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

Module - 11
Lecture - 44
Lapping Plan Execution - Pattern Disc and Pattern Drum

Welcome participant, to week number 11, lecture 1. So, in this particular week, we are going to learn the lapping plan execution with the help of pattern disc and pattern drum. So, the topic is, you have to understand what is the role of pattern disc and pattern drum in execution of lapping plan. In the previous 2 weeks, I was focusing more on the, denotation of warp knit structure with the help of lapping diagram and lapping plan.

So, once you know the lapping plan, then how do we execute on the machine with the help of pattern disc and pattern drum? Today we are going to learn from this lecture. Before we move on, just a quick recap of what we covered in the previous 2 weeks. Because everything is linked, so I expect all of you to please follow the lapping plan. Because, once you do not understand the lapping plan, then there is no meaning to learn about pattern disc and pattern drum. So, whenever you go for any designing of a particular warp knit structure, lapping diagram and lapping plan should be clear to you.

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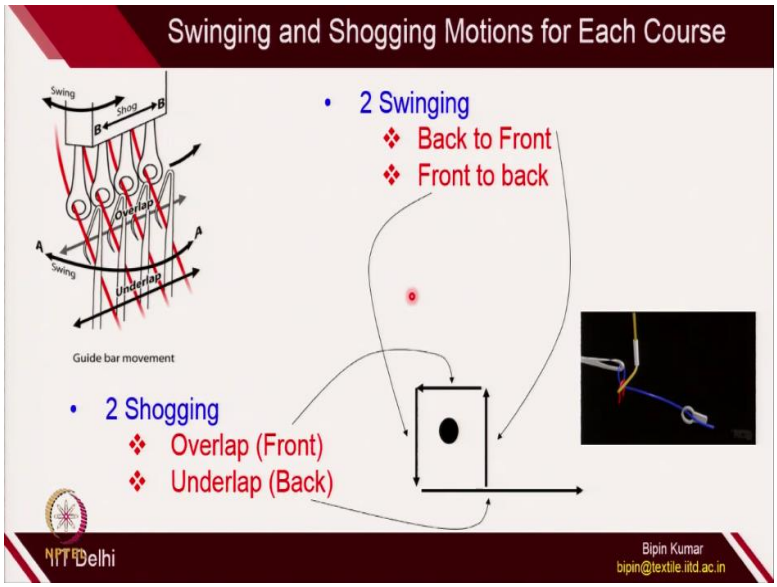

So, previous week, I given more emphasis on swinging and shogging motion. So, as you know, like for each course development in a warp knit structure, there are 2 swinging motion

and there are 2 shogging motion. So, whenever the guide bar provides yarn to a needle, it first do the swinging motion, then it does the shogging motion on the front side of the needle, which is called overlap. Then it again go for swinging motion from front to back side.

And after that, it does the underlap at the back side of the needle. So, once it completes 4 individual motions, then it go for the development of next course in the different needle. So, this is what we learned in the previous classes. And one thing was also clear, like between every overlap and underlap, there was 1 swinging motion. So, 1 swinging, 1 shogging, 1 swinging, 1 shogging. So, swinging and shogging motions is happening alternatively. So, this is very, very important in a warp knit design.

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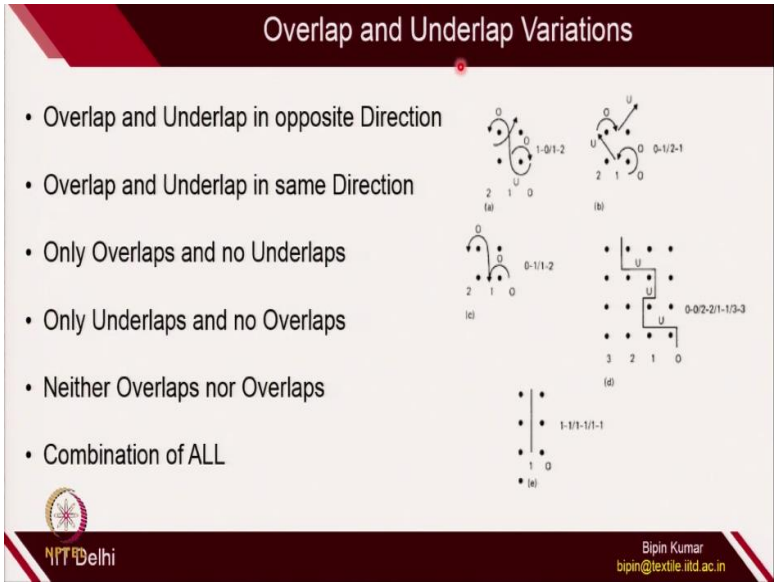

In the last class, I given more emphasis on the shogging motion, because depending on what type of shogging motions you are achieving, you can go for different types of warp knit structures. So, overlap and underlap are the 2 main shogging motion which is very, very important in terms of warp knit design. And there are a lot of possibilities where you can play with overlap shogging motion and underlap shogging motion.

So, I have given plenty of example in the last week, like overlap and underlap can be in opposite direction. So, which you can see it from here. So, here the overlap is in right direction, underlap is in the left direction. Similarly, in the second course, overlap is in the left direction, underlap is in the right direction. So, overlap and underlap are in opposite direction in each course.

Now, if you see the other possibilities where overlap and underlap are in the same direction. This is the overlap and underlap in the same direction. So, overlap happens on the front side from right to left; and underlap also right to left in the first course. And in the second course, if you see, so overlap on the right direction, underlap on the right directions. So here, overlap and underlap in the same direction for each course is shown here.

So, why these 2 possibilities is so important? Because, in one case, when overlap and underlap is in opposite directions, then you are producing closed loop structure, which is more, more stable. And then, when the overlap and underlap are in the same direction, then you are producing open loop construction where the loop is highly unstable and distorted. There are other possibilities where also where there is only overlaps and no underlaps.

So, for example, here if you see, there is only overlap and there is no underlap between 2 overlaps. So, in each course, only overlaps are present and underlaps is not happening. So, this is the diagram or schematic for this particular situation. The other case is where you have only underlaps and no overlaps. So, this is here, where you can see, there is only underlap on the back side; there is no overlap on the front side.

There could be other possibilities where neither overlaps nor underlaps is happening. So, this is where there is no overlap, no underlap. So, the yarn is just in a straight fashion. So, it just like the warp being is provided to each guides. And the yarn is just moving in a straight fashion. So, here the loops cannot be generated. Only the yarn is moving in a straight direction.

And the other complicated possibilities is where you can combine all of these together. You can go for designing for multiple courses, where you can have the possibilities of open loop, closed loops, no overlaps, underlaps, everything combined together, which is there in atlas construction. So, once overlap and underlap is clear to you, then you know how different warp knit designs are created.

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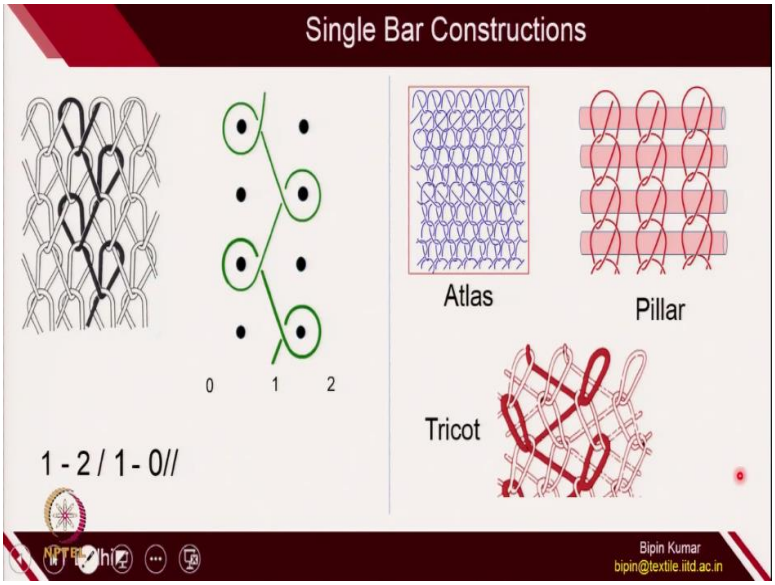

Once this was done, then I already introduced you some common single bar construction which is frequently used in market as well as in research. So, the first one is the tricot design. So, here is this tricot design. So, here you can see, the underlap is also 1 pitch and overlap is also 1 pitch. And the other 2 categories is atlas and pillar. Especially, the pillar is not possible because here the loops or the columns are not connected with each other. So, that's why we need weft inlays to make the fabric possible. So, atlas, pillar and tricot are usually produced on tricot machines, where you just need 1 guide bar to create this structure.

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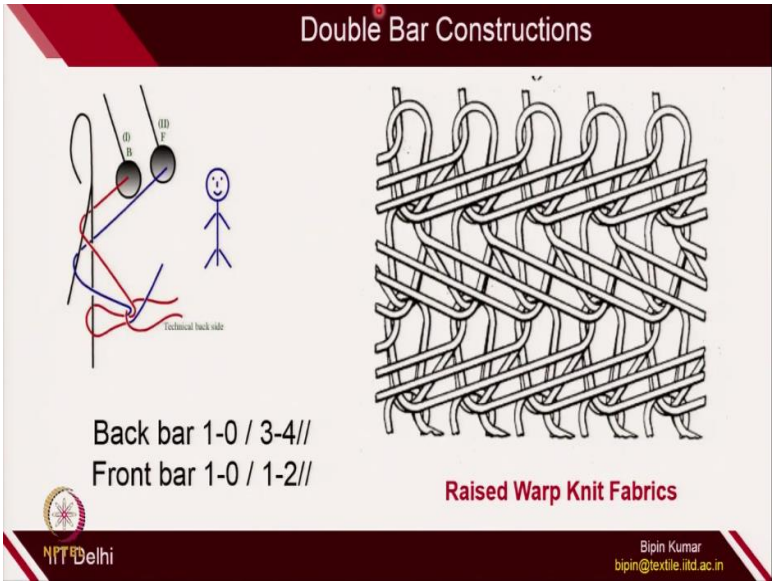

Other structure which I discussed in the last week was double bar structure or double bar constructions, where each needle is associated with 2 guides. So, basically 2 guides has different movements. And these 2 guides can be attached with 2 different guide bars. So, I

already given the denotation of these 2 guide bars. So, one which is very close to the needle on the back side is called back guide bar.

And the one which is fastest from the needle at the back side of the needle is called front guide bar. So, if you see this particular structure, 2 different types of shogging motion is provided by 2 different guide bars. So, the back guide bar, the lapping plan is 1, 0, 0 to 3 and 3 to 4. You can see the underlap is 0 to 3. It means 3 unit or 3 pitch. But here, if you see the front bar, here the underlap is 0 to 1 unit.

So, definitely, once the guides is having different overlap and underlap movements during the course, it is only possible when these guides are attached with different guide bars. So, this particular structure is called raised warp knit fabrics. From the understanding point of view, you need to only focus on the lapping plan for back bar and front bar.

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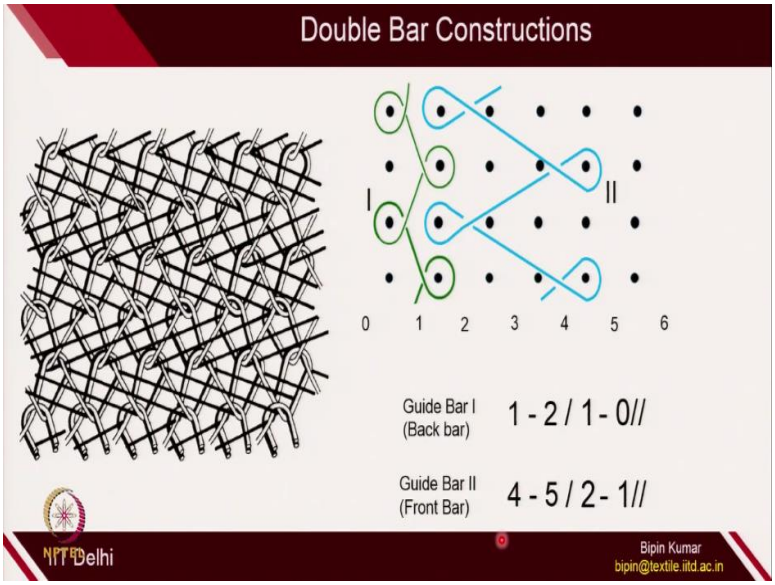

We given lot of examples also. For example, if you see this particular double bar construction. So, there is a white color yarn and black color yarn. So, the white color is attached with back guide bar. And the lapping plan is this one, where the underlap is 2 to 1, 1 unit. And black color yarn is attached with the front guide bar, where the underlap is 5 to 2. It means 3 units.

So, this is the lapping diagram. Now, you can understand, the lapping plan, especially this numbers or the digit and its sequence is very, very important in terms of fabric design in a

warp knit categories. So, lapping plan is the key in fabric designing in warp knit constructions.

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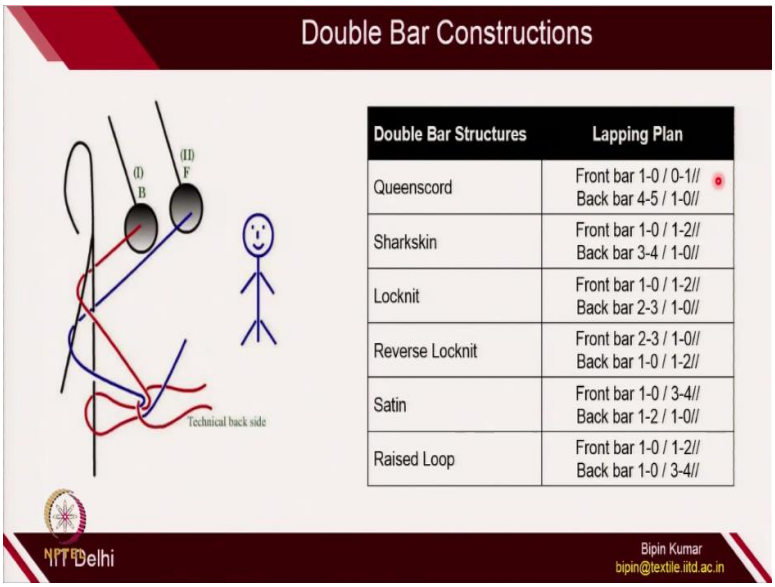

There are other double bar constructions and some generic names is here; and their lapping plans are shown in this way. So, from understanding point of view, what is more important, you just understand the sequence of these numbers. Each guide bar has the 4 sequence. And you can imagine how many permutation and combinations are possibles for each guide bar. And when you have 2 guide bars, definitely the permutation and combinations will be double.

So, in this way, the warp knit construction with having 2 or double bar will give lot of possibility in terms of warp knit designs. Also, you can also switch or swap the position of back lapping plan with the front lapping plan as vice versa. Then design can also be improved or increased. So, these are some generic names: queenscord, sharkskin, locknit, reverse locknit, satin or raised loop. So, all these 6 type of structures can be easily made on tricot warp knit machines, which is having 2 guide bars and 1 needle bed.

And once you follow these lapping plans, those structures can be made. Now, the question here is: Once you have the lapping plan for each particular fabric design, how the machine is set? What exactly the machine is doing in terms to achieve this particular sequence of shogging motion and swinging motion for development of warp knit structures? So, in this particular lectures, we are going to understand the performance of the machine to achieve the particular sequence.

So, how does the machine do the sequence of shogging and swinging to achieve a particular warp knit structure. It actually does with the help of pattern drum and chain arrangement.

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So, pattern drum and the chain arrangement is a one of the machine element which is responsible for controlling the shogging motion of guide bar. So, in this particular lecture, we are going to understand the functioning of pattern drum and the chain which is fixed on the pattern drum; and how the revolution of pattern drum and chain arrangement controls the shogging motion of a particular guide bar.

So, this is what we are going to learn today. And shogging motion is actually very, very important. As you know, the, if you change the shogging motion of guide bar, the lapping plan of a particular fabric will changed; and you will generate a new type of warp knit structures. So, let's see what is exactly the pattern drum and chain. So, before we move on, just a quick recap of how the guides are attached on a particular guide bar; and how it provides yarn to the needle.

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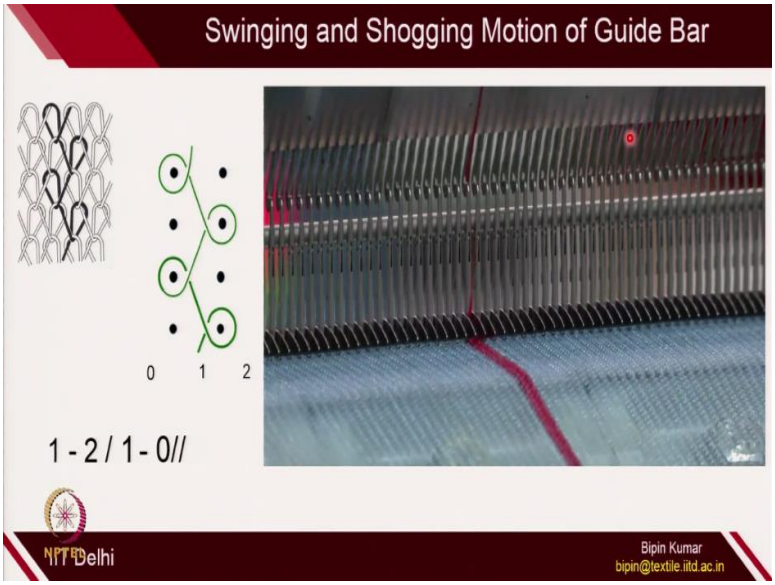

So, if you see this particular simple warp knit structure. We started the lecture on warp knit with the help of this simple structure, which is nothing but 1 cross 1 tricot fabric, where the underlap is also 1 unit and overlap is also 1 unit. So, if you see, overlap is 1 to 2, 1 unit. And underlap is 2 to 1, which is also 1 unit. And the direction is opposite. So, 1 to 2, it means left to right direction.

And 2 to 1, it means in opposite direction. So, this is what is shown as a lapping diagram, where you can easily find out this is 1 cross 1 tricot in a closed loop construction. So, this is basically a closed loop construction, because the direction of overlap and next underlap is in opposite directions. So, here is the actual running condition of the machine. And since on the machine there are like 1000 needles placed on the bed.

And for each needle, 1000 guides are attached, which will be providing yarns to each individual needles. So, for understanding the sequence of this particular fabric, you just need to follow the movement of one guide bar; how it is switching the yarn from one needle to other needle. So, each guide bar is actually switching from one needle to next consecutive needle; and then again going back to the same needle.

So, this is what is **(Video Starts: 14:31)** shown here. So, if you carefully follow the guide which is carrying the red yarn, so you can easily see, first time it is giving yarn to the right needle. And then, in the next course, it is giving yarn to the left needle. So, you can carefully see in this video, this is how the guide bar is switching with the help of shogging motion **(Video Ends: 14:56)** from one needle to other needle.

So, this is clear. Now, the question is, how these guides; which is shown on the top; so, you can see, these are all guides which is connected with the same guide bar. So, the question is: How this particular guide bar gets the motion? So, the swinging and shogging motion of this particular guide bar is coming from the main motor with the help of some particular mechanical arrangement.

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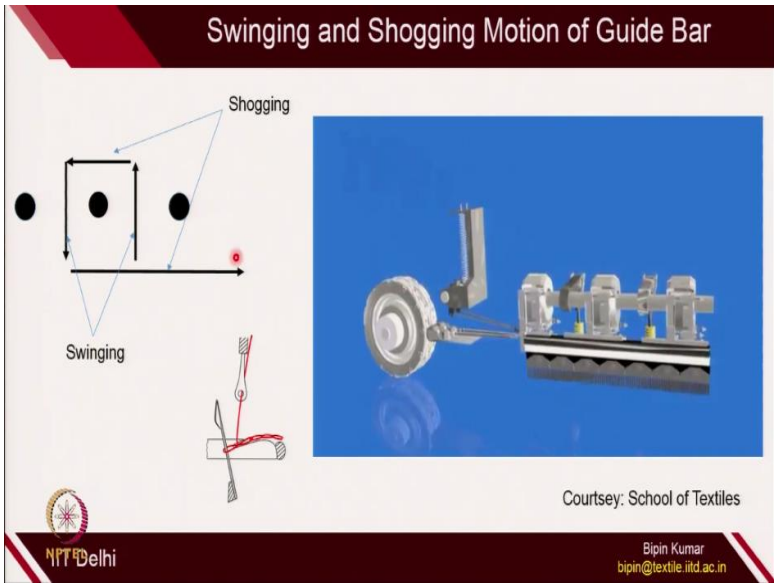

So, swinging and shogging motion of particular guide bar or individual guide you say; because whether you say the movement of one guide or related guide bar, it has the same meaning. So, the swinging and shogging motion **(Video Starts: 15:47)** is actually coming from the mechanical arrangement which is there on the machine. So, this is the entire guide bar which is having so many guides attached.

And you can see. So, the first motion is swinging motion, which is just the guide bar is swinging from back side of the needle to front side; and then front side of the needle to the back side. So, this is what swinging motion is shown here. These 2 swinging motion. And the other motion which is important during the course is shogging motion. Now, let's see the moment of shogging motion. **(Video Ends: 16:40)** So, swinging and shogging motion is actually happening simultaneously during the loop formation in a particular course by a particular guide.

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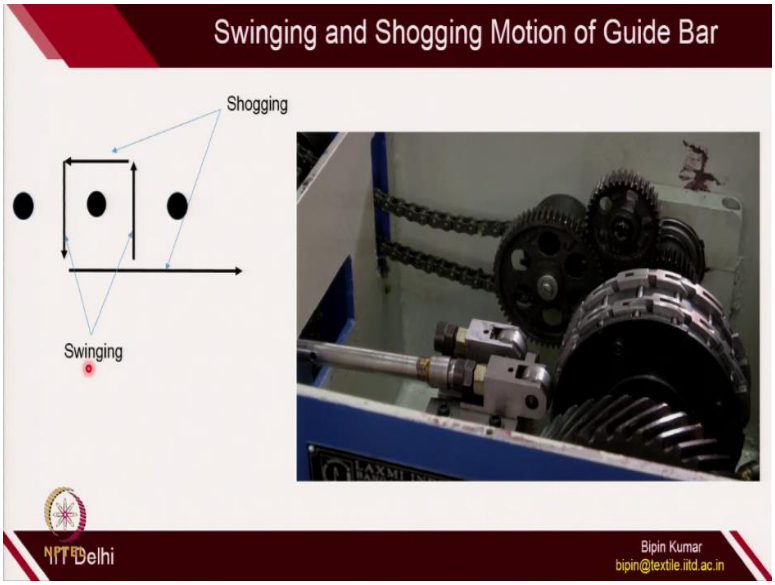

So, here the actual arrangement of the machine. So, this is the mechanical assemblies where the pattern drum is placed. And it is, this is having the chain links. And this is the push bar which is connected with the guide bar, which gives the lateral shift to the guide bar and providing shogging motion. **(Video Starts: 17:20)** So, just see here. So, you can see this particular arrangement.

So, there is a crest and trough on this drum. Because of that, the guide bar shifted. And this is where you can see both the motions, both swinging and shogging motion is happening simultaneously. So, these motions can be divided into 4 parts which is shown in the left side So, first swinging, then shogging. So, this is the shogging motion happening with the pattern drum; and swinging motion from the other sides.

Here, this is the swinging motion. And both swinging and shogging motion for each course can be shown in a planar view here. So, the sequence of swinging motion and shogging motion is decided. Whenever swinging is **(Video Ends: 18:10)** happening, there is no lateral shift. Because, if the lateral shift is there then the guide bar can hit the needle. And whenever shogging motion is happening, then there is no swinging. Because in that case also, it can hit the needle. So, swinging motion and shogging motion is done in a intermittent fashion to achieve the loop formation in warp knit fabrics.

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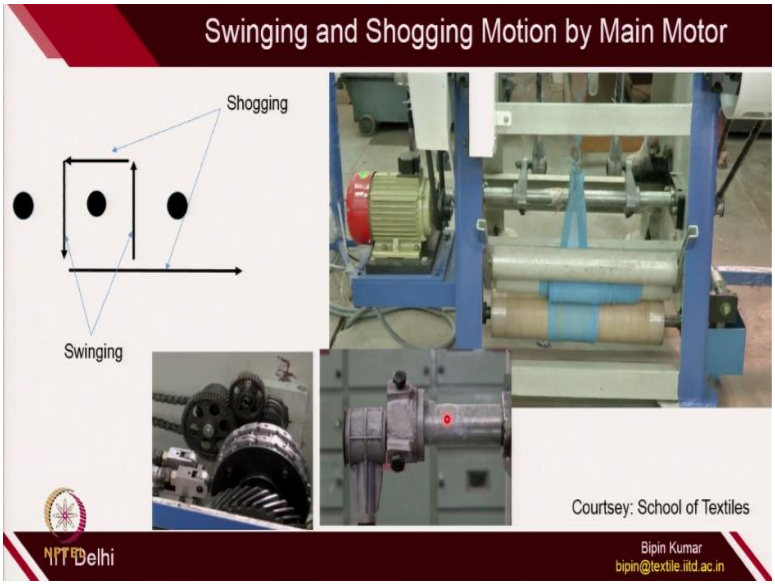

So, here is the video which can show you how the same motor; this is the main motor; is actually connected and given the drive for this pattern drum and the swinging motion for guide bar. So, swinging motion, here just the guide bar is swinging from front side of the needle to back side and vice versa. And shogging motion is the lateral shift of the guide bar with respect to needle bar.

So, here you can see. **(Video Starts: 19:09)** So, this is the main motor. So, from the right side, the guide bar is attached with swinging arrangement. On the left side, with the help of push rod, it is getting drive of shogging motion. So, swinging motion; and this is shogging motion. And this is, this 2 drives is actually coming from main motor. So, here is the rod which is giving drive to the drum on the right side.

And this is the left side which you can see; this part which is shown here. So, here you can see this is the swinging motion. So, the guide bar is one side **(Video Ends: 19:53)** attached for the swinging motion with the main motor. And the other side, it is attached **(Video Starts: 19:59)** with the pattern drum for getting the shogging motion. So, this is the schematic of the machine.

Now, from engineering point of view, you need to concentrate mainly on the shogging motion, because overlap and the underlap is the only thing which **(Video Ends: 20:17)** decides what type of warp knit design you are going to make on the machine. So, we will be focusing mainly on shogging motion in this particular lecture.

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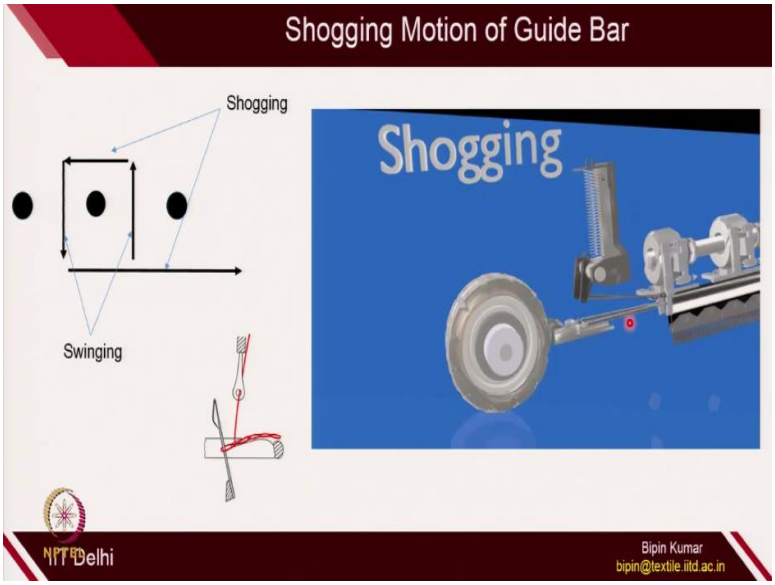

So, shogging motion is nothing but the lateral displacement of guide bar with respect to the needle bar. So, this is the pattern drum which is responsible for shogging motion of guide bar. So, this is the pattern drum which is revolving. And this pattern drum is connected with this guide bar; this is the particular guide bar; with the help of push rod. So, this push rod actually follows the profile of pattern drum.

And there is a crest and trough on this pattern drum with the help of chain link arrangement. Because of this, this push rod shift laterally in the positive direction and negative directions. Because of that, the guide bar gets the lateral shift. **(Video Starts: 21:22)** So, this is what you can see. So, this is the profile of pattern drum which is having crest and trough. And because of this, this guide or this push rod actually pushes this guide and give lateral shift.

So, this is the lateral shift you are achieving. So, you can see it here. If you follow the motion carefully, you can see, it is shifting left to right and then right to left with the help of spring arrangement. So, you can see it here now. So, it is going right to left; now it is going left to right. **(Video Ends: 22:02)** So, this is what shogging motion is achieved. So, as from the video also it is clear that the shogging motion is achieved with the help of pattern drum.

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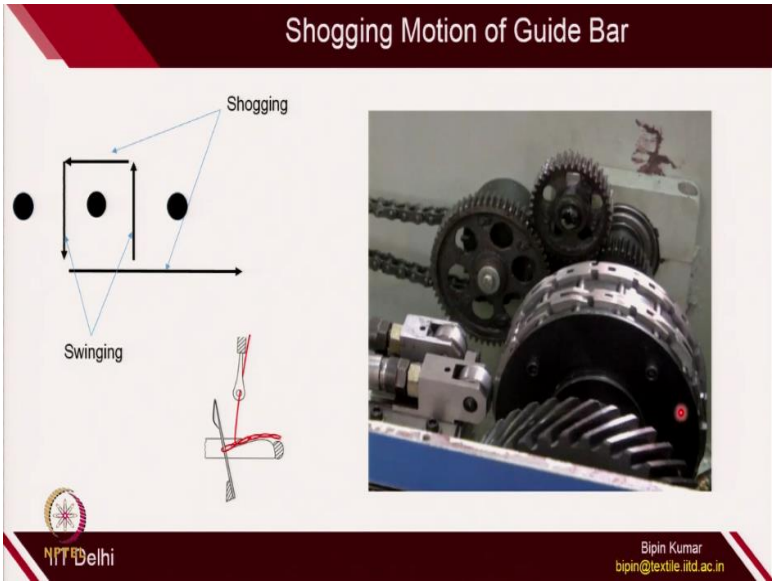

So, this is the pattern drum on which this chain's links are aligned. And this is the push rod. And this is the follower which follows the path of this chain links. And this chain links had some crest and trough. It means, it has the elevation and depression. So, when the follower follows any elevation path, it pushes the rod in, from right to left. And because of that, the guide bar shift towards the right to left direction.

And whenever there is a depression; for example, if you see here, there is a depression; then the guide bar actually moves from left to right direction. So, whatever is the path of this particular chain, that decides at what amount the guide bar shifts with respect to needle bar. Okay. **(Video Starts: 23:22)** So, this is exactly. So, you can see, the moment crest and trough is happening, it is either moving left to right or right to left direction.

So, you can see it here. So, either it is shifting by a small amount. And that distance is actually very, very small. Because, if you see, the gauge of the machine, if it is 14 gauge, it means 14 needles per inch; and distance between 2 needle is 1 by 14 inch. So, the distance is actually in mm. And it varies from 0.5 mm to 2 mm, depending on the machine arrangement. So, because of that, you can see this shift is happening and the guide bar is shifting from one needle position to other needle position.

So, if the distance between these 2 needles is, let's suppose 1 mm, this is pushed by this rod. And the whole guides shift to 1 mm right or left, for a 1 cross 1 tricot. So, this is what is the shogging motion, with the help of pattern drum and chain links. **(Video Ends: 24:35)**

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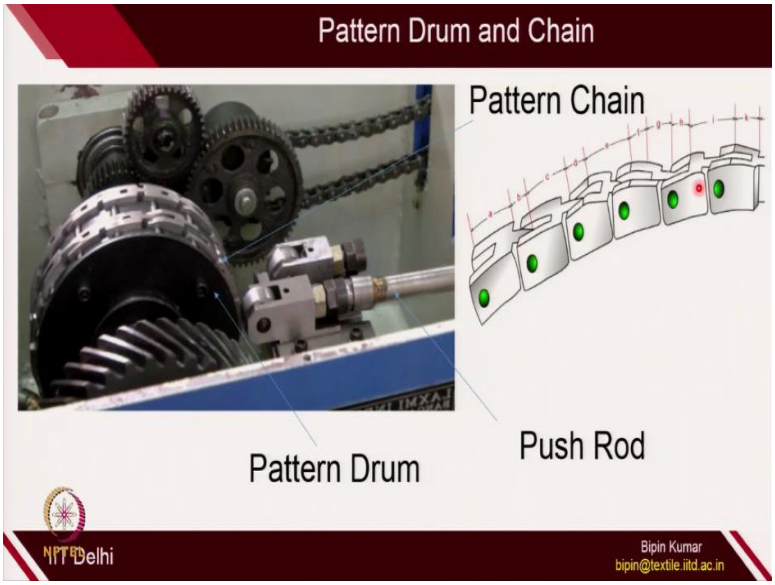

So, this is actually the photograph in a stationary conditions. So, you can see, this is the pattern drum on which this chains are arranged. And this chain profile is followed by the follower, which is connected with push rod. And this push rod is connected with guide bar, which shifts the guide either left to right or right to left with respect to needle bar. So, this is what pattern chain looks like.

So, this is what pattern chain looks like, which is wrapped around a circular periphery. And I have this arrangement of chains with me. And you can see how these are connected and then put it on the pattern drum. So, let me show you some of the chain's links which is there. So, these are individual **(Video Starts: 25:38)** links of the chain. So, you can see the height of the link.

So, this is, the height is smaller. And these are, height are bigger. And these are much even bigger. And this is the bar which connects each of these links. So, what exactly is done is, these different links of the chain are connected. So, you can, from here you can able to understand. And the follower follows this profile. So, right now, you can see, this is the elevated part. And then, this is the smaller part.

So, here the guide bar goes down. And once this links will come, again it has to rise. So, whatever will be the distance between the elevation of these 2 guides, that will decide how much lateral shift is happening in the guide bar. Okay. So, that sequence can be decided depending on fabric design. Okay. So, here you can see, this is the elevation is low. So, here the elevation is fine.

So, after elevation, it is going down. So, it means, from here to here, the guide bar is moving in, let's suppose if it is moving in left to right direction because the elevation is coming. And after that, it is moving in opposite direction, because, after elevation it is going into depression. So, if you see here; so, from here, if you carefully see. So here, this is the elevation one.

After elevation it is going in depression. So, for example, if it is going from elevation to depression, it is moving in left to right direction. After that, it is again elevation. So, it is moving from right to left direction. After elevation, it is again going to depression. Okay. So, it means left to right direction. So, in this way, the sequence are designed; and you are achieving overlap and underlap of different amounts.

So usually, whenever overlap is happening, it is equals to 1 pitch. So, whatever depression you are looking at, the distance of these depression is actually equivalent to 1 pitch. And if you are looking at this point, here the depression is much more. It means, you are basically doing the more than 1 pitch of underlap. So, underlap can have more than 1 or 2 pitch, but overlap is usually 1 pitch or 0 pitch.

So, you can see there, so many links are there. And you can you can combine these links and create a particular fabric. Okay. So, let me do one for you. So, I am, right now I am attaching links in much random fashion. So, once this is done; so, you can see, all chain links, all links is attached. And now it is become a chain link. Once chain link is developed for a particular fabric, then we can fix this chain link on the pattern drum **(Video Ends: 30:22)** for the shogging motion of guide bar. So, once you design this chain depending on a particular fabric, you can fix it on the drum.

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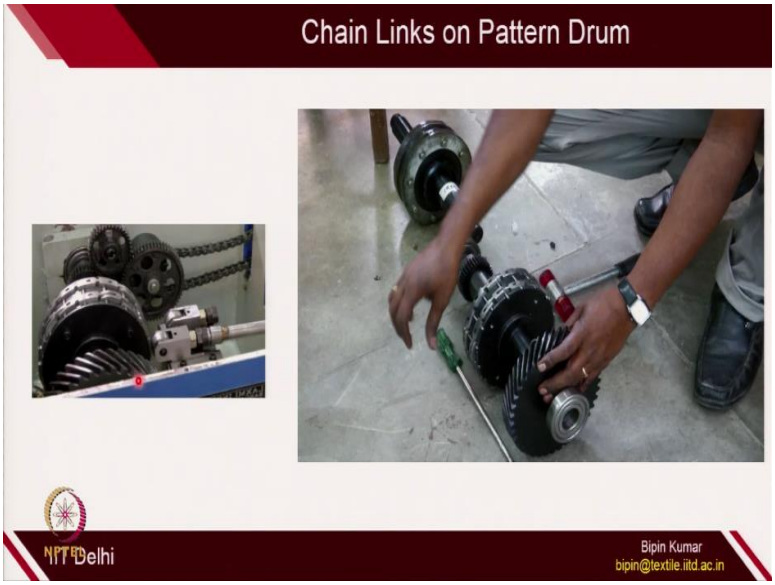

(Video Starts: 30:36) So, this is where, you can see, these chains, in a certain sequence is fixed on the drum. And once this drum is ready, you fix it on the machine and you let the guide bar follow this particular profile. Okay. So, this is how you fix the **(Video Ends: 31:06)** chain links on the pattern drum. When this is done, then this is, this drum is actually fixed on the machine. And this is the follower which is connected to the guide bar with the help of push rod. Okay.

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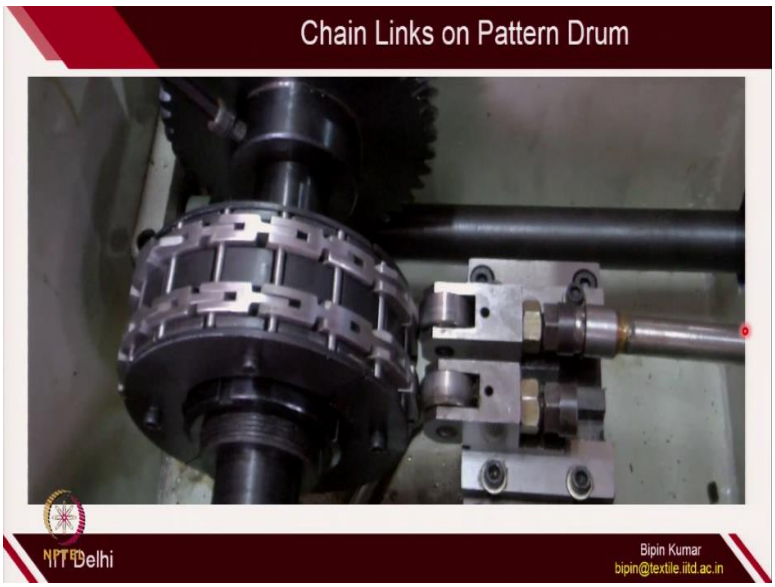

So, this is, you can see it here. So, this is the pattern drum over which the chain links are there. And this is the follower which is connected to the guide bar. Okay. So, clearly you can see, depending on the crest and trough or the elevation and depression, this follower will push this rod either right direction or left direction. Because of that, you are achieving shogging motion in a guide bar.

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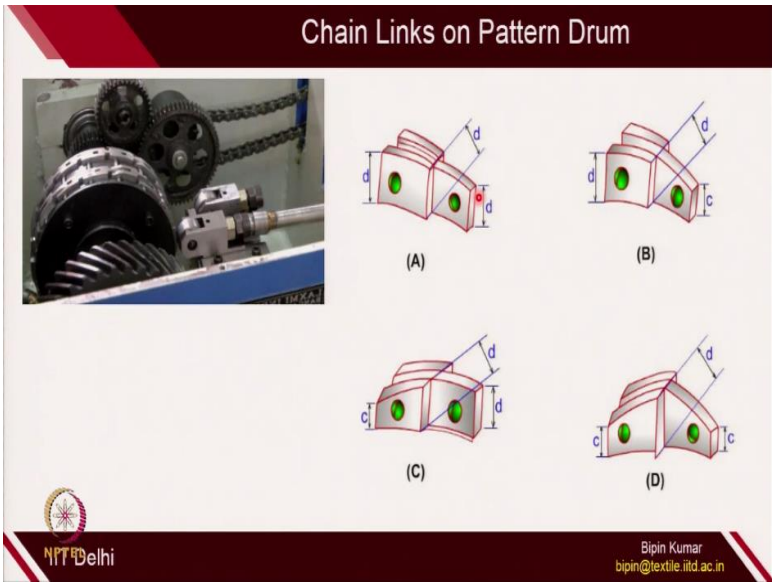

So, chain links on the pattern drum is actually prepared by combining different types of links of different types of elevation and depression. So, just now I showed you, you could have different height of links. And depending on a particular type of shogging motion, you can arrange these type of links to create lapping plan for a particular fabric. Okay.

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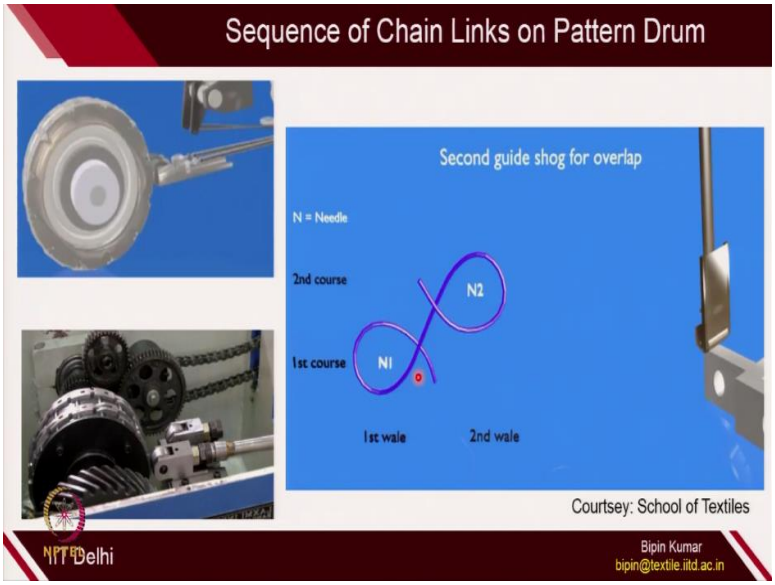

So, this is one of the simplest video, which you can see, where the sequence of chain links decides what type of fabric you are going to produce. So, **(Video Starts: 32:46)** here is a small video. Courtesy to school of textiles for making such a beautiful video. So, here you can see, whenever this elevation is happening, it is doing underlap. After that, it is stopping. Then, again elevation.

It is doing overlap on the front side. You can see here, this is rising. So, that's why it is doing overlap. Then, it is stopping. Then, it is doing underlap, because it is coming to the left direction. And this is how we are creating 1 cross **(Video Ends: 33:23)** 1 tricot. So, depending on elevation and depression, you are allowing the guide bar to do the overlap or underlap in a particular direction on the machine.

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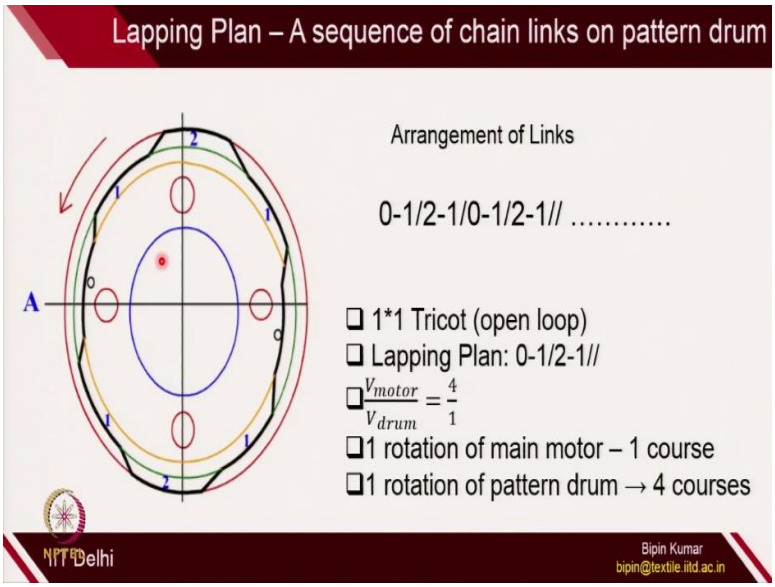

So, what is more important for us to understand, how these sequence are decided. So, for example, if you see here, the pattern drum is rotating in anti-clockwise direction. Okay. And this is how the elevation and depression is created with the help of chain links, which I just showed you. So, if you see here, the 0 indicates a particular position of the guide. After that, when the follower reaches to this particular position, here the elevation is happening. Okay.

So, from 0, it is rising to 1 position. So, 0 to 1. So, this is nothing but, you are doing overlap. After that, it is rotating keeping the radius same. So, if the radius is same, there is no shogging motion happening. So, it means, this much time you are giving for swinging of the guide bar. Okay. Once swinging is completed, then there is a lateral shift from first position to second position, because there is a elevation.

So, from 1 to 2, you are doing the lateral shift, which is nothing but underlap. Once you reach to the second elevation point, you are keeping the radius constant. It means, the follower will not do the lateral shift of the guide bar; and the guide bar will be doing swinging. After completion of swinging, it is again coming to the 1 position. So, from 2 to 1 position. So, you can see, from 2 to 1 position.

So now, it's the underlap in opposite direction. Okay. After reaching to 1, again the radius is constant. You are giving time for swinging. And then, you are again going down to 0 position. So, 1 to 0. This is again underlap. So, once you reach to 0 position, now you are going for swinging position. Then again 0 to 1 position, which is overlap. Then 1 to 2 position, after completing swinging, which is underlap.

Then, you are doing swinging, keeping the radius same in the second position. After swinging, you are doing again 2 to 1 overlap. And then you are doing swinging. And after that, from 1 to 0, you reach to the same position. So, this is how when the pattern drum actually rotates, this is the sequence of shogging motion you achieved. So, you first did 0 to 1 overlap; then 1 to 2 underlap; then 2 to 1 overlap; and then 1 to 0 underlap; and then 0 to 1 overlap; then 1 to 2 underlap; and 2 to 1 overlap; then 1 to 0 underlap.

And this is how 1 rotation is completed. So, if you see the lapping plan, whatever number which you are generating, it is nothing new. It is basically the arrangement of links on the pattern drum. So, you are following the sequence of links on the pattern drums. So, that's why, depending on the pattern chain links arrangement and their sequence warp knit structure is denoted.

So, if you carefully see this structure, it is repeating after 0, 1, 2, 1. So, 0, 1, 2 1; then 0, 1, 2, 1. So, basically it is a 1 cross 1 tricot, this pattern drum is making. And it's a open loop construction. Because 0 to 1, it is overlap; and 1 to 2 underlap in the same direction. So, whenever a overlap and underlap is happening in the same direction for a same course, it is a open loop construction.

And the fabric design which is going to create, it has a lapping plan of 0 to 1, 2 to 1. And as I already mentioned, the main motor is actually giving drive to the drum. So, if you see the motion of one particular revolution of this drum, you are basically created 4 courses. Okay. So, it means, if the drum rotates for 1 revolutions, the motor must have rotated for 4 times; because the motor must rotate to give swinging motion.

So, every 1 rotation of motor is making 1 course. And since here 4 courses are being formed by 1 revolution of the pattern drum, so that's why the motor must be having the speed 4 times higher than the drum speed. So, revolution speed of motor should be 4 times higher than the

drum speed. So, 1 rotation of main motor is actually making 1 course. And 1 rotation of pattern drum is actually making 4 course.

It means, pattern drum is rotating at a smaller speed. So, every 90 degree rotation of pattern drum, you are able to create 1 course. And this is also visible from here. Because, from 0 to 1, you are doing overlap. And then 1 to 1, you are doing swinging. Then 1 to 2, you are doing underlap. And then 2 to 2, you are doing again swinging. So, 1 swinging, 2 shogging, 1 swinging.

So, swinging, shogging, swinging, shogging. So, once you complete 2 swinging and 2 shogging, 1 course is completed. So, every 90 degree, you are completing 1 course in the machine.

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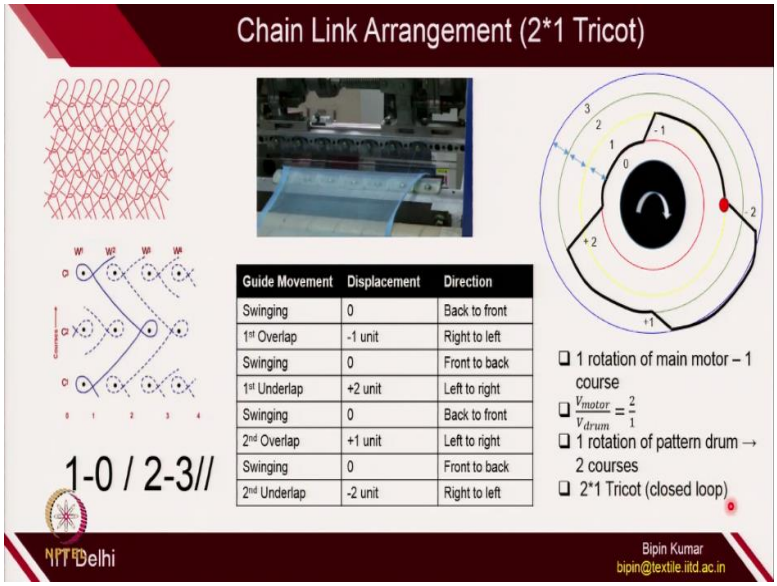

Let's see another example for a different tricot design. So, here is a 2 cross 1 tricot closed loop construction. So, this is the fabric and this is the lapping diagram and its, this is the lapping plan. So, 1 to 0 is the underlap, sorry overlap; and 0 to 2 is underlap. So, 1 to 0, it is in left to right, right to left direction. And 0 to 2 is left to right direction. So, both the directions are opposite.

So, it means there is a closed loop construction. So, if I have to make this particular fabric, this chains has to be arranged in a particular sequence. When whatever elevation and depression we want to achieve, for that, the links has to be arranged in a certain sequence. We will do some practices, the real practice in the next lecture. But since I have some of the

links with me; so, let me help you to understand how we position the link on this particular drum to create this particular fabrics.

So, if you follow this lapping sequence; so, first it must have done the swinging where the guide bar should move from the back side of the needle to front side. And then it will be doing first overlap. So, 1 to 0, it means it is moving from right to left direction. So, minus 1 unit. So, 1 to 0, it is moving in the right to left direction. So, minus 1 unit. After completion of overlap, it is doing swinging and going back to back side of the needle.

So, it is staying at the 0 position and it is doing the swinging. After completion of swinging, it is moving from 0 position to 2 position. So, from 0 position, it is moving to this position which corresponds to 2. So, this is the underlap. So, plus 2 unit. And here, it is moving from left to right direction. So, you can see here, left to right direction. After reaching to second position, it stays there and does the swinging, because it has to go to front side of the needle.

So, it goes to front side of the needle. And from second to third, it is doing the second overlap on different needles. So, first it does the overlap and underlap on this needle. Now, it is going to third needle to do the overlap. So, second overlap, left to right, because 2 to 3, it is a plus 1 unit. And once it reached to third position, it stays there, does the swinging to go back to its back position, front to back position.

And once it goes back to back position, it is again doing the underlap to 3 to 1. So, 3 to 1. So, this is the second underlap, minus 2 unit, right to left direction. So, once you made 2 loops for the course, actually the fabric design is completed. So, because this particular fabric is repeating every 2 courses. So, once the pattern drum follows this sequence and 1 revolution is done, then you would be able to create the same pattern again and again for every rotation of drum.

So, this is how this particular fabric is created. So, what is more important is to give the elevation of minus 1 unit, plus 2 unit, plus 1 unit and minus 2 unit in a sequence. So, first time, it is the depression, minus 1 unit; then elevation, plus 2 unit; then elevation, plus 1 unit; and then depression of minus 2 unit. So, when you start arranging the links on this particular drum, **(Video Starts: 44:17)** so every link has certain radius.

So, you can imagine, when this pattern drum is rotating, there are different types of concentratic circles which can be generated depending on the profile of the links. So, if the link size is smaller, then it's a 0 position. If it is bigger than that, then it's a first position. If it is bigger, if the link size is even higher, then it's second position. And then, third position. And the drum is rotating in clockwise fashion.

So, the follower, let's suppose is meeting **(Video Ends: 45:07)** the links at this particular position. So, at this particular position, it is first meeting the chain link of first position. So, this is where the follower is meeting the chain links; so, on the first follower. The first follower meets on the first chain link, which is having the height of, which is equivalent to this particular concentratic circle. Okay.

So, once it meets the 1 position, it is staying here, doing the swinging to go back to the front side of the needle. So, this is what it does. It keep the radius same. So, when the radius is same, there will be no lateral shift. So, in that time interval, basically, it does the swinging, go back to the front side. Once it reached to the front side of the needle, then it is changing the position from 1 to 0.

So, it means, it is at the first position; the follower is at the first position. And now, it has to go to the 0 position. So, now it reached to the 0 position, because it is depressing. So, 1 unit, it is depressing. Okay. So, this is the shogging motion. And this is the first overlap. So, here, the overlap happens. And this one is the swinging motion. So, once the overlap happen, the position of the guide bar is now on the 0 position.

Or now the follower is with the 0 link. Okay. So, once it reaches to 0 link, it stays there. And now, it is doing the swinging to go from the front side of the needle to the back side. So now, it is keeping the radius same, doing the swinging motion. Because here, the radius is not changing. So, there will be no lateral shift. Okay. So now, once it does the swinging, front to back side; now at the back side, it can does the lateral shift to do the underlap.

So, now the underlap, you can see, it is plus 2 unit. It means, there is a elevation. So, it must be encountering link of second position. Okay. Because it has to rise. So, that's why, from 0 position, it is reaching to 2 position. So, from 0 position, it is reaching to 2 position. Okay. 0

position to 2 position. So, this is the elevation. And your underlap is over. So, this 4 sequence completed the 1 course of the fabric. Okay.

Once underlap completed, it stays at the 2 position and does the swinging to go to the front side of the needle. So, now it is doing the swinging on the front side of the needle. And it reaches to the front side of the needle. After swinging, now it is going for the overlap in the second course. So, this position, it is going to do. So, the overlap is 2 to 3 unit, which is plus 1 unit.

So, this is the plus 1 unit. So, plus 2; now it must has to elevate. So, it means, it has to go to third link position, okay, which is the highest height of the chain links on the pattern drum. So, plus 1 unit, it elevated. Now, when it reached to third position, it has to remain there for the swinging to front to back. Now, it again swings, keeping the radius same. After swinging, it goes back to back position of the needle.

Now, it has to complete the underlap. So, underlap is minus 2 unit. So, 3 to 1; because the next stage it is 1. So, it is going back to its starting position. So, 1 position. So, minus 2. So, this is the depression. So, this is how the pattern drum is providing the swinging and shogging motion with the help of links. So, the sequence of links of different height has to be carefully placed on the machine to achieve this particular sequence. Okay.

So, in totality, if you see this particular structure; so again, whenever a main motor is rotating, 1 course is being formed by 1 rotation of main motor. And here, 1 complete rotation of pattern drum is actually creating 2 courses. Because, there are 4 swinging motion and 4 shogging motion is happening, so, 1 rotation of pattern drum is actually creating 2 courses. And this particular fabric is 2 cross 1 tricot, with a closed loop construction.

And the motor speed and drum speed is 2 is to 1. So, this is the overall chain link arrangement for simple type of fabric. This is a single bar construction. And we have seen the 2 examples: one for 2 cross 1 tricot; the another one is for, if you see the previous one, this is for 1 cross 1 open loop construction with a, for a single bar. So, this is how the chain link arrangements and pattern drum is very, very important to achieve the shogging motion of guide bar.

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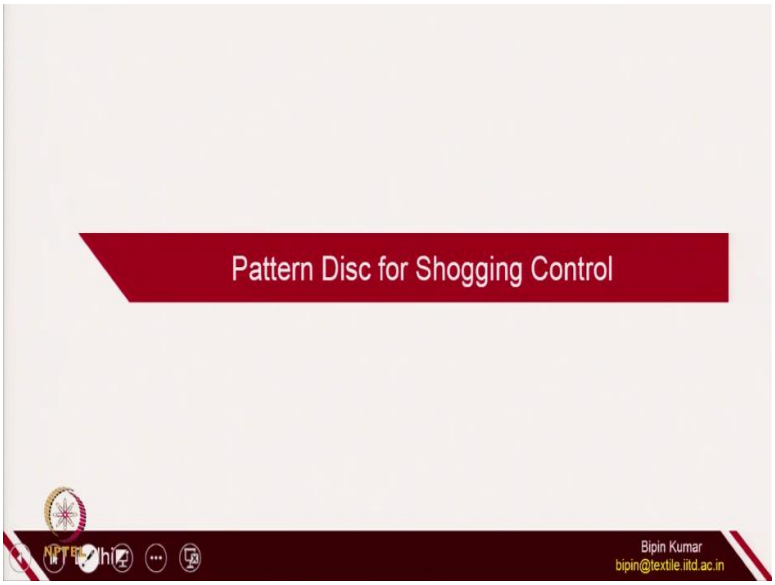

Now, let's move to the other simple topic which is pattern disc for shogging control. So, so far you have seen pattern drum. And on that pattern drum, chain links was placed. Now, for higher speed, we go for pattern disc. So, how they are different?

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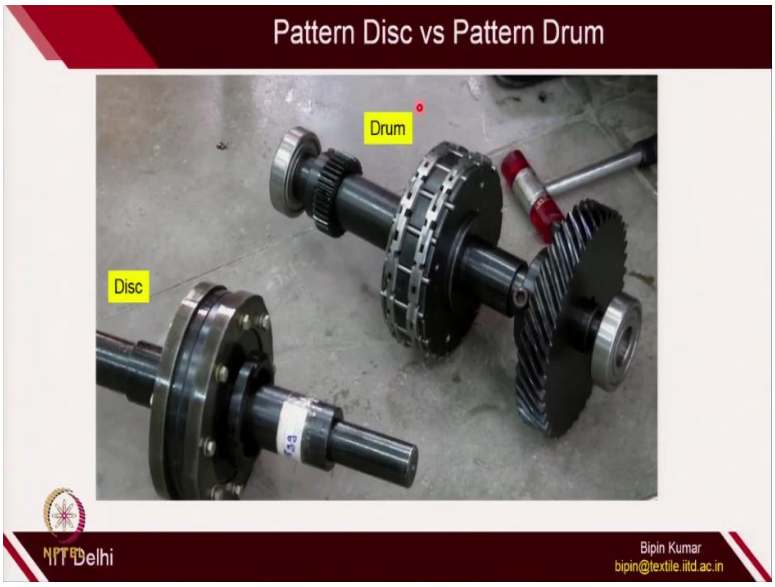

So, this is the drum where the links are being placed. So now, after several modifications, they realized, instead of creating this links, if one has to design a particular type of fabric continuously, then there is no need to go for links arrangement. You can simply go for disc arrangement. So, this disc is there. And you can do the profiling of this disc. And you can create the elevation and depression similar to the links.

So, here you have used the links of different height. Here, you can do the profiling on the surface of this disc and achieve different shift of elevation and depression on this disc. So,

disc and drum is the common one which is used in warp knit construction. They can be both used in raschel machine as well an in tricot machine. But disc is very, very useful when you want to have very, very high productivity.

But the problem with this is, once you created the elevation on a disc, it can create only one type of design. It cannot go for multiple designs. The reason being, because the elevation and depression is fixed; the filing has been fixed. But here, in the drum, you have the links. And anytime you can take out the links and you can put different height of links. In this way, if you are doing research, then, there is a high possibility that you can change the sequence of these links and create different fabric.

But in the disc, the sequence of underlap and overlap are fixed for a particular disc. So, there is no possibilities of changing the design once the disc is created. But the beautiful thing about disc is, this is more stable, because this is a more robust design. And here there is lot of vibration is happening; lot of noise is happening; because of depression and elevation. But disc is more smooth, the profiling can be done very smooth.

And in this way, you can find out the machine which is using the disc based pattern disc. Then, the speed is also very high. And the control is also very good. But when you are using pattern drum, the control over the shogging and swinging motion is not that accurate, because there will be lot of vibration, because these links are not very tight. Even a small changes or disturbance in this link, the guide will not be doing its functioning properly.

So, both the designs has its own advantage and disadvantage. But usually drum, pattern drum is very useful when you want to actually learn the warp knitting by changing different links arrangement. Because, if you keep changing the sequence, you can go for multiple designs of the fabric. And this is very, very important from engineering point of view. This is the actual running condition of pattern disc.

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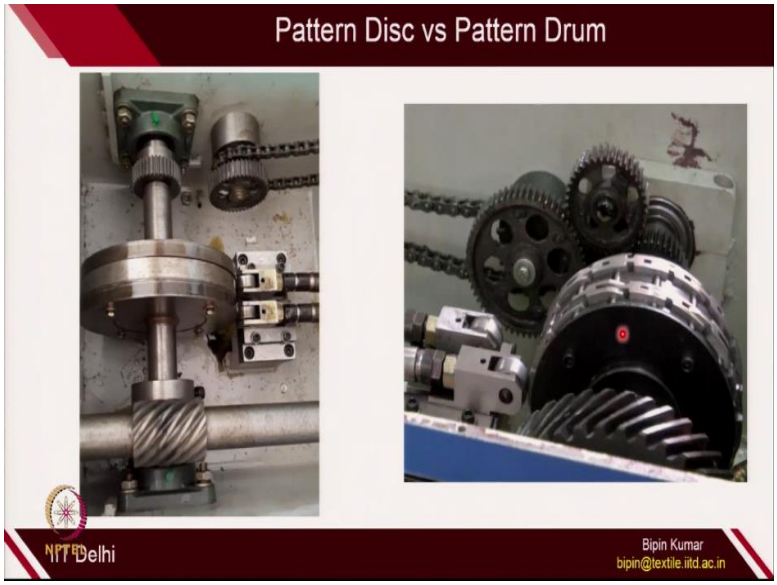

And this is the pattern drum. **(Video Starts: 54:52)** So, you can see it here. So, this is the disc. And you can see, the profiling has been done. And this is the follower doing the same thing. But if you see here, this is little bit more rapid. And here, the movement is very smooth. So, the more control on the disc, that's why you can go for the very, very high speed.

But here you can see, there are lot of jerks here, because of sudden elevation and sudden depression, when you are shifting from one links to other links. So, because of that, this particular drum arrangement is not suitable for very high speed. So, once speed is more and more important, pattern disc is more followed. When speed is not the concern, rather than the creativity of different warp knit structure, then pattern drum is more used.

But the profiling and depression has to be created in a particular sequence for designing a particular warp knit structures. **(Video Ends: 56:02)** So, in the next class, we will see the arrangement of links and we will do as a practical. Like how, if you want to go for a single bar construction, how you should be placing different links. And when you want to go for 2 bar construction, how you should be placing links.

So, here if you see, **(Video Starts: 56:27)** both the disc and drum, it has 2 profiles. So, 2 chain links. And here also, 2 disc. And you can see here also, 2 possibilities of 2 bar. So, usually, on the market, you will always find like most of the tricot machine or warp knit machine is having minimum **(Video Ends: 56:46)** 2 guide bar. Single guide bar machines are usually not found.

But 2 guide bar is most recommended, because anytime you can use any particular guide bar. If you want to go for single guide bar construction and if you want to go for 2 guide bar construction, you can use the other **(Video Starts: 57:06)** follower with the other chains. So, in the next **(Video Ends: 57:11)** class, we will do some practical of how we create this sequence for certain type of fabric structure. So, thank you very much. Catch you in the next class.