Science and Technology of Weft and Warp Knitting
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Module - 11
Lecture - 45
Chain Links Arrangement - Single and Double Bar Constructions

Welcome participants. Now, I am going to give you lab demonstration on how we do the chain link arrangements for some common warp knit constructions related to single and double bar. So, if you see, in the last class, I already mentioned you regarding the importance of chain links and pattern drum. So, your lapping plan of warp knit structure is actually derived from how you are placing the links of different height on a pattern drum.

So, today, I am going to give you the real practical of how you can arrange the links in a certain sequence for achieving swinging and shogging motion for a particular warp knit structure. Before we move on, just a quick recap of what we covered in the last class.

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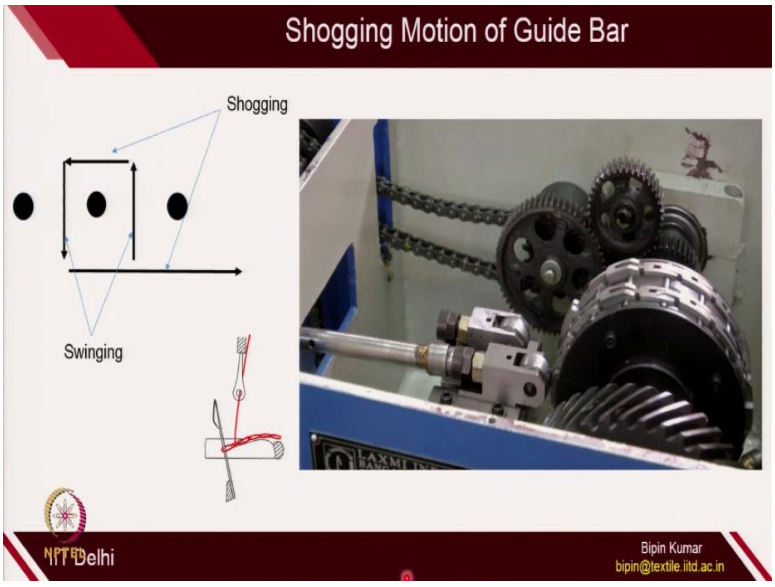

In the last class, I talked about the shogging motion with the help of pattern drum and the chain links. So, if you see the shogging motion or the lateral displacement which is actually given to guide bar with the help of pattern drum revolution; on the pattern drum, there are chain links **(Video Starts: 01:46)** which provide depression and elevation to the follower which is connected with the guide bar with the help of push rod.

So, whenever there is a elevation, the follower push the guide bar to the left. And when there is a depression, automatically the, with the help of a spring system, we can see, there is a spring system. This is spring. The guide bar moves **(Video Ends: 02:17)** to the right direction.

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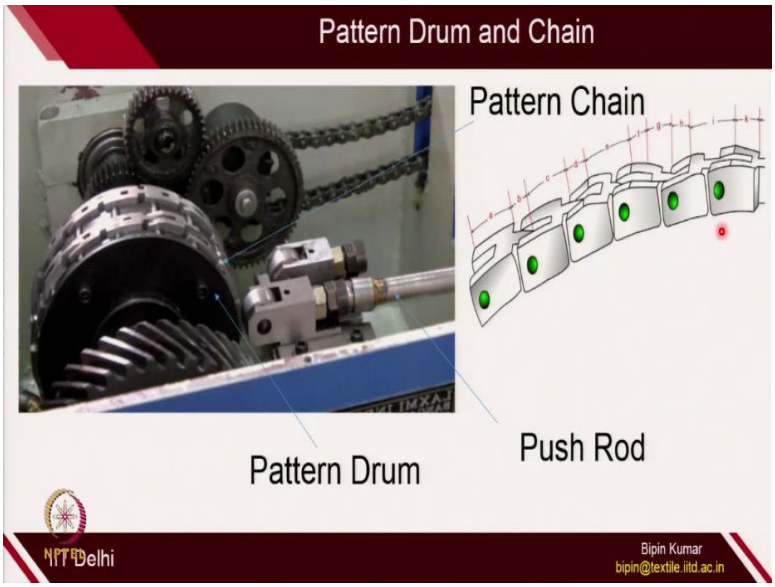

So, this pattern drum, pattern chain, push rod and the follower is very, very important for shogging motion. But what is more important is the sequence of pattern chain links. So, these are the links which is placed in a certain sequence with the help of bar. And these chain links are placed on the pattern drum which is shown here.

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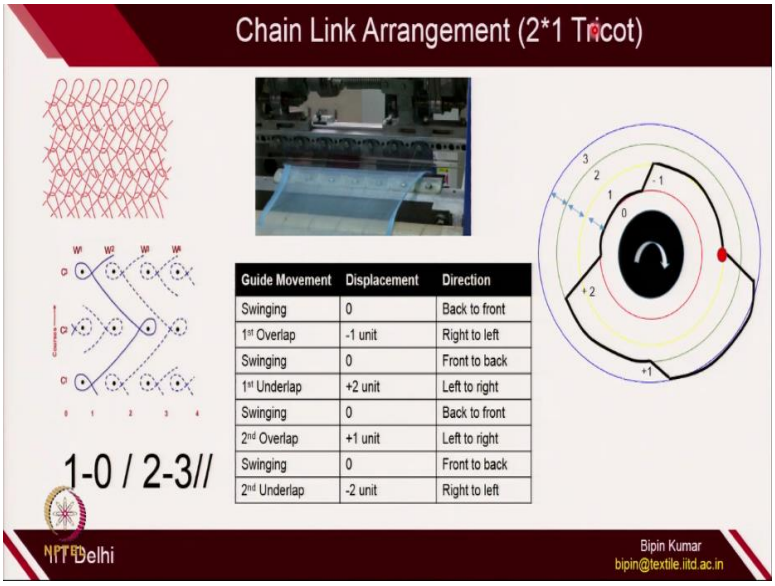

So, I given you also one example of how these sequence are used and links are arranged on a pattern drum for making simple type of a structure. For example, let's suppose if you want to

make 2 cross 1 is structure here. So, where the overlap is 1 to 0; and 0 to 2 is underlap; followed by overlap; and then underlap. Between each overlap and underlap, there was swinging motion.

(Video Starts: 03:25) So, this is how the pattern drum elevation and depression are denoted. So, basically it could be the profile of the pattern drum can be divided into different concentratic circle of different radius. So, this elevation is coming from using different height of links on the pattern drum. So, you have the follower following the chain links at this point. So, when the revolution is happening; so, based on the revolution, whatever is the profile which is created with the help of chain links, the follower will be following exactly at this point. **(Video Ends: 04:09)**

So, the radius is same. It means there will not be a lateral shift. Only swinging will be happening. When it is going down, it means it is moving towards left direction. When the radius is increasing, it means the guide bar is moving towards positive direction. And this is how sequence are arranged for creating this particular 2 cross 1 tricot. So, now the question is: How we actually arrange this?

What is the steps that need to be followed before making any warp knit fabrics? So, I will selectively do some of the lab demonstration of particular warp knit structure, where with I will be using different types of links. And I will be putting them in a sequence. And you can then visualize how this might be done in a real practice for creating different types of warp knit structures.

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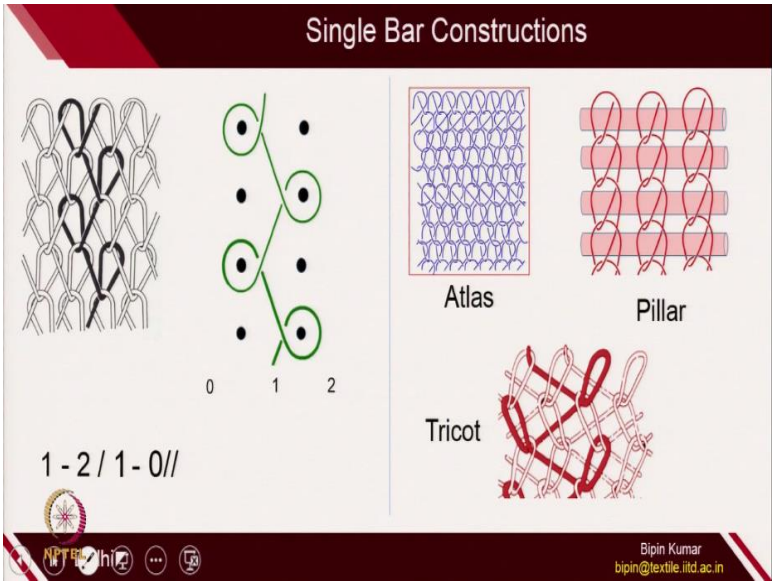

So, I will be choosing both single bar and double bar construction. So, let's go for single bar construction. So, in single bar construction, there were different constructions like atlas, pillar, tricot was there. And for making single bar construction, we just need to worry about only one guide bar. So, let's first start with this particular single bar structure, which is 1 cross 1 tricot and with lapping plan of 1 is to 2; then 2 to 1; and then 1 to 0.

So, this is what is the lapping diagram and lapping plan for 1 cross 1 tricot closed loop. So, let's see how we do the chain link arrangement. For, **(Video Starts: 06:04)** before you start to design any particular fabric, it should be clear that what type of lapping plan you want to achieve. So, once that is done, what you need is the links of different heights. So, you can see here, I have used 3 different height of links.

This is the smallest height. This is little bit bigger. And this is even much bigger. Okay. So, if I can zoom for you, you can see the height difference carefully. Okay. So, you can clearly see, this is the smallest one; this is the bigger size; and this one is even bigger. Okay. So, 3 different heights are there. So, when I am switching from this to this, it means 1 pitch is possible.

And when I am switching from this links to this link, 2 pitch is possible. Okay. So, this height actually is carefully designed. And profile has been created, so that, what amount of pitch can be generated. So, in normal practice, up to 3 **(Video Ends: 07:13)** pitch is possible. Usually, we do not go more than 3 pitch, because then there is a high strain on the needles; and needles may break.

But usually zero pitch is always available. 1 pitch, **(Video Starts: 07:30)** 0 to 2, when we are using this two, it means we are using 1 pitch of overlap and underlap. When I am using 0 and 4, it means, we are using 2 pitch. If I am using this two, again 1 pitch. So, for you, this numbering is very, very important. So, let's denote some of the number. Let's suppose this is of 0 height.

This set of link is of 1 height. And this set of link is of 2 height. And these are the bars. Whenever we combine these links, we need bar to secure them, because bar is actually helps to secure them in the place. If bar is not there, these will be very unstable. And you would not be able to fix it on the machine. So, it's always better. The hole has been created. You use this bar to fix the link in a particular place. Okay. So, now let's move for simple type of fabric structure. So, the first fabric structure which I want to design is a single bar construction **(Video Ends: 09:05)** of 1 cross 1 tricot.

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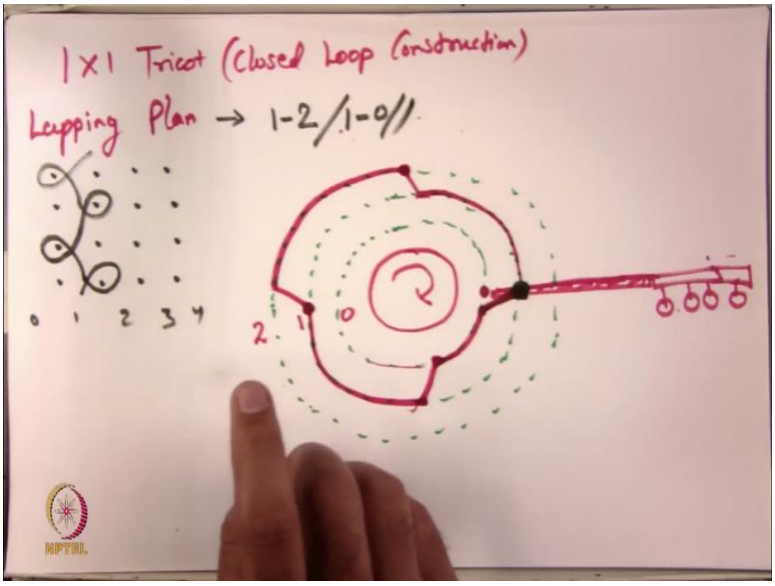

So, first fabric which I want to create is 1 cross 1 tricot with closed loop construction. Okay. So, if I have to create 1 cross 1 closed loop construction, first thing you want to do is, you get its lapping plan. So, lapping plan for 1 cross 1 construction is, 1 to 2, 1, 0. This is your lapping plan for closed loop construction, 1 cross 1 tricot. And you can also, for better visualization, you can use lapping diagram as well, just for better understanding.

So, 0, 1, 2, 3, 4. So, 1 to 2; then 2 to 1; then 1 to 0; and this. This is how it has been created. Now, the question is, how we should put in the sequence. Okay. To make this fabric on a pattern drum; usually, this is the pattern drum without any chain links. And if we are putting

the chain links, then we can generate different profile of concentratic circles. So, let's give those profiles some names.

This is the third concentratic circle, depending on a chain link side. So, I already denoted you, there 3 chain types of chain links. One chain links height was 0; another one was 1; and the second one was 2. So, 0, 1, 2. So, if I use chain links on, 0 chain links on particular drum; so, this is the profile that the follower will be following. If I use 1 chain link, then this is the profile that follower will be following.

If I use second chain link, so this much, this profile which the follower will be following. And the distance of these 2 heights are 1 pitch. From 2 to 0, the distance of this height is 2 pitch. And let's suppose I am starting from this point. And because here, the follower is connected with this guide bar. And guides are there, which is keeping individual yarns. So, this is the push bar; this is the guide bar.

So, if the push bar is shifted from one position to other position, depending on that, what type of links you are creating on the surface. So, since the first interaction is on the first position; so, basically, when the follower start interacting with pattern drum, the guide bar is actually in the first position. Okay. So, this is your first position. So, the guide bar is actually starting from this point position; or the follower is starting from this position.

So, from first, it is, it must be doing swinging to go on the front side. So, it must be doing swinging to go on the front side. Okay. So, it must be doing swinging to certain time. So, this is the swinging to go on the front side. From first, now it is moving to the second position. So, this is your second position. Now, it is shifting to this particular position. So, the once this is rotating, so the follower will follow this part.

And when this position is coming, suddenly the follower will be pushed towards right. So, it will move in right direction when this point is coming and interacting with the follower. Okay. So, 1 to 2. Once it reaches to 2 position, then it again will be doing swinging to go back to its back position of the needle. And then 2 to 1, it is underlap. So here, you can see it is depressing.

So, it is going down. So, this is, it is going to the first position. So, after first position, it is again doing swinging in the same position. And then 1 to 0. So, this is where 1 to 0. Okay. Because this is the 0 circle. And then, 1 to, once it reached to 0, it again does the swinging. And then finally, 0 to 1; this is the shogging or underlap. Okay. So, it is started from here; swinging; overlap; swinging; underlap; swinging; overlap; swinging; underlap.

So, this is what the profile has to be created. How do we actually create this profile? So, first of all, out of the 3 links which I showed you, it is, it has to be first interact with the first link. Okay. So, the first link, **(Video Starts: 15:25)** I have chosen the middle height. Okay. So, this is the middle height. And the profile is of certain height. So, this distance, the follower will move without doing anything.

After that, it has to jump. So definitely, once the follower reach to this point, whatever links we are going to fix here, it must be of bigger height. So, this is what bigger height is coming. So, once it reaches to this position, you can see, there is a bigger height. So, you can see it here. If you carefully see, so, this is the bigger height. So, I can fix it here. Okay. So, swinging; then, this is the first overlap.

So, this is what is happening here. So, once the follower coming here, it may get some kind of jerk. So, it is always better to do some kind of profiling here to protect the machine. So, I can use someone with some kind of profile. Without profile also the machine can run, but there will be lot of wear and tear. So, you can see now, the profile is there. So, which will help in shifting the follower from first height to second height.

So, from first height to second height, it can shift here. So, once this is there, then swinging, because the, you can see there is no change in radius. So, this is the time where the swinging is happening. Up to this much point, the swinging is happening. After that, there is a depression. So, depression up to which point? It the same one height. So, I have to take another one height. Okay.

So, this is what the same height I have used; this one and this one; second position. Once this is done, I can fix the link. Okay. So, after 1, there is a swinging. So, you can see, there is no change in radius. And then, we are going to depress to 0 level. So, I need to find out which is

smaller than this height. So, this is 0 level. Okay. So, after this, this is swinging. Once this is done, then it has to go back to its second position.

So, this could be your second position again. So, 2, 4, 2, 0. Okay. So, this is what I have used. This is 1; this is 2; then again 1; then this is 0. So, this is what is the sequence which you can find it from this arrangement. So, first is 1 which is placed. Then, I placed 2. Then, again I placed 1. Then, I placed 0. Okay. Then again, from here, 1. And then, I can place 2. Okay. And then, I can place, after 2 there must be 1.

And then, after 1 there must be 0. Okay. After 0, again we can start from 1 and 2. So, this is 1. After 2, we have to use 1 again. So, this is 1. Again, the bar to fix it. And then, finally, we can go for the last one; this is 0. And after 0, then again 1 is coming. So, this is how I can fix it with the entire. So now, anytime, if you follow the sequence; 1, 2, 1, 0, it will be coming. So, this is 1, 2, 1, 0; 1, 2, 1, 0; 1, 2, 1, 0.

So, if your drum is of this much radius; so, in 1 complete rotation, it will be making 1, 2, 3, 4, 5, 6 courses. So, depending on what is the radius of your pattern drum, you can keep following the sequence of these chain links. And you can keep creating the courses. So, this is the simple one. So far, if you see, this particular design. So, here only 4 links has to be used; 1, 2, 1, 0.

So, this is 1, 2, 1, 0. So, for this particular pattern drum, only 4 links are required. But their, the links can be bigger also, which can be used depending on what type of machine capability you are having. So, this is how you can follow the sequence of chains. So, if you want to see, you can clearly see, there is a elevation and depression. And once this is done, you can fix this sequence of chain links on the drum to get this particular fabric. Okay.

So, this is one simple example for **(Video Ends: 22:34)** 1 cross 1 tricot. Similarly, you can go for pillar stitch. If you want pillar stitch; for pillar stitch, you need to first write down its lapping plan. So, pillar stitch.

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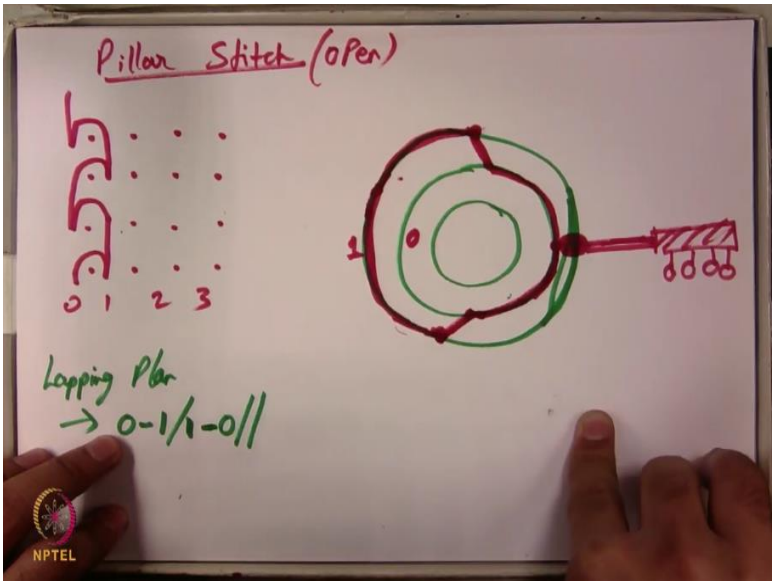

So, in pillar stitch; let's look at pillar stitch. So, in pillar stitch, as I mentioned in the previous class also, there are 2 possibilities: one is open pillar stitch, another closed pillar stitch. So, in open pillar stitch, the loops are open. And usually underlaps are missing, only overlaps. So, this is what your pillar stitch is all about. So, 0, 1, 2, 3. So, you can simply note down its lapping plan.

Lapping plan: So, 0 to 1. Then, 1 to 1 is the underlap. And then, 1 to 0. And this is what is repeating. Okay. So, 0, 1, 1 to 1 and 0. So, if I have to make the chain link arrangement of this, I simply need to follow the chains of this number and put it in a sequence. So, I can simply, this is the pattern drum radius. This is the radius due to 0 chain link. This is the radius due to first chain links. Okay.

So, let me start from here. So, this is the point where follower is following. So, this is 0 position. This is 1 position. There is no 2. So, there is no need to put it here itself. So, this is 0 position; this is 1 position. And the follower is first with the 0 position. And this is the push bar which is connected with the guide bar. And this guide is having each individual guides. So, it is 0 position.

So, it first swings. And then, it shifts to first position. This is the first position. Then at first position, it is again has to swing. And then, it is remain on the first position. Okay. And then, again it has to swing back. And then, it is moving to 0 position, because 1 to 0, this is overlap. And then it is moving 0 to 0 position. So, this is what is the profile for pillar stitch. So now, how I can put the sequence?

So, we start from 0. So, this is the 0 height. And then, I will go for 1. Then, the second digit is also 1. So, I can go for two ones simultaneously. And since the profile is same; so, you can see, there are lot of continuously swinging motion. And because there is no underlap, so, it is just like a stop motion for the guide bar. Okay. Only swinging is happening; no shogging motion for, due to no overlap.

Once this is done, then 1 to 0. And I can put it in sequence. So, this is for pillar stitch. Once this is done, if you want to make pillar, you can simply put it. And you can keep in a sequence: 0, 1, 1, 0; 0, 1, 1, 0; again 0, 1, 1, 0; depending on how many courses one rotation of drum is making. So, this is how you make the pillar stitch. Similarly, you can go for atlas construction.

In atlas construction, the only difference you will observed is, there will be lot of sequence that need to be followed. Let's go for another simple one, where you have more than 3 courses. So, let's suppose, if you have single bar construction which is repeating in 3 courses.

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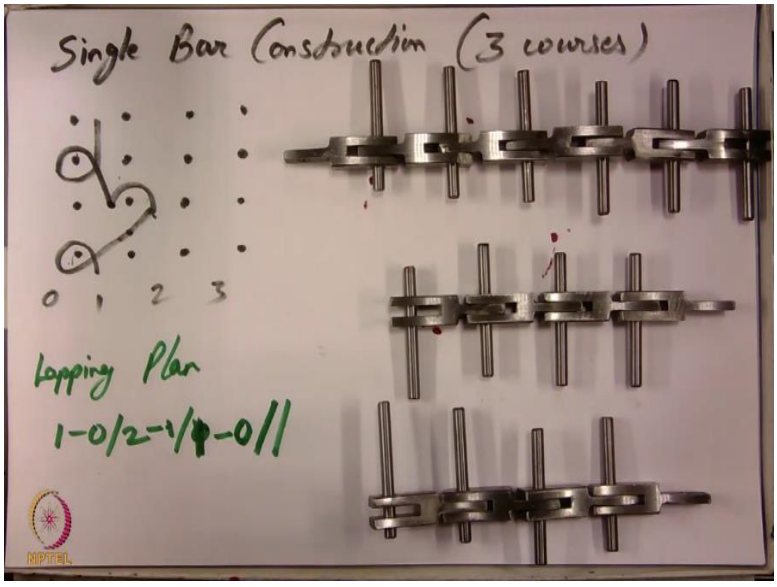

So, let's suppose it is repeating in 3 courses. So, 1 to 0. Okay. So, let's suppose some design is like this. So, 2 closed loop, 1 open loop. This is just like a atlas construction. So, 0, 1, 2, 3. So, if it has to be followed, you can just simply find out lapping plan. So, we start from 1 to 0; then 0 to 2; then again from 2 to 1; 2 to 1 is the overlap; then 1 to 1 is underlap. There is no underlap here.

Then, 1 to 0; and 0 to 1. So, this is how the sequence has been followed. So, if we want to create the chain link arrangement for this, it's very, very simple. So, we start from **(Video Starts: 28:55)** number 1. So, this is number 1. Then we start to 0 position. We can fix it here. After that, second, much bigger height of the link. We can fix it here. Okay. After that, again 1 position, we can fix it here.

After that, again from 1 to 1. You can fix it here. And then from 1, then we are going to 0 position. Okay. So, 1, 0, 2, 1, 1, 0. So, this is 1 position, 0; 2 position; then again 1 position; then 1 position; then 0 position. So, this is how you get the single bar construction for atlas. So, this is how we do it for all. So, this is for pillar construction. This is for atlas construction. And this is for tricot construction. Okay.

So, this is what, 3 constructions we have just covered. What is more important is, just sequence of lapping plan. And according to that, we can simply achieve whatever structure you want to do it. So, this is for tricot, this is for pillar and this is for atlas. So, with this, this is the sequence we followed in the **(Video Ends: 31:19)** real practice. Now, let's move to the double bar construction.

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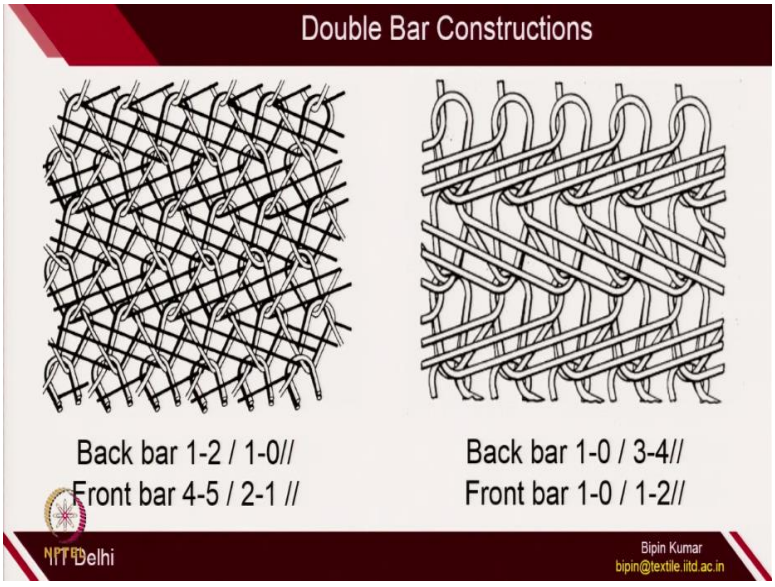

In double bar construction, as I already told, there are 2 sets of bars. So, definitely you need to follow chain link sequence for individual guide bar. So, there are different possibilities or double bar constructions is possible.

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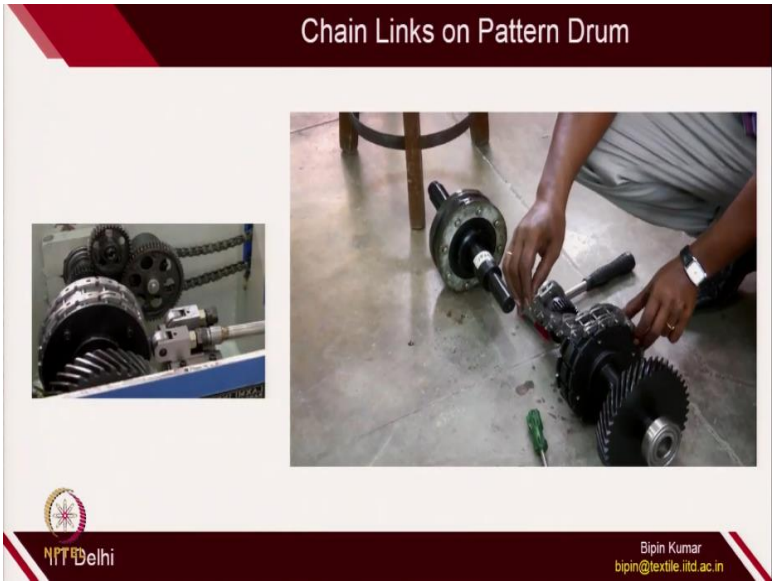

And once you have the sequence for each individual bar, **(Video Starts: 31:50)** you can fix it on the machine, on the pattern drum. And then, you can go for fabric production. Now, let's see a very simple example of how you can combine sequence of 2 double bar construction. So, let's go for a double bar construction. **(Video Ends: 32:21)**

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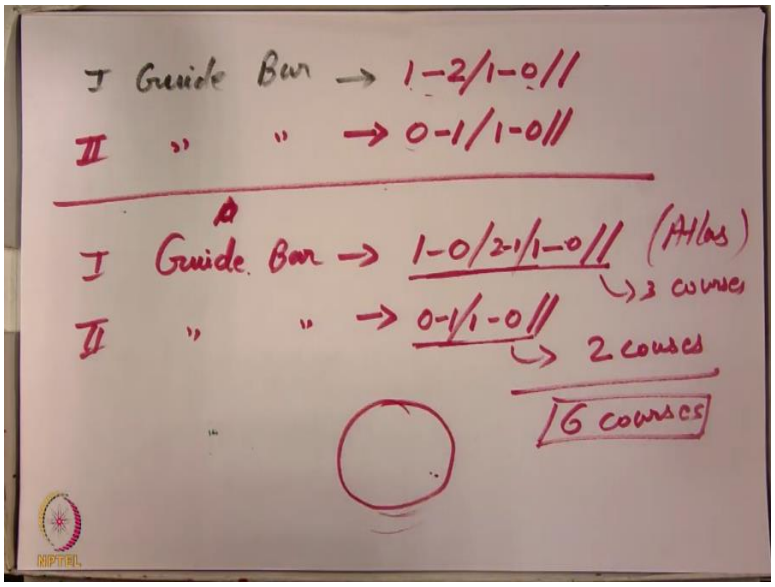

So, let's suppose, we want to create a double bar construction having first guide bar with lapping sequence of 1, 2, 1, 0. And second guide bar, lapping sequence is of pillar stitch 0, 1 slash 1, 0. So, if this is there, we need to combine together both the sequence. So, whenever we are fixing the chain link for one guide bar, we have to also make sure; when 1 is there, the next guide bar should be interacting with 0.

When the first guide bar is interacting with 2, the second guide bar should be interacting with first. So, we have already done the practice for these two. **(Video Starts: 33:24)** So, this is for first guide bar; this is tricot. And this is for second guide bar. We have already done this. So, this is 1; this is 2; 1; 0. Okay. So, 1, 2, 1, 0. And this is 0, 1, 1, 0. So, the only things which you, which need to be carefully followed here is; whenever you are using 1 for first guide bar, then for the second guide bar, you must be using 0.

So, this need to be attached with the same sequence. So, this is for 1. This is 0. When it is interacting with 2; so, this is 2; then it must be interacting with 1. Okay. So, once this is done, then 1, 1. So, this is 1. So, 1, 1. So, here also, we need to use 1 for second guide bar. Okay. And then, this is 0 and 0. So, this is, 0 is fixed here. And this is 0. So, once this is done, this, our chain link sequence for both the guide bar is arranged.

And once this is done, we can fix it on the double bar machine on its pattern drum. So, this is how double bar construction is used. **(Video Ends: 35:20)** There could be very much problem when you are using fabric of different repeat designs. So, for example here, the first guide bar is repeating in 2 courses. Here also in 2 courses. For example, when you are making first guide bar, second fabric, which is repeating in 3 courses.

For example, 1, 0, 2, 1, 1, 0. This is your atlas. And second guide bar is, let's suppose making pillar; 0, 1, 1, 0. Okay. So, this is repeating in 2 courses; this is repeating in 3 courses. And if it has to be used on the same pattern drum. So, when the pattern drum actually revolves the complete revolution, it has to be ensured that the repeating pattern should be repeated after every revolution of pattern drum.

So, when this type of guide bar has to be produced using 2 bar tricot machine, then 1 revolution of pattern drum should be making 2 designs for first guide bar. And should be making 3 designs for second guide bar. Because this is repeating in 3 courses, this is repeating in 2 courses; so, both the designs will be repeating after every 6 courses. Okay. So, the pattern drum should be arranged in such a way that it should be having 6 courses.

It should be forming in the sequence, so that it can repeat the design of both 1 and 2. So, in 1 rotation of pattern drum, it should be making 3 repeat design of guide bar 2. In 1 rotation of pattern drum, it should be making 2 rotation of guide bar 1, 2 design for guide bar 1. So, this

is the only thing which need to be taken care when you go for many complicated designs. In multi-bar constructions, when you have different types of guide bar, like 1 to 8 guide bar, you can see how the designs can keep on getting complicated.

But the principle remains same. First step, you need to put it the links in a sequence for 1 guide bar. Similarly, you need to put the sequence of second guide bar. If the repeat course is different, then you have to make sure that the pattern drum revolutions should be completing the repeat designs for each guide bar. Okay. So, this is how the chain links for double bar constructions are made.

So, this is your double bar constructions are made. Once the chain links is done, you can put this chain links sequence **(Video Starts: 38:41)** on the machine. You can see it here. So, this is where you are putting it. And after fixing this, you can take this on the machine. **(Video Ends: 38:57)**

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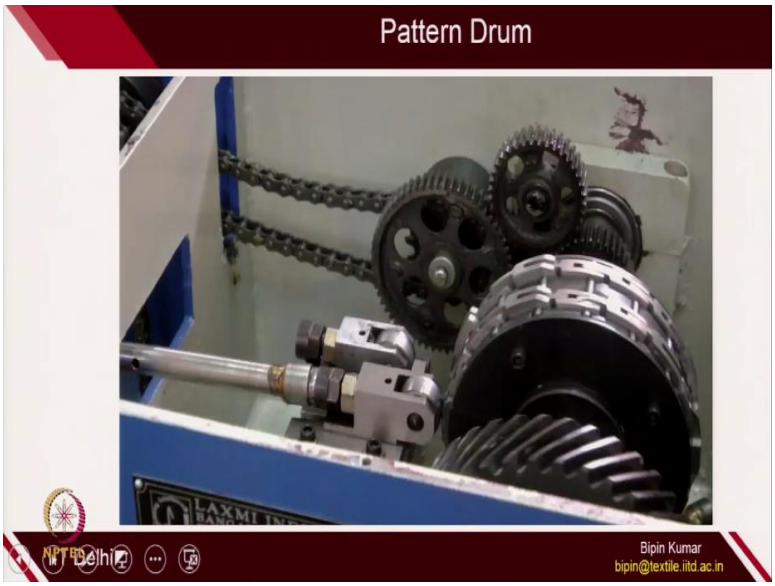

And you can put it. So, here you can see, there are 2 chain links are **(Video Starts: 39:05)** placed, although we are using single guide bar. But if the other guide bar is attached, then it will be a second 2 bar construction. So, with this, I am **(Video Ends: 39:18)** stopping here on the practical aspects of warp knitting. In the next lecture, I will be summarizing all the technologies.

There are many other technologies, especially 2 bed, raschel machine, multiaxial warp knitting machine, pile warp knitting fabrics. There are different types of technologies are

there. But the principle of those type of fabrics remains same. So, I would recommend all of you to keep reading many other literatures and practicing on warp knitted structure design and principles. So, with this, I am stopping here. See you all in the next class. Thank you.