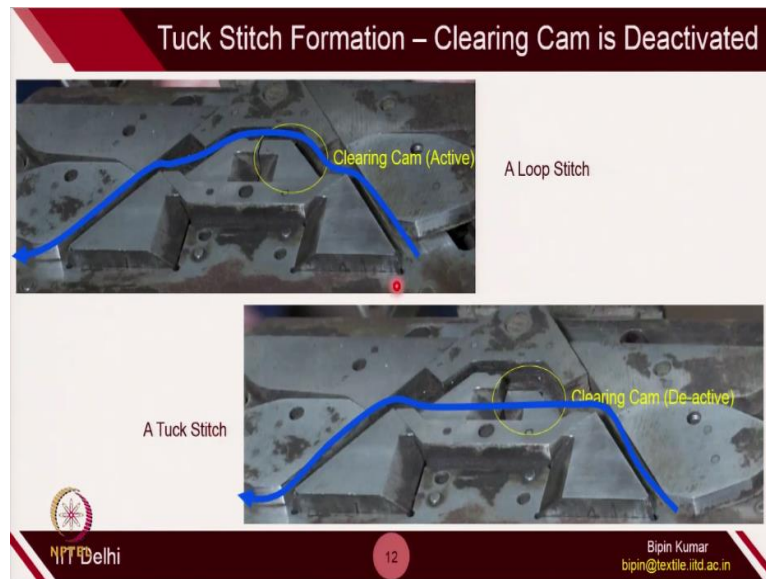
To create tuck loop, we have to deactivate the clearing cam. So, I hope, if you remember this photo; this is the cam profile of V-bed machine. So, this is particularly the clearing cam; if you remember. So, this is the raising cam; then clearing cam; then stitch cam; and this one is the guard cam for V-bed machine. So, in one of the position, you can see, the clearing cam is actually raised on the surface.

So, when the needle butt hits here, it will hit the clearing cam. But if you see here, this particular clearing cam is being projected downwards. So, somehow, with the help of knob, you can push this clearing cam inside the plane. So, in this way, when the butt actually moves, it will not hit the clearing cam, it will not able to rise further. So, let's see what exactly will happen. So, when the needle butt will hit here, it will rise from the raising cam then with the help of clearing cam it will further rise and then it will do the stitching.

So, in this way, you create usually loop stitch, if you follow 3 sequence. But in case of here, the raising cam is allowing the needle butt to rise, but clearing cam is since deactivated. This is deactivated means, it is going inside. So, it is not there. So, the butt will not strike with this clearing cam, because it is pushed inside the plane. So, there is no projected wall which can hit the butt. So, that's why, the but will simply move straight.

So, in this way, you make tuck stitch. So, this is the, how the cam profile or the cam track of loop stitch and tuck stitch is defined. So, in loop stitch, the needle has to do all the knitting sequence. In tuck stitch, the needle has to do all the sequence except clearing of the old loop. Then only you can create a tuck stitch. So, again you see how things are going.

So, this is the clearing cam which is in deactivated positions. So, in deactivated position, you can see, it is being pushed inside the plane. So, there is no projected metallic surface which can hit the butt of the needle. So, when the cam traverse on the machine, the butt will follow this particular path. It will not go above this clearing cam, because clearing cam is deactivated. **(Video Starts: 24:19)** This is the actual path.

So, this is how needle will go, **(Video Ends: 24:25)** because clearing cam is deactivated. So, this is why, all the cams on a cam jacket is extremely important. So, if you play with the cam jacket, you are actually controlling the stitch amount on the fabric structure.

**(Refer Slide Time: 24:42)**

Let's see, actually this is a small video **(Video Starts: 24:44)** how you can; so, this clearing cam is in a deactivated position. So, it actually raised and then goes like this. So, you can see here, raising cam is allowing it to rise, but clearing cam is not activated, so it will just go straight. So, in a machine, for 2 traverse, there are 2 clearing cams from one side. So, this is, now this time we are **(Video Ends: 25:09)** forcing this clearing cam to go down.

So, when you are moving the butt from opposite direction, from right to left, now this clearing cam is not activated. So, it will not allow the old loop to pass from the needle and the hook and latch combination. So, this is how tuck is being formed. So, that was the surface which was actually not visible on the machine. So, if you see the front or top view of the machine;

(Refer Slide Time: 25:40)
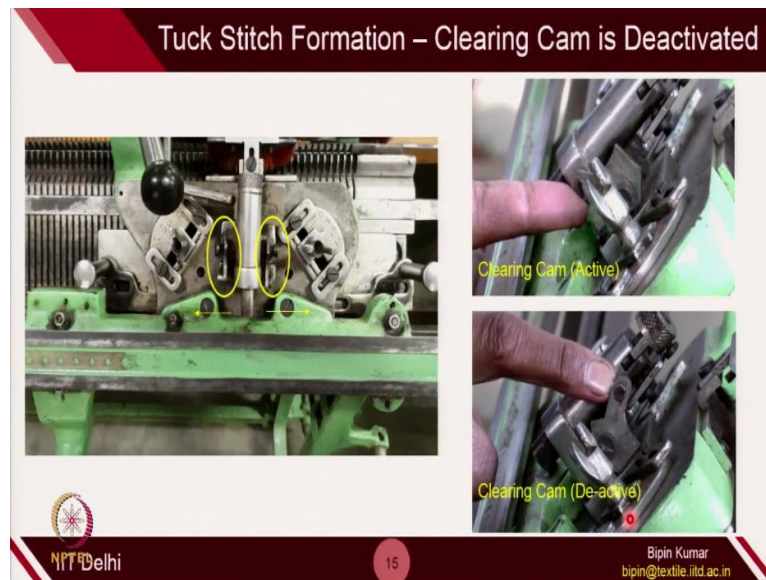
The cam jacket will actually look like this. So, if you see this cam jacket, there are 2 knobs, metallic knobs. And for one when the cam jacket is moving from right to left and the other when the cam jacket is moving from left to right. So, this is there to either raised or depressed the clearing cam on the back side of this cam jacket. This is the active position of the metallic bar with in, on which the clearing cam is at active position.

When you push this bar and rotate it to other side, the clearing cam will deactivate. So, this is how, while in a running condition, in anytime, you can push this metallic bar portion to activate or deactivate the clearing cam. Let's see this video.
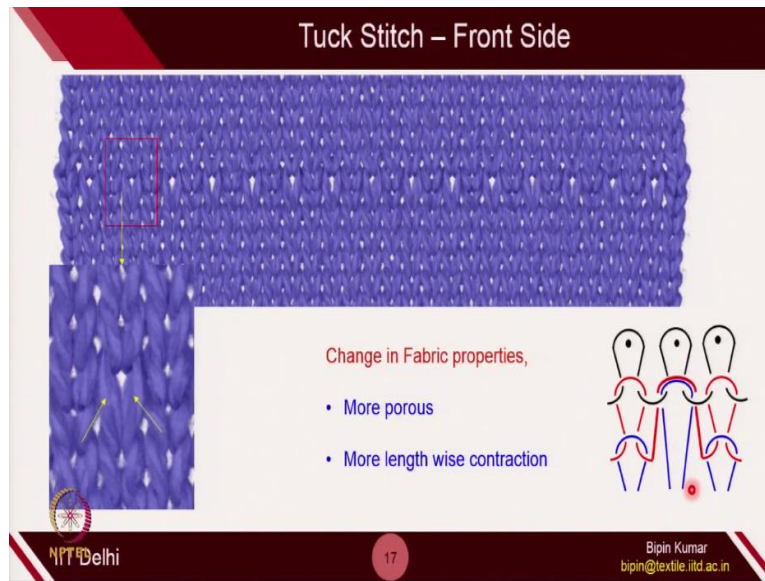
(Refer Slide Time: 26:36)
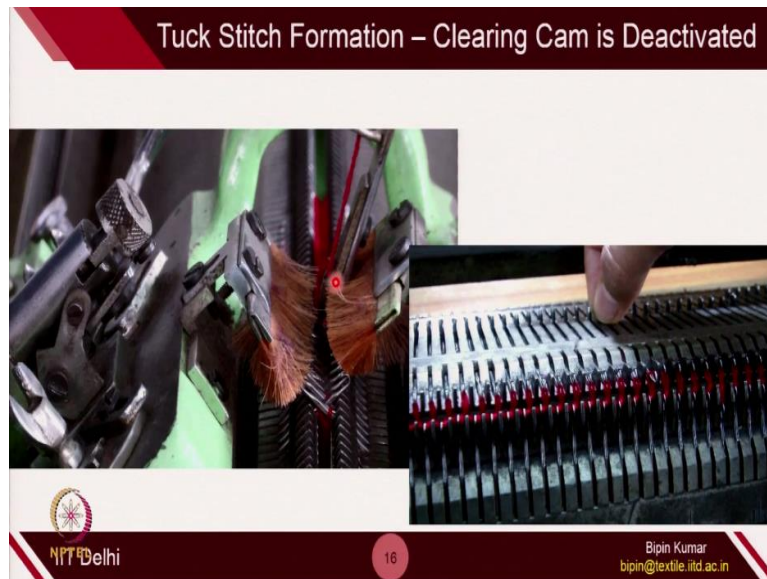
When I am pushing this with my finger; **(Video Starts: 26:39)** so, this is how you push it. So, when you do this, the clearing cam on the back side of this cam jacket goes inside. It will not allow the needles on this particular bed to rise and clear the old loop. Okay. There are actually 4 position where you can play with the **(Video Ends: 27:04)** clearing cam. So, on each bed, the jacket is moving from left to right and right to left.

So, whenever you are moving from left to right, you have to play with this particular clearing cam bar. And when you are moving from right to left, then you have to play with other metallic bar. So, this is for one bed. For the opposite bed also, you have to do the same. So, there are actually 4 position on the cam jacket where you can either activate or deactivate the clearing cam.

(Video Starts: 27:36) So, if you do this; so, especially, for this particular bed, so for this bed, you can observe, there are 2 needle loops are actually hold by each of the needles. So, this is how tuck is being formed on the machine. **(Video Ends: 27:54)** Now, if you see the structure of tuck on the front side, the structure will look like this.

(Refer Slide Time: 28:01)

Tuck Stitch – Front Side

Change in Fabric properties,

- More porous

- More length wise contraction

So, if you enlarge any one of the tuck loop; so, you can see here, the bigger size of the leg. So, this bigger size of the leg is nothing but the held loop. This 2 legs are actually the held loop legs which is visible on the front side of the fabrics. So, you can see a clear distinction of the bigger holes which you can observed on the front side. So, each of these bigger holes, actually which has been created by bigger held loops.

And at this position, tuck has been formed. When you make the tuck, the lot of fabric properties will change. First, it will become more porous. So, you can see here, much bigger holes are present whenever a tuck stitch is introduced. So, wherever tuck stitch is introduced, since the legs become open. So, that will open up the holes. So, the fabric will become more porous.

More lengthwise contraction; so naturally, you can see this held loop which is in most tight condition. So, it will pull the loops along its column. So, it will try to contract the fabric in length direction. So, the length of the fabric will little bit reduced.

(Refer Slide Time: 29:19)

Tuck Stitch – Back Side

- More wider
- More thickness
- Slightly less extensible (width wise)
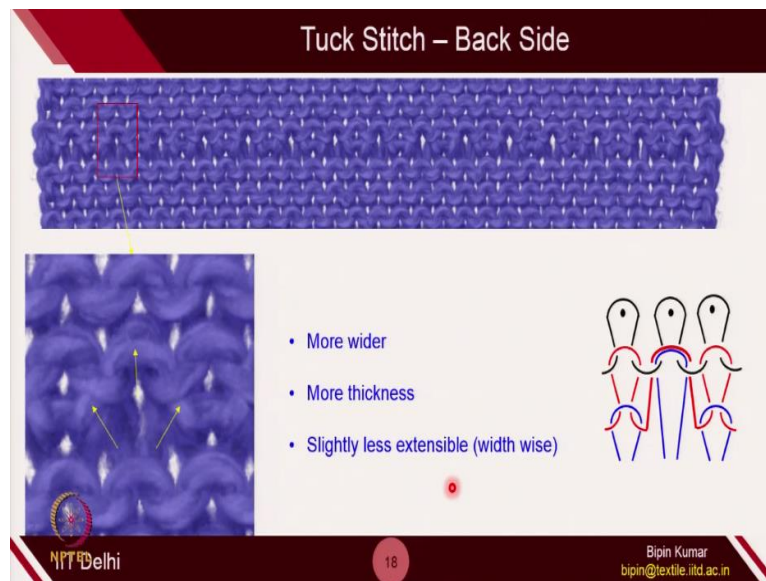
If you see the back side; back side, the loops are being projected towards the plane. So, if you enlarge it, this is how the back side will look. So, you can easily see the legs. This is the tuck loop. On the front side, held loop is visible; on the back side, tuck loop is visible, at this particular needle position. So, you have only the head and 2 legs in a tuck stitch. So, there is no foot part, because the there is no bottom loops which is holding this tuck loop in place.

So, because of this, the legs has been open. So, if, you will realize, the fabric will just become wide, because the leg has become open. So, the more and more tuck loop, if you introduce along a course, you will realize the fabric width will increase. Naturally, at this particular position, you can see, there are 2 needle heads are present. So, because of that, the thickness at this particular location will increase, because it will have at least 3 times the yarn diameter.

And also, since width wise it has already extended; so, you will realize, the fabric is not extending width wise. And it will become less extensible compared to a normal rib structure or single jersey structures. So, I have the fabric with me, where you can able to see how the width is increasing by introducing more and more tuck loops. And also, you can able to see the thickness and wider part.

So, I am going to show you that fabric. **(Video Starts: 30:56)** This is the single plain rib structure. I have done this analysis in the last week. So, this is the rib structure where you are creating technical front loops on both the sides. Okay. So, 2 beds are there. Both the beds are making loop stitch. But, after this point, I started introducing tuck. So, because of tuck, in, out of 2 beds, first bed is actually making only loops and the opposite bed is making tuck.

So, you can see how the fabric with the same number of needles, the width has been increased. This is because, on the front bed, you are making technical front loops. So, on the front bed I am making front loops. But on the back side, when I reverse this fabric, actually on the back side, I am creating tuck loops. So, on the back side, you can see, this is all made up of tuck loops.

So, because of the tuck, the legs of the loop become open. And this allows this fabric to spread. Also, if you see the thickness, when you measure the thickness of the fabric, you will find out the thickness of rib part. And thickness of this part will be more because you have the tuck stitches here. So, the thickness of the fabric will increase, because at the tuck point, you have 2 heads, which are intermeshed with the new loop.

So, because of that, the thickness will increase. If you see the extensibility; so, the rib part, when you have loops from front and back beds, the stretching is much more easy. But if you see the tuck part, the stretching is actually, is very difficult. So, this is how the fabric structure will change. So now, **(Video Ends: 33:08)** let's see how it will influence the appearance. So, naturally you have seen, on the front side, only legs are visible.

But on the back side, the structure of double jersey will also change. So, not only the appearance, but also the fabric property will change because of tuck stitch in the fabric. How do we denote tuck stitch?

(Refer Slide Time: 33:35)
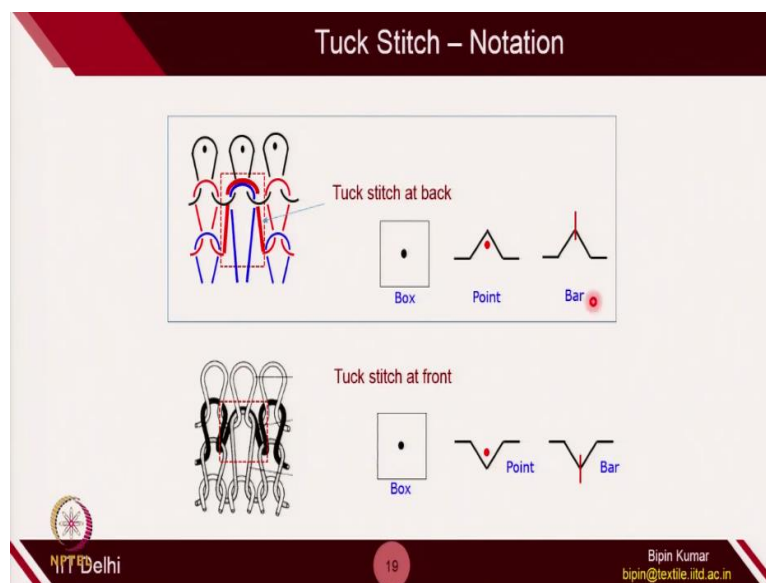
So, this is how you denote the tuck stitch. So, especially the red part. You denote tuck stitch by pointing one point in a box notation. When you have, using point notation for the back side, you have to represent like this. On the bar notation, you have the representation like this. When you are looking the tuck from the front side and the box point will remain same, but in point notation, the notation will become reverse.

In bar notation also, it will become change. So, this is how you represent the tuck loop from the front side and from the back side. So, this is the front side and this is the back side. Sometimes, we can even create more complicated structures;

(Refer Slide Time: 34:25)
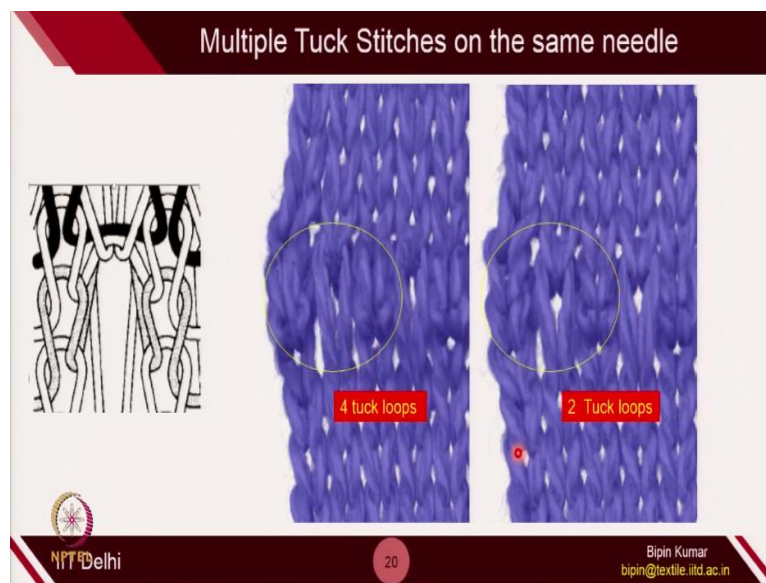
(Video Starts: 34:25) Where you have, the needle is keep holding the old loops multiple times. And it is not releasing the old loop for consecutively 2 or 3 courses. Then you can create much bigger held loop. And you can create multiple tucks in the same location. So, here you can see, 4 tuck loops has been created. So, if you see this diagram, so 1, 2, 3. So, 3 tuck loops are there, but in the fabric part, you can see here, 4 tuck loops has been created.

So, you can see the length of this held loop, which is much, much bigger compared to other loops present in the structure. If you have 2 tuck loops, the length of held loops is lower. **(Video Ends: 35:10)** So, this is how tuck loops create influence on the fabric surface.

(Refer Slide Time: 35:16)
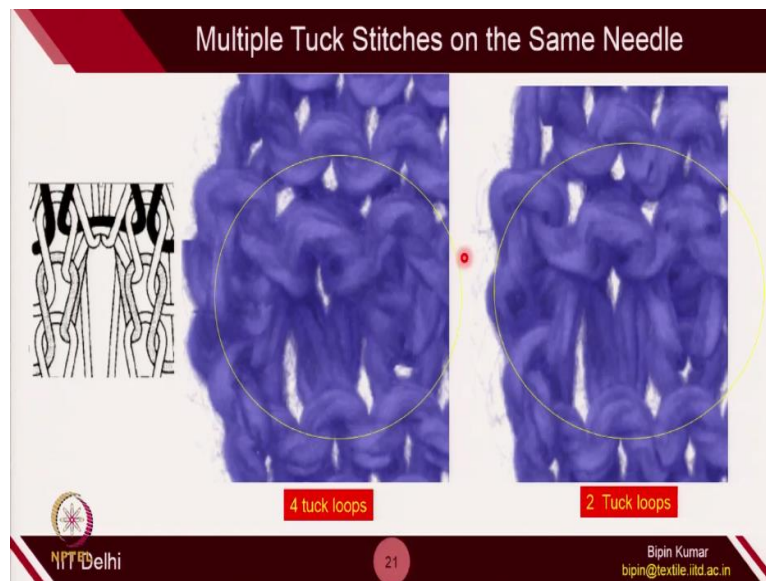
If you see the back side, back side is even more complicated. So here, you can see at 4 tuck loops, 4 tucks legs are present with. So, if you go even more deep at microscopic level, you will be able to see that 4 legs. In 2 tucks, the design looks much more simpler. So here, 2 tucks has been formed. In this figure, there are 3 tucks which is there with the held loop. So, this is how, not only the fabric property, but the design of the fabric will also change from the front side to back side.

So, most of the projected part, whenever you are seeing on the garment, it is coming because of the tuck stitches at that location. Because tuck is actually forcing that loop to come forward, because the needle is catching 2 yarns and it is releasing 2 yarns, it is knocking 2 yarns here. So, at a particular head position, you can have multiple yarn segments. So, because of that, the thickness will increase and the fabric will look projected. So, it will, it looks like sometimes pearls. So, something, some projected part is coming from the surface. So, this is all about tuck stitches.
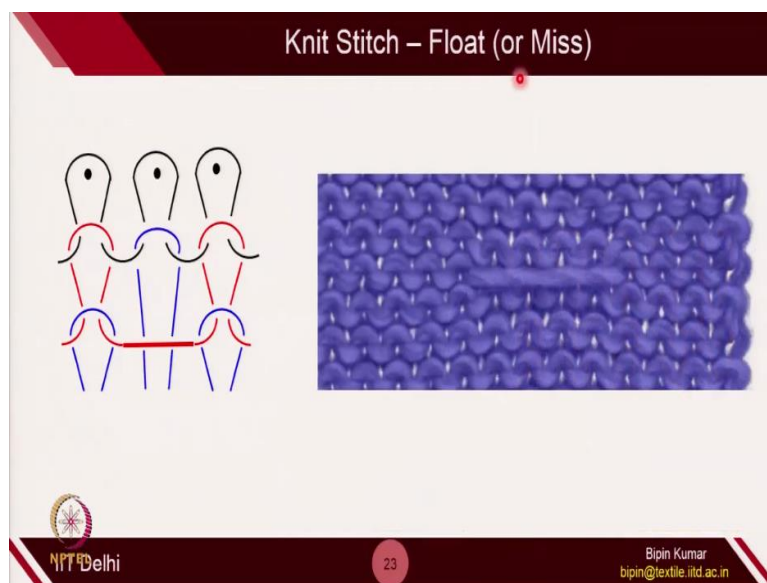
(Refer Slide Time: 36:32)

Now, let's move to the float stitches. This is also very, very important from design point of view.

(Refer Slide Time: 36:39)

(Video Starts: 36:39) Float stitches is when a particular needle is not doing any functions. In that case, the yarn will not have any intermeshing points with its old loop. So, because of that, the yarn will become straight. So, this is how you can see here, the this part of the yarn is just straight. So, in this particular course, the yarn is not intermeshed with its bottom loops. This type of stitch is called **(Video Ends: 37:06)** float stitch or miss stitch.

(Refer Slide Time: 37:10)
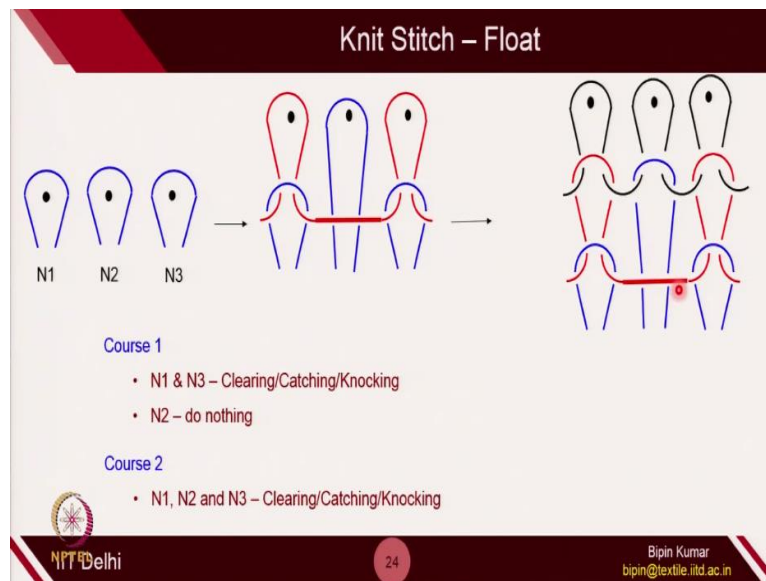
Now, let's see how it is being formed. So again, now I am going to create on the needle number 2. So, to create float on needle number 2, N1 and N3 has to do its normal knitting process where it has to clear old loop, it has to catch yarn and it has to knock the old loop on the new loop. N2 has to remain idle. So, the concept behind making float is: N1 and N3 is participating in knitting; but N2 is doing nothing, it is just holding its old loop.

So, this is how N1 and N3 has done the knitting process. So, it has cleared the old loop and it has catched the new yarn which is shown in the red color. But the N2 is doing nothing. So, that's why it has not catch the red yarn, but it is holding the old loop. Because of that, the new yarn will just present as a floating pattern at that particular needle position. So, this is nothing but the float stitch.

In the next sequence, when you make the next course, you release all the loops, the 2 new loops from N1 and N3 and old loop from the N2. So, in course number 2, all the needles are doing the same knitting functions. And in this way, it catches the new loop and old loop is being released. Since, in course number 2, needle 2 was idle, because of that, the yarn which was present to the needle, it was not cached by that needle. That's why the yarn remains in the straight position inside the fabric structure. So, this is how you create the float stitch.
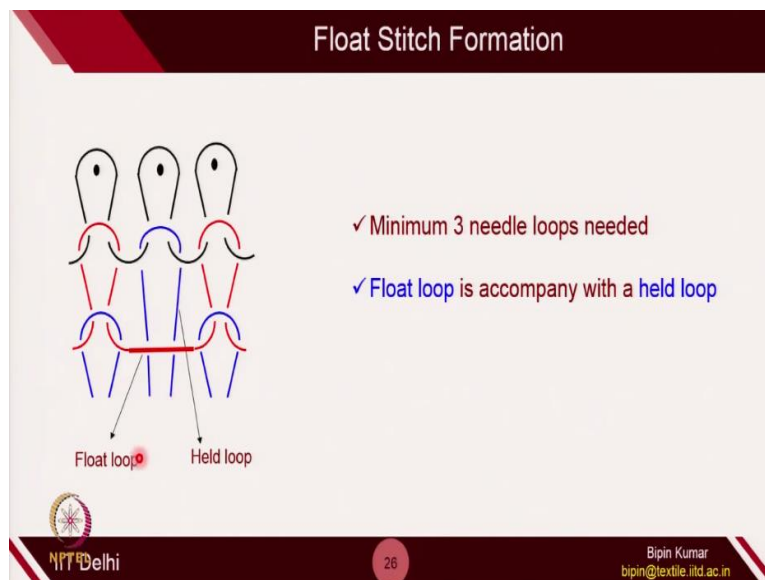
**(Refer Slide Time: 38:54)**

Float (Miss)
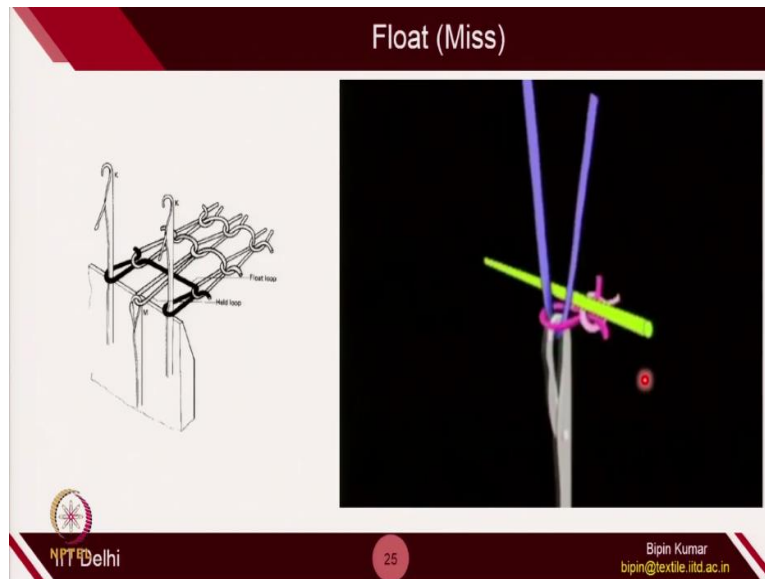
So, to create **(Video Starts: 38:54)** float stitch, again you can see here, there is a animation. So, the yarn is being present, the needle is not rising, not clearing, nothing. So, yarn just remain in a straight position. After that, for the next course, it is going up. And now, it is catching the yarn. So, in one of the course, **(Video Ends: 39:17)** it has not done anything, especially when the green yarn was present in the course. It was not doing anything. So, that's why, this green yarn segment remains in the floating position.

(Refer Slide Time: 39:29)

Float Stitch Formation

✓ Minimum 3 needle loops needed

✓ Float loop is accompany with a held loop

Float loop   Held loop

So, when you see the structure of float inside the fabric, the float will always accompanying the held loop. So, to create a float, again we need to create 3 needles loop. And float loop is always accompany by held loop. So, whenever you have to create a float, naturally, that needle will not release the held loop in that particular course. So, similar to tuck, float is also accompanying the held loop.
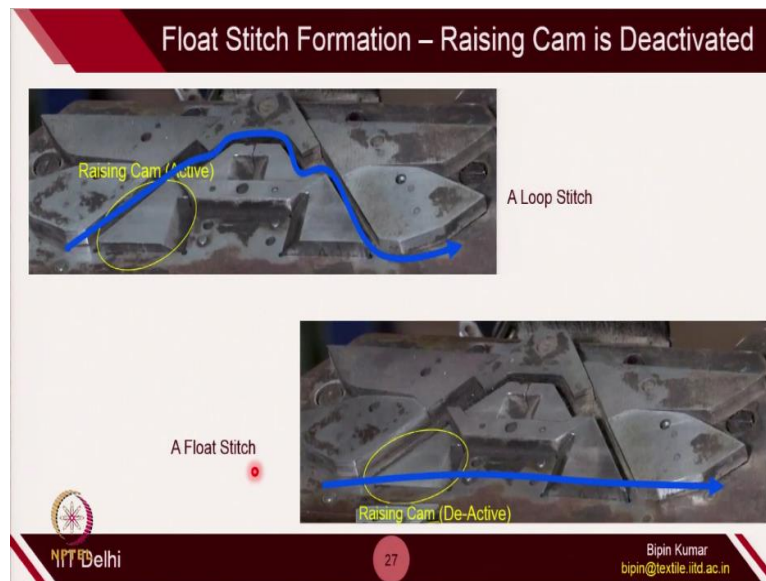
Now, let's see, on the cam jacket what need to be changed to create this particular held loop? To create float stitch, the raising cam on the cam jacket has to be changed or you have to play with the raising cam. So, if you see this particular raising cam, this is in active position. So, when the needle butt is coming from the left side, it will hit the raising cam and it will go up and follow the cam profile.

But, if you deactivate the raising cam; at this position, you can see that metallic block is pushed inside, so that it will not hit the needle butt. So, because of that, the needle will just pass straight. So, in this position, the needle is hitting the raising cam. So, that's why it is following the cam track. So, here you are creating loop stitch. But in this position, the needle butt is coming here and there is no wall which is present to the needle butt.

Because of that, the needle butt will just pass in a straight form. So, this is how the needle butt will just pass. And this is how you create the float stitch for that particular course. So, raising cam is extremely important whenever you want to create floats in the fabric structure. Clearing cam is important when you want to create tuck in a fabric structure. So, these 2 cams are extremely important.

And stitch cam is important when you want to control the loop length. So, these all cams which we learned in week number 2 is very, very important. And you must understand these, functioning of these cams.

Float Stitch Formation – Raising Cam is Deactivated
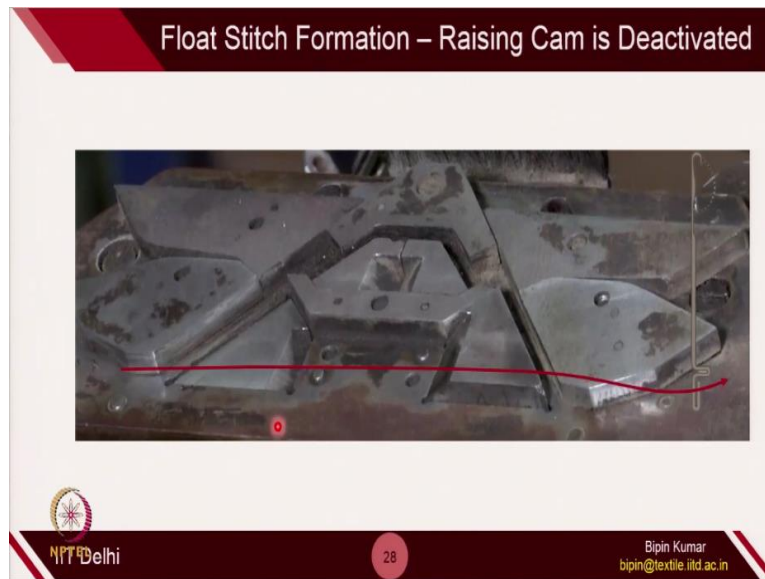
Let's see how things are moving here. **(Video Starts: 41:45)** So, if you see the needle, needle just follow this particular path. **(Video Ends: 41:49)** So, needle is not rising. So, needle is just remain in idle position. So, this is how the float stitch is created.

(Refer Slide Time: 41:57)

Float Stitch Formation – Raising Cam is Deactivated

So, I have a the video where you can see what is exactly happening. So, I have pressed this raising cam inside, so that it will not hit the needle butt. **(Video Starts: 42:09)** So, you can see this is in downward position. So now, the needle butt, nothing is there. So, it will not rise, it will just pass. So, if it is not rising, naturally it will neither catch the yarn, neither it will clear the old loop. **(Video Ends: 42:25)**

So, when the needle is in idle position, the yarn which will be present to this particular needle will not interact with the needle at all. And it will just remain in a floating position inside the fabric structure.

(Refer Slide Time: 42:40)

Float Stitch Formation – Raising Cam is Deactivated

This is the cams where how you control the actually floating cams. So, these 2 bars, when you push inside, actually you are deactivating the needle cam. So, when the cam jacket is moving from left to right, and then you, if you push this inside, then you are creating floating loops. And when you are moving from right to left, then this cam has to activate for creating float stitch.

(Refer Slide Time: 43:07)

Float Stitch Formation – Raising Cam is Deactivated
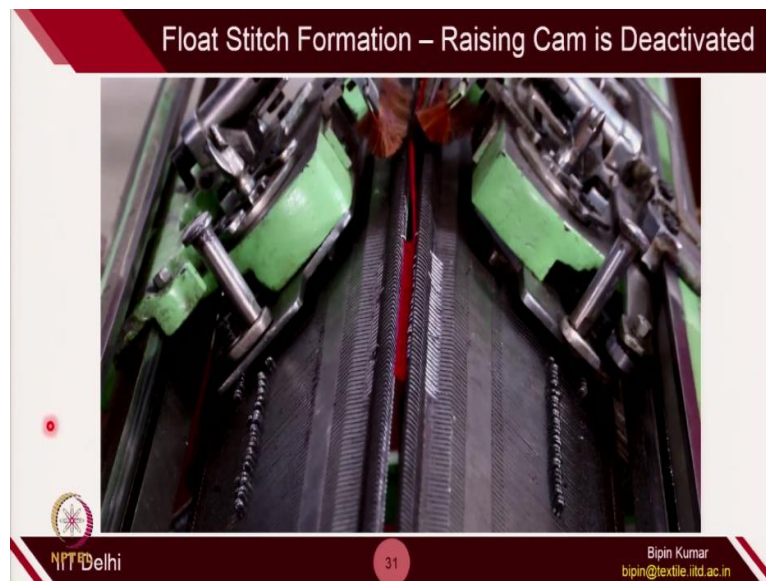
This is the video. So, this is the cam which you can push it inside and outside, depending on, if you want to create. So, you can see here. **(Video Starts: 43:15)** So, I am pushed inside. So,

in this way, actually, I am pushing that metallic block inside. So, because of that, the needles on this bed is not doing anything. So, you can see here, only this needle bed needles are active, but the this particular bed is not doing anything.

When I am moving from this side to this side, the cam from the other side is active. **(Video Ends: 43:40)** So, because of that, whenever you are moving from this side to this side, the needle is participating but when you are moving from top to bottom side, then needle is not participating, especially on this bed. So, depending on which side you want to create float stitches in the fabric, you play with the float cams, which is the raising cams. So, now let's see the appearance.

(Refer Slide Time: 44:07)
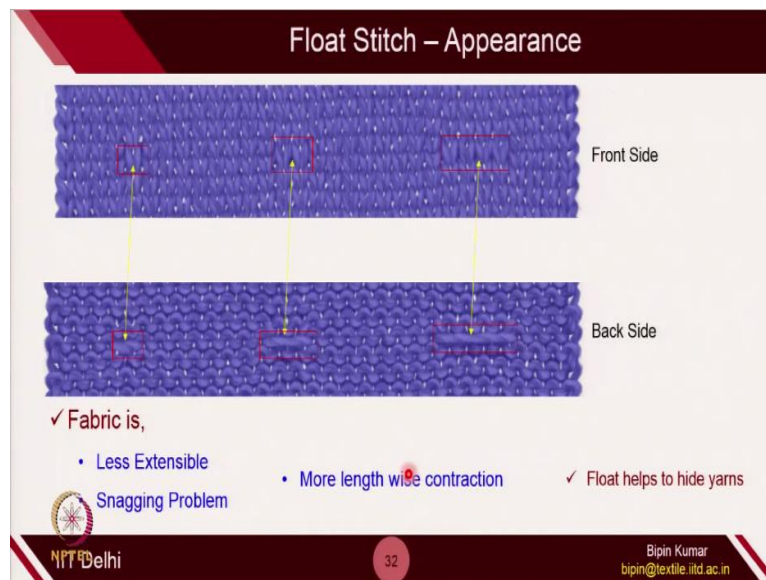
If you see the appearance, you can clearly see the bigger loop. So here, one float has been created. Here, 2 floats has been created. And here, 4 floats has been created. And you can see how it is pushing the fabric in length direction. So naturally, the length of the fabric will decrease. So, this is the back side of the fabric. So, if you see 4 held loops, and with the 4 held loops, there is the floats which is floating for the 4 columns.

Here, there are 2 held loops and the floats is on the back side, which is floating in 2 columns. Here just 1 float. This is the held loop and this is the float on the back side. So, depending on wherever you want to present float loop, you can play on the machine. So, the beauty of float loop is, the float is not visible on the front side. So, you can, if you see the front side of the fabric, the float is not visible.

But if you reverse that fabric, then only it is visible. So, the float sometimes helps in hiding the yarns. So, on one side you can get other colors, the other side you can get different colors, when you play with the float loop. So, if you see the fabric properties, the fabric will become less extensible, the because, here the yarn is in straight segments. So naturally, when you extend the fabric, a straight yarn is very difficult to extend compared to loop state.

So, when you have the loop, the yarn will just open up very easily, but when you have a straight yarn, the fabric cannot be extend so easily. So, fabric will become less extensible. Snagging problem: When you are using or making the garment from the back side, there is a chances that something can struck with this free segment of the yarn, these floats. And it will just come out. You can pull the yarn very easily.

So, snagging problems can happen on the fabric. So, we have to make sure that we do not create simultaneously float loops for more than 2 or 3 columns. Because, if it is more than that, then there is a chances that, that part of the yarn can struck easily. More lengthwise contraction: So, you can see here these, all loops are actually pushing the fabric in, or contracting the fabric in length direction or along the course direction. So, more lengthwise contraction, you can observe with the help of float stitch.

(Refer Slide Time: 46:31)
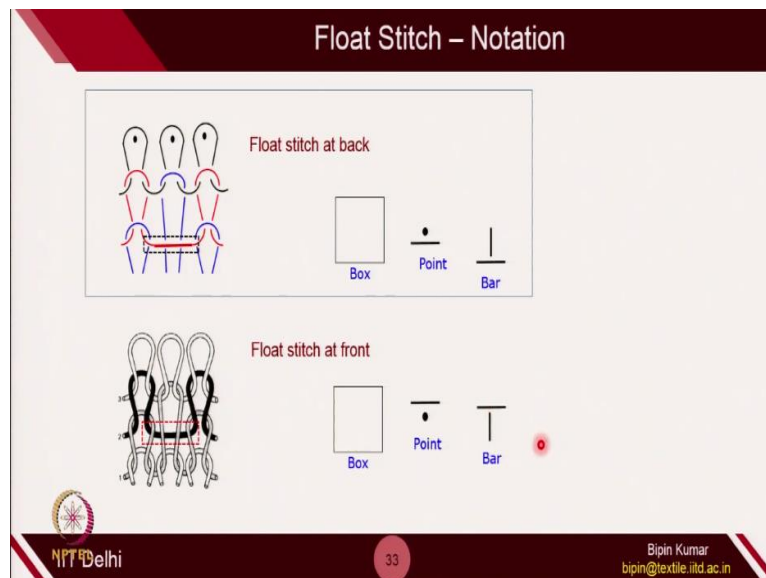
So, now if you note this float stitch; since in float stitch, in box diagram, since the needle is not participating; so, you can leave the box as a blank which represent the float stitch in technical back side as well as technical front side. In point diagram, the yarn is present in a

straight form; so, in point diagram, in back side, the yarn is on the back side. In front side, the yarn has to be present on the front side of the fabric.

So this, and, with the help, on bar diagram; so, on this needle bar, you put a line at the bottom side which will represent float. And when you are playing on the front side, you put the line on the top side. So, this is how you represent the float.

(Refer Slide Time: 47:21)
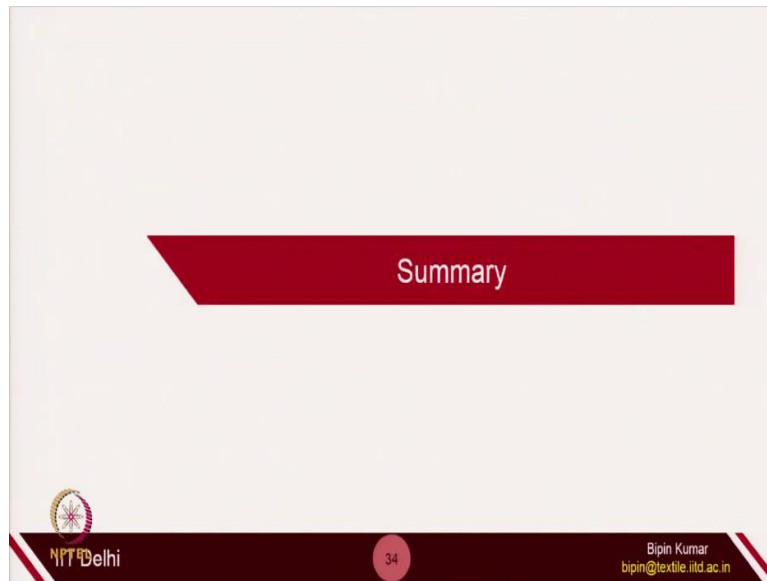
Now, let's summarize what we have learned in this particular lecture. So, we have learned how you can play with intermeshing points. So, you can have 4 intermeshing points, you can have 2 intermeshing points, you can have no intermeshing points.

(Refer Slide Time: 47:38)
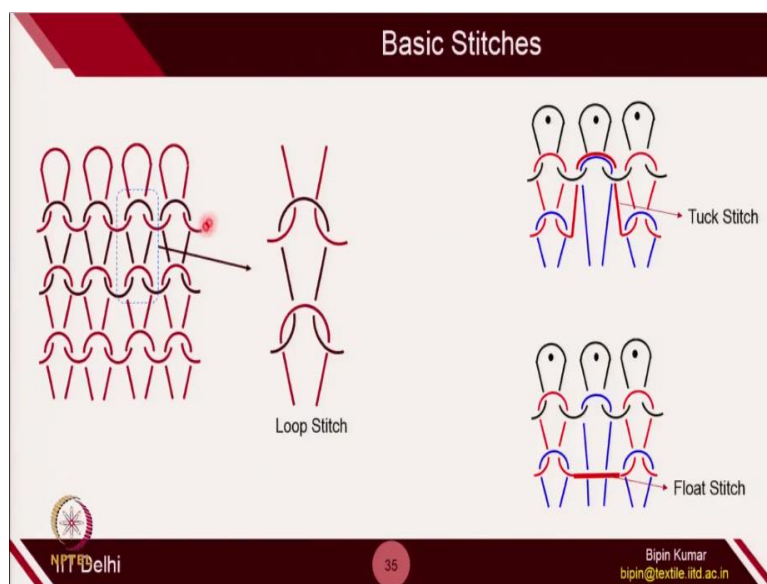
When you have 4 intermeshing points, then it is loop stitch. When you have 2 intermeshing points, it is tuck stitch. As well as, when you, when the tuck stitch is present with the held loop. In case of float also, you have no intermeshing points and it is accompanying with the held loop, the bigger part of the loop. So, these 3 stitches is, should be present in almost all weft knitted structures.

So, whenever you are looking at the weft knitted structure, either you are interacting with loop stitches, tuck stitches and float stitches. So, if you see carefully any fabric, you will be able to know what the needle was doing exactly at this, that particular location of the fabric. So, this is very, very important aspect in fabric designing engineering. So, I hope you have understood these 3 type of stitches that you can create by playing cams track on the machine. So, this is the cam track which I was saying.

(Refer Slide Time: 48:45)
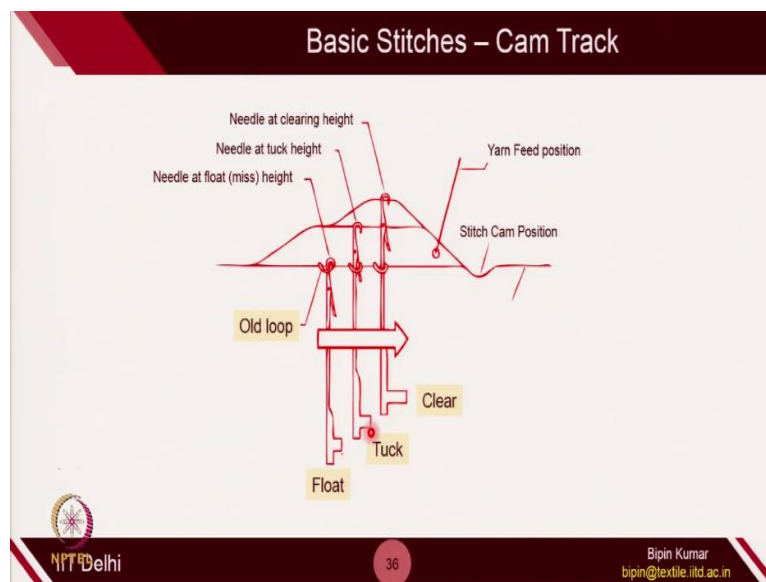
So, in case of float, the needle just go straight. In tuck, the needle go to certain height and then it descends. And in clearing position, you are actually making the actual loop. So, the needle actually raise to the maximum height position. So, this is the maximum height position. This particular position is the tuck height position. And this particular position is the miss height position.

When the needle which is holding the old loop, if it is not raised at all, then it will move or make float stitch. It is raised to this particular height which denotes needle at tuck height. So, when it reach the this particular height, then it will not clear the old loop. So, you can see the

old loop is not being cleared. After that, it is actually catching the yarn at this particular location.

So, having old loop in head and latch, it is catching the yarn. That's why you are creating a tuck stitch. When you allow the needle to rise to the maximum position, at this position, you can see the old loop has cleared completely. And while moving in downward direction with the help of stitch cam, it is catching the yarn. So, this 3 different heights of the needle play a very, very important role in determining what type of structural elements you are creating.

(Refer Slide Time: 50:10)
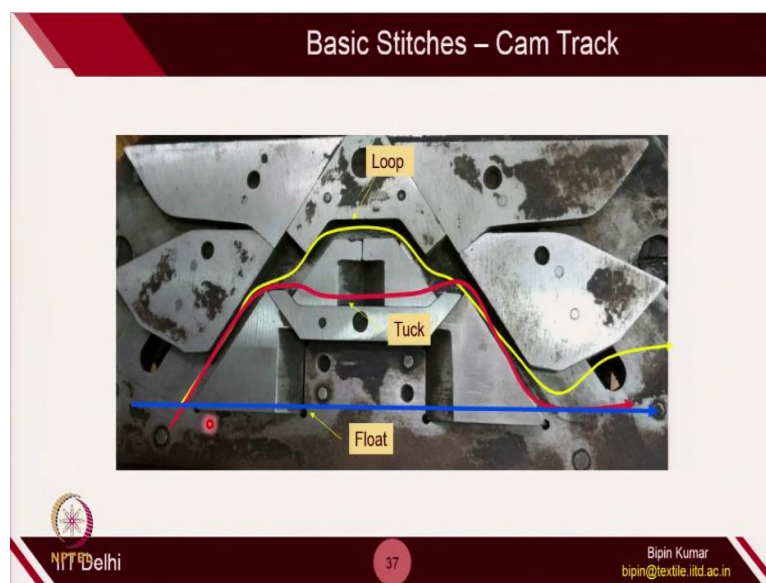
So, if you see the cam track, so this is the raising cam, clearing cam and this is the stitch cam. So, if you rise to the maximum height, when you interact with rising and clearing, you actually create a loop. When you only rise but do not interact with clearing cam, then you create tuck. And when you are not interacting with the raising cam at all, then you make float. So, depending on how much you are allowing that needle to rise from the bed, you are playing or designing different structure elements.

(Refer Slide Time: 50:49)

Last, these stitches can be represented in different form. In box form, the loop is represented by cross; tuck, by just point; float, as a blank. In point form, the loop is represented by like this. And in bar form, it is representing like this. So, in technical front, the denotation is like this. In technical back, the denotation is like this. So, I expect you to please remember this. Because, in next few classes, the structure which we will be analyzing will become highly complicated. So, you should be knowing this denotation. So, we will be using these type of notations to represent some of these structures.

(Refer Slide Time: 51:36)
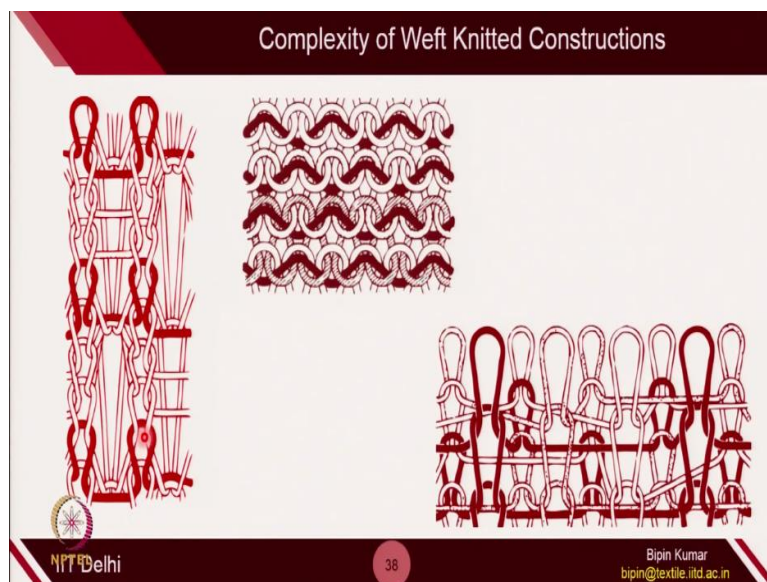
Some common structures which we are going to analyze is like this. So, you can see how complicated the structure will become. Please go through this once more and note down the basic stitch notation. So, loop, tuck and float. So, if you see this particular structure, this structure is nothing but the combination of loop, tuck and float stitches. So, here; so, in the

next class, I will let you know how you can identify at which particular position whether it is a tuck stitch or loop stitch or miss stitch.

And you are going to represent these type of fabrics. Because, when you try to make the diagram of this type of fabrics, is highly impossible. So, it is always better you go by the notation to represent these type of fabrics. So, in next class, it is all about fabric notations. So, I hope you liked this class. Stay tuned. Where we are going to give you, how you can represent this fabric structure. Thank you very much for listening. Thank you.