Science and Technology of Weft and Warp Knitting
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Lecture-39
Warp Knit-Structural Identification

Welcome participants in this particular lecture we are going to learn some practices on how you can identify a particular warp knit-structure. In the previous lecture I give more emphasis on swinging and shogging motions. Because once you understand swinging and shogging motions you would be able to get the idea of how the yarn was provided in the fabric structure. And what is the role of guides in changing the position from one needle to other needle.

Now in the market you will find lot of fabric structures which has very very complicated in nature. But how you will be able to identify some of common knitted structures especially which is in warp knitted categories. What is the process and what is the techniques through which you can identify whether how many guides are interacting with each needle, how many guide bar is required to make those structures, what are other principles, how many needles which a particular guide is moving.

So all these basic informations, if you can collect just by looking to the fabric structure that will be more than sufficient. So let's move on this before I move on just a quick recap of what we covered in lecture number 3 because this lecture is going to be little bit complicated. So I recommend you, you must listen to lecture number 1 carefully because all those principles we are going to use it right now, we already have discussed about warp knitted structure.

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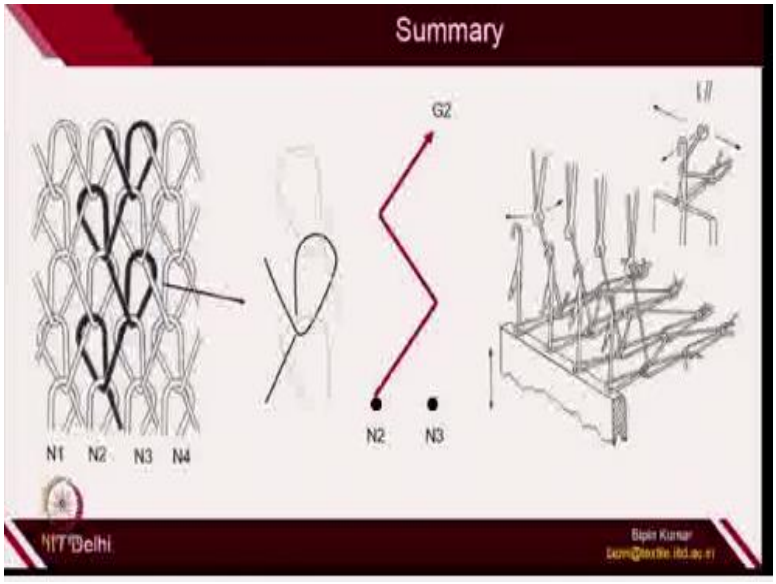

We have seen how the yarn moves from one needle to other needles ok and the guide is responsible for this. So in the last class we discussed about the movement of these guides it does not only changes the location from one needle to other needle. For doing this motions it performed certain motion in a sequence which is swinging and shogging.

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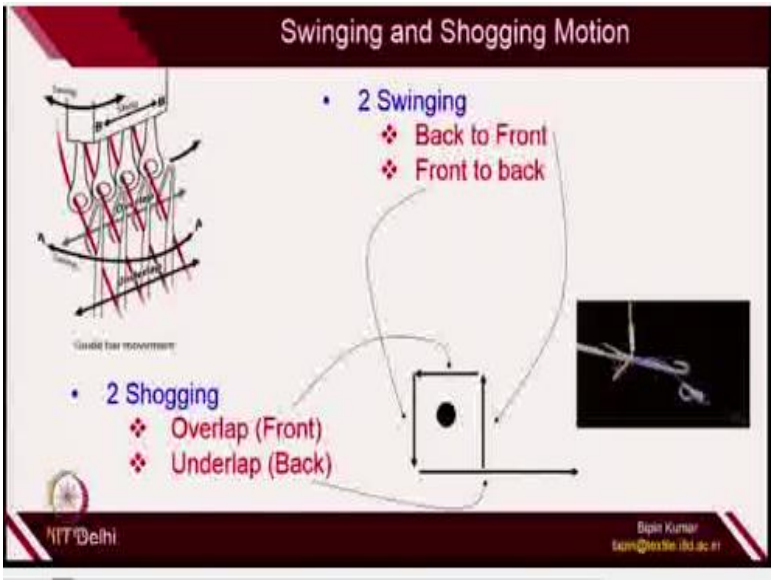

So swinging and shogging motions I described for each guide which is responsible for loop formation. So there is 2 swinging motions one is when the guide is started from the back position then it is moving towards the front side of the needle. Second when it is after providing the yarn it is moving back from front side to the back side of the needle. So there are 2 swinging motions for each core formations and by a particular guide.

So 2 swinging and 2 shogging, shogging motion is nothing but the displacement of guide along the direction of needle bar ok. So that directions which is shown in the arrow, so this is the lateral displacement. So one is on the front side of the needle this is called overlap which is on the front side of the needle and the second one is called underlap which is on the back side of the needle. So overlap is always for one needle pitch underlap can be switching from 1 pitch, 2 pitch, 3 pitch.

And because of that you will get different nature of fabrics, if you see this particular animations swinging, overlap and another swinging is described here. So first swinging, so you can see it here the guide is swinging then overlap and then second swinging. And after that the guide is moving on the back side because it has to change the needle location. So this is how swinging and shogging motion is important.

Now I am going to show you many types of fabric samples where the structure is only different because of the movement of either underlap and overlap. Swinging motion remains same in almost all the fabric structure which you see in the market. The only difference in different fabric structure is comes because of the overlap and underlap movement.

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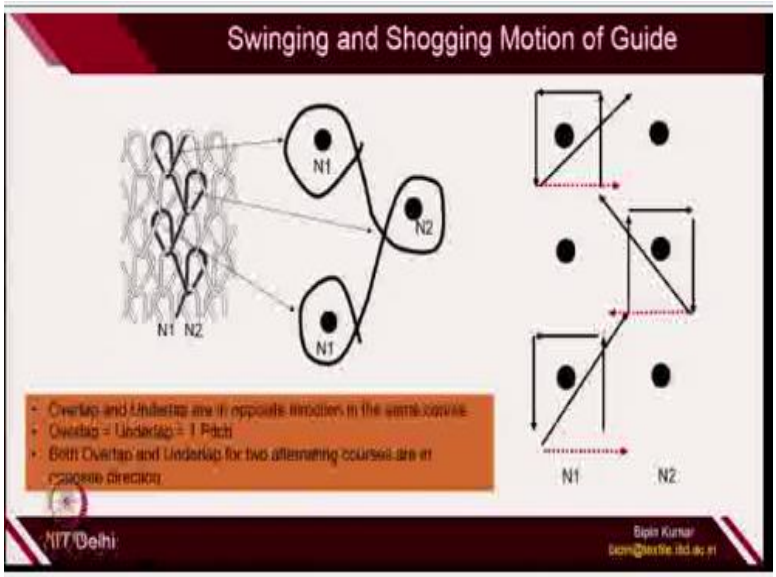

In the last class I give you 1 hint for basic simple structure, so first guide actually provides loop to the needle N1 then N2 second needle. Then N1 in the third course and this is how the swinging and shogging motion was happening. I also mentioned like overlap and underlap in each course are in opposite direction there are certain fabric structure where you will find overlap and underlap in same directions.

But when once in the subsequent lectures I will demonstrate those type of fabric structure also, but this fabric structures where overlap and underlap are in opposite direction. So you can see in this particular course when this loop is being created. So in this course the first overlap is on the right to left direction and the underlap is from left to right direction. So the directions are opposite, although the magnitude is same.

Also we have seen the both overlap and underlap in alternating courses are in opposite direction. So we have seen like in the first course the overlap is from right to left, in the second course the overlap is from left to right, so these 2 directions are opposite. Similarly if you see the backside first underlap is from left to right, second underlap is from right to left, so and this is how the motion was repeated ok.

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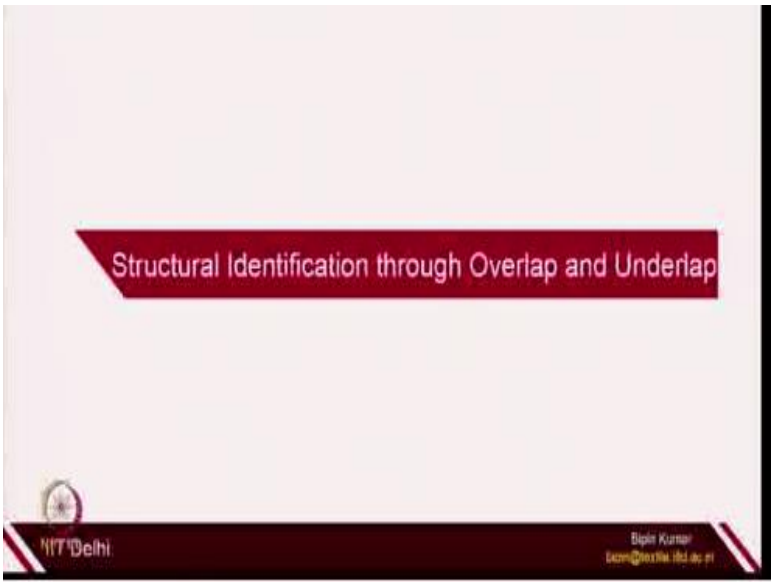

Now this idea of overlap and underlap is very very important because whenever you see the fabric structure what you exactly need to do is like you need to first analyze the movement of

each particular yarn in the fabric structure. And with that you would be able to see how the overlap was happening and what was the amount of underlap and what was its directions. Let me show you the most simplest one the fabric particularly this fabric before I give the description of this one.

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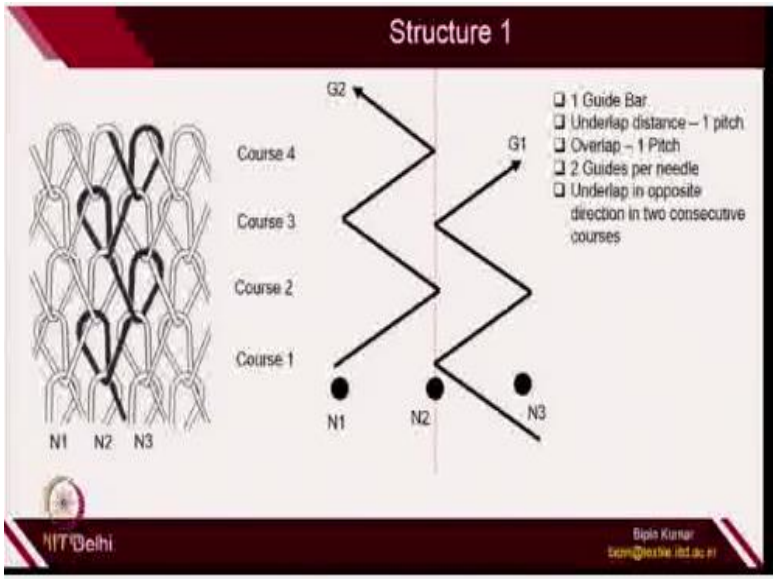

Let's see the this fabric actually which is with me in reality, so let me show you the fabric which I am showing in the slide.

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So this is the fabric I have zoom because in reality the pores is very very small, so you need to either use microscope or high zoom camera through which you can able to analyze the yarn. So once this type of figure is known to you, you can follow the path of the yarn. So the path of the yarn if you carefully see whatever I shown you in the schematic, if you carefully see this structures each guide bar is actually moving from one needle to other needle, one needle to other needle, so they are switching from 2 alternating needles in alternating courses.

So the structure which this fabric represent is nothing but this is the structure which is represented by this fabric ok. So this is the structure of the fabric, so in reality you would not be able to see because the yarns are very very small, the thickness is very very small. But if you

follow the path of each yarn by zooming this fabric you would realize the yarn is moving in this way.

So the yarn is actually not moving rather the guide bar is moving in this way, the guide bar is switching position from one column to other column, then one column to other column. So if I can zoom it for you, observe, so if you carefully now see the schematic of the fabric is exactly matching with the real photo of the fabric. So immediately when you see this type of structures where the loop is tilted left side and then in the next course the loop is tilted on the right side.

So if you see the actual fabric photo, so this is the same, so loop is tilted towards the left side, here the loop is tilted on the right side, then loop is tilted on the left side, then loop is tilted on the right side. So this portion and this portion is visible in this fabric, so if you try to carefully look again. So if you carefully see, so the loop is tilted left and then one single yarn is going in the second course then the loop is tilted towards the right, then again the loop is tilted towards the left.

So this is how the yarn is being provided although this is very very small I cannot point it on the fabric because the fabric dimensions is very very small. But the schematic is hopefully it should be clear to you, so this is exactly the same thing. So the loop was tilted on the left, then it is tilted on the right then again it was tilted on the left and then it was tilted on the right. So this is how the yarn was moving, at least the magnifying image of the fabric will give you some hint. So now let me explain how this fabric was being formed.

So in this particular fabric as you noticed in the real fabric also, the guide was moving from one needle position to other needle position. So each guide if you see I have shown 2 guides which is denoted by G2 and G1. So each guide is switching from one needle to other needle in alternating courses. So in the first course this G2 is with N1, in the second course G2 is with N2, in third course it is again with N1, in fourth course it is with G2.

So all guides will be switching in the same way but if you follow one particular needle, so if we follow the particular needle N1. So in the first course if you see the course number 1, if you

follow this black one the yarn is coming from G1, so this is the yarn which is provided by guide bar G1 the guide G1. So the first yarn is provided to N2 in course number 1 is G1, after that in the second course different guide which is G2 is providing yarn to the same needle.

So this is the position of the needle in this vertical line, so the first loop is being formed by G1, second loop by that same needle is formed by G2, third course, in this third course but for this loop the yarn is again provided by G1, in fourth course this particular loop is provided by G2. So ideally speaking all the guides if you follow it follows same zigzag movement, so all the guides will be attached to the same guide bar.

So for making this fabric we just need 1 guide bar because the movement is symmetric for or same for all guides. Underlap distance if you see the changing of position for each guide bar it is changing from 1 needle to second needle. So that's why underlap distance is just 1 pitch, overlap if you see as I already mention overlap is always on the front side of the needle. So that will always be 1 pitch, one other thing is like for each needle you can see 2 guides are required, 2 guides per needle.

So for this needle N2, guide number G1 and guide number G2 is providing yarn in alternating courses, so 2 guides per needle. And if you see underlap in opposite direction in 2 courses, so if you see the movement of any particular guide, so this guide moves from left to right after completing first course. Then in the second course it is moving from right to left, so the direction are opposite.

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So some basic information will be very very useful in explaining this fabric structures and here underlap and overlap helps you to do the same. Now let's move to other structures which is little bit different.

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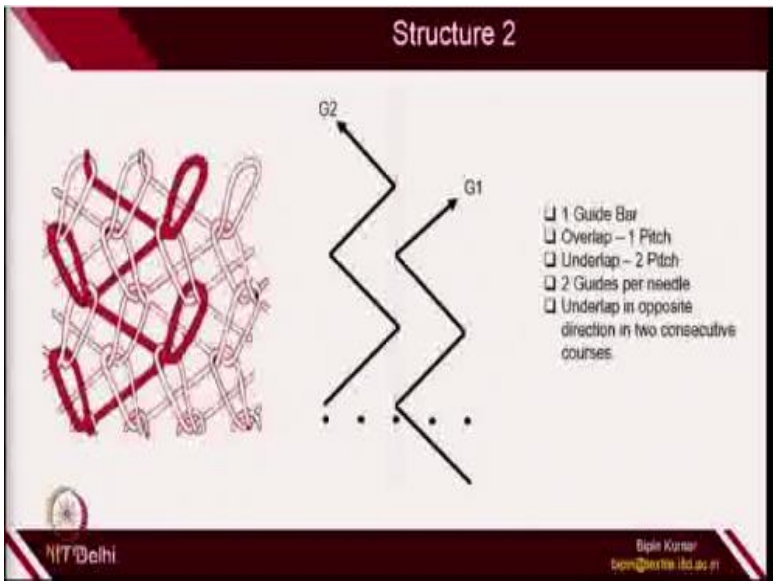

If you carefully see this structure after if you magnifying I don't have the fabric sample especially for this one . But if you magnify, if you get it in the market if you can magnify it will get this type of structure. Here you can easily see by following the path of 1 yarn, so first column the loop is being formed after that the loop is being formed on the third column, after that the loop is formed on the first column, then again third column, so first third, first third.

So the guide is shifting position from first needle then to the third needle, so each guide is shifting position by 2 pitch. So the underlap which is actually the shifting of position of each guide is basically 2 pitch, overlap will always be 1 pitch because it is always on the front side. And since the movement of each guides are same, so we need just 1 guide bar for making this fabric.

And the other difference which you can observe is if you follow the needle movement for just 1 needle you will realize in alternating courses 2 different guides are coming. So in the first course which is here guide number G1 is providing yarn. In second course which is here the guide number G2 is providing the yarn to this particular needle. In third course guide number G1 is again providing, in fourth course guide number G2 is again providing.

So again this is clearly because of overlap and underlap movements of each guides you can express this particular structures. So whenever you see these structures if you can collect these

type of information that is more than sufficient, in next class I will give you more hint how you can express this particular structures with some numbers. So that will be the fabric notations but let's try to first give the brief details of some fabric structures which you can able to analyze.

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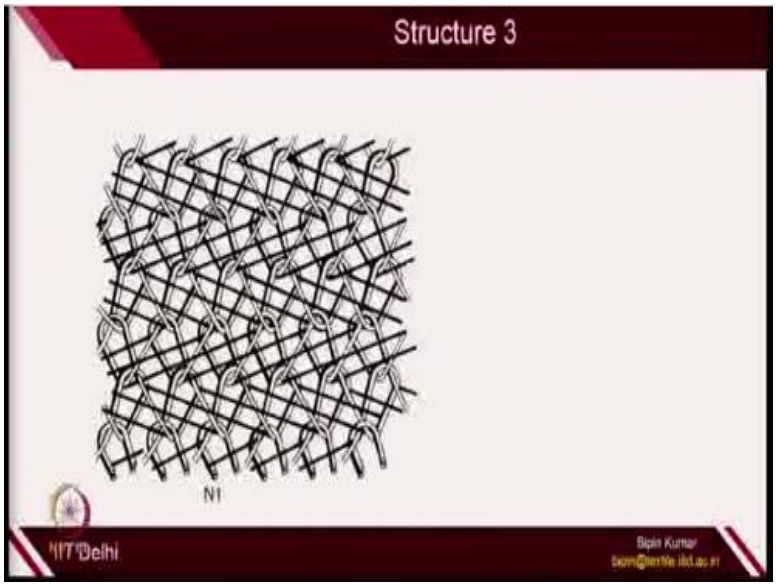

Now let's loop to the another structures, if you carefully see here this structure looks very very complicated. But if you just focus on 1 particular loop, for example if you see this particular loop you can identify 2 different colors of yarn, one is white color of the young and the other one is black color of the yarn ok. So one is white color of the yarn and another one is black color of the yarn.

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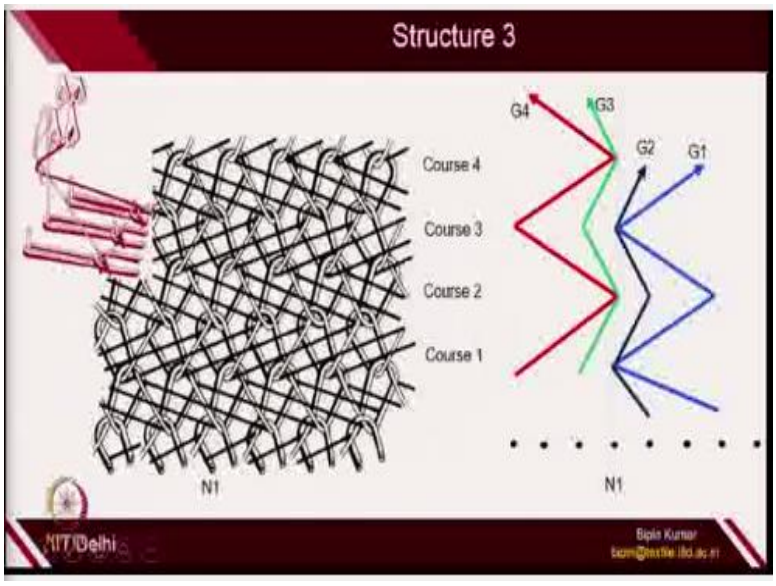

So it clearly indicates when the loop was being formed by the needle basically there was 2 guides which was interacting with the needles. So at the same time 2 guides are coming to the same needle, this is only possible when there is a 2 different guide bars ok. So one guide bar will be giving white color of the yarn other guide bar will be focusing on black color of the yarn in this fabric structures.

So this structure is basically a 2 bar structures because you need 2 guides 2 individual guides for each needle. So this is a 2 bar structure and now let's see how many guides each needle is interacting. So if you follow any particular loop let's suppose if I am following the movement of needle N1. So needle N1 is here this is the first course let's suppose this is the course 1, if we follow the horizontal line, this is the loop which is formed by the needle 1.

So if I have to make this particular loop, so basically there are 2 loops here, so one made by white yarn and another made by black yarn ok. So obviously there are 2 guides should be there, so 2 guides which is G1 and G2 which is coming to needle N1 for providing the yarn ok. So at the same time 2 guides are coming G1 and G2, one is coming after 1 pitch another one is coming after moving 3 pitch.

So if you see the pitch, so if you follow the length of black yarn which is floating you can easily see it is coming from third column from the right side. So for this particular loop if you follow the path of black yarn which is here last column, then second last column, then this is third last column and then it is providing yarn to N1. So naturally the black yarn is coming from guide number G1 which is shown here which is coming from after providing yarn after moving 3 pitch.

So 1, 2 and 3, if you see the white yarn, so white yarn is coming next column from the next column. So this is the loop and if you see the white yarn is actually attached with the next column, so it is coming from the next needle from N1. So naturally from this you can carefully see the underlap movement for G1 and G2, so G1 is only one pitch and G2 is 3 pitch. So once the underlap for the 2 guides are different it completely means this fabric must be created by 2 different guide bar ok.

So once this first course is being formed, so this particular loop is being formed after that the same needle is making loop here in course number 2. So in course number 2 if we follow the horizontal line this is the loop, so for making these this particular loop again white yarn and the black yarn has to be there. But that black yarn and white yarn is coming from the left side, so from 2 different other guides, so this is the course number two, 2 yarns are provided to N1.

So one is coming from guide G3 another one is coming from guide G4, so this is the loop and the yarn is coming from the left side. And in course number 3 if you go to course number 3 follow the horizontal line and this is the loop. So again the yarn is coming from the left side, so the same 2 guides which is G1 and G2 it is coming back to the same needle N1 and in the course number 4 again G3 and G4 are coming.

So this structure is different in many ways because each needle is interacting with 4 different guides G1, G2, G3 and G4. Also the underlap movements of these guides are different, so we need to have 2 guide bar for making this fabric. Because a one guide bar the underlap is 3 pitch, for second guide bar the underlap is only one pitch.

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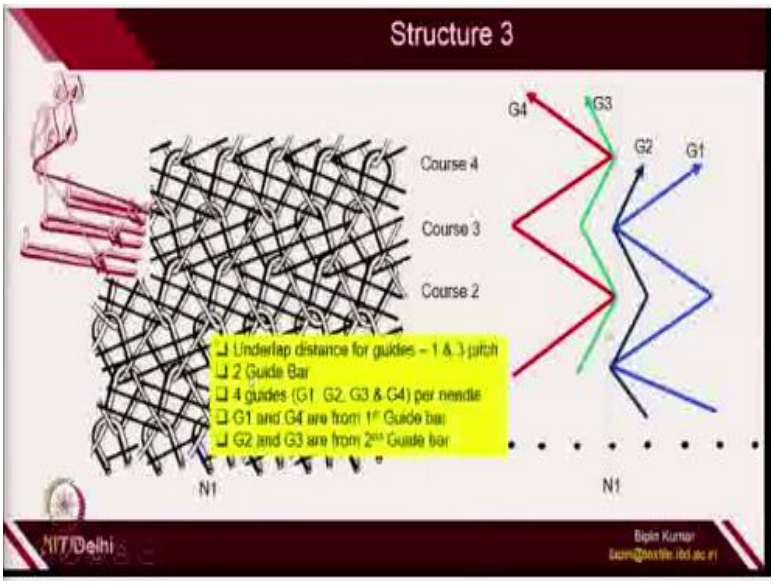

So some basic information which you can extract by looking to the fabric itself is underlap distance for guide is, so 1 and 3 pitch. Because the underlap distance is different, so that's why we need to have 2 different guide bars, one guide bar will be having 1 underlap movement by 1

pitch. Another guide bar will be doing 3 pitch lateral shift, so these guides must be attach to different guide bars, 4 different guides are required per needle which you can show it here.

So if you just follow the path, so G1, G2 and G3 there will be coming, so G1 and G4. If you see G1 the blue one and the red one they have almost similar movements, so these similar movements can be attached to the same guide bar. So G1 and G4 you can imagine it must be attached with first guide bar and if you follow the movement of G2 and G3 guide bar their movement are also same, so they must be attached with the second guide bar ok.

So this is how you can identify a double bar fabrics where 2 loops will be formed and 2 guides will be interacting with each needle. So I have 1 double bar fabrics which you can able to analyze.

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So this is a double bar structures which you can see it here, so you can clearly see loop is tilted but there are actually 2 yarns which is provided to each needle. I have also single bar structures for you to just compare how they are different. So you can see this is a single bar structures, so in single bar structure you can see if you follow the path of one yarn you can just see one single yarn after providing yarn to one needle it is moving towards there is only one floating length of yarn which is visible.

But if you see this particular fabric, so on each loop left side or right side 2 floating yarns are visible. So because of that you can say this is clearly a double bar and single bar structure, so I have also the schematic also incase if you do not understand.

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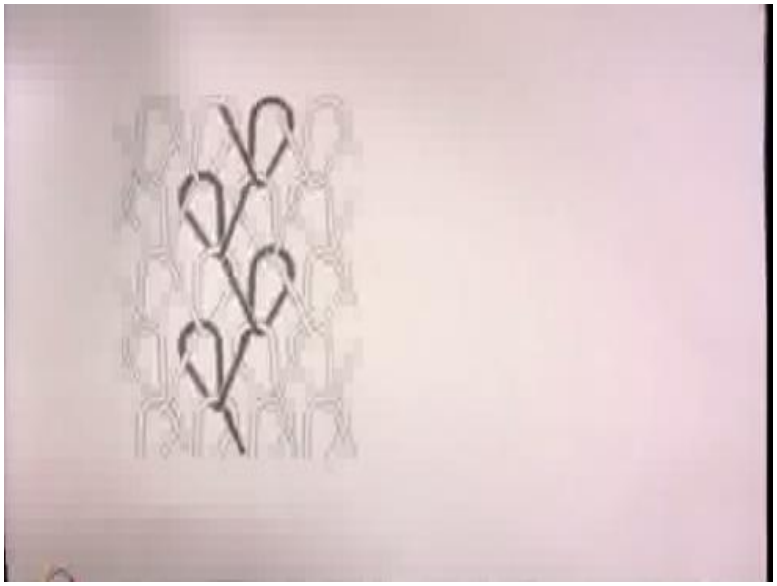

So this is the schematic part, so how this is different is you can see after making the loop it is just one floating yarn was there, so this is one floating yarn.

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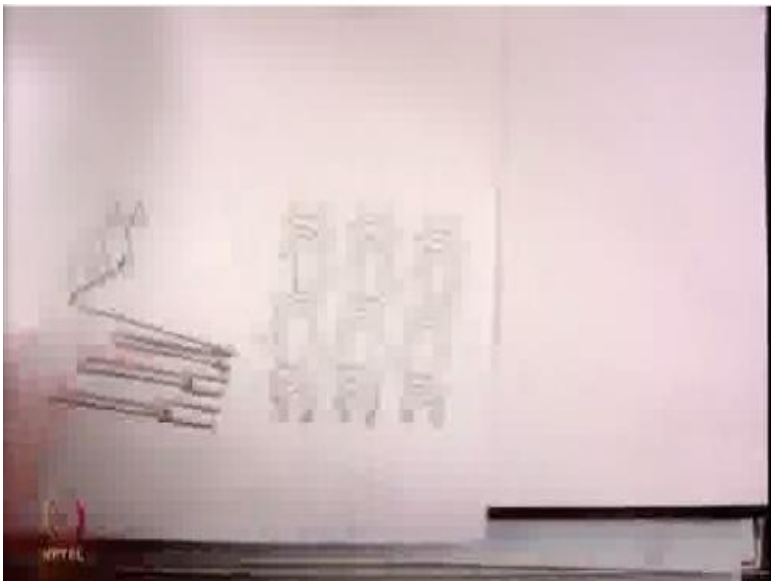

But if you see any double bar structure, in any double bar structure there was 2 floating yarn which was visible. So you can see here there are 2 floating yarn, so you would be able to identify whether it is a single bar structure or double bar structure.

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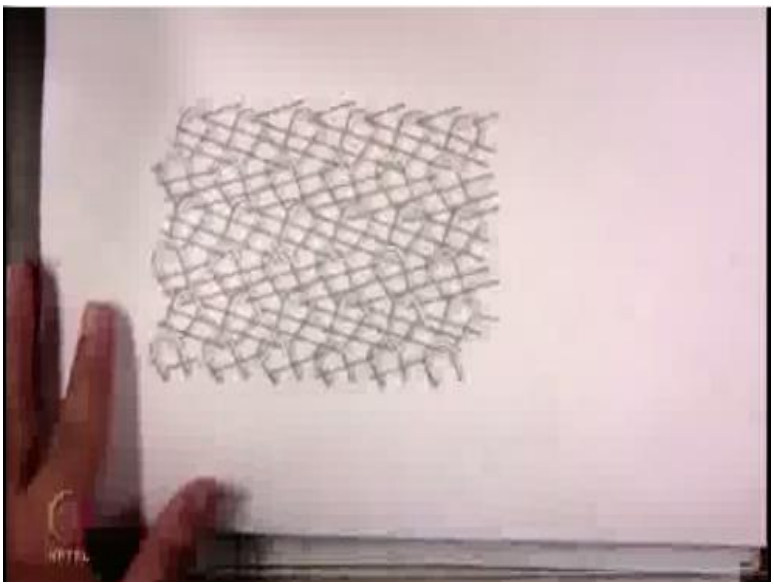

Similarly also I have another double bar structure.

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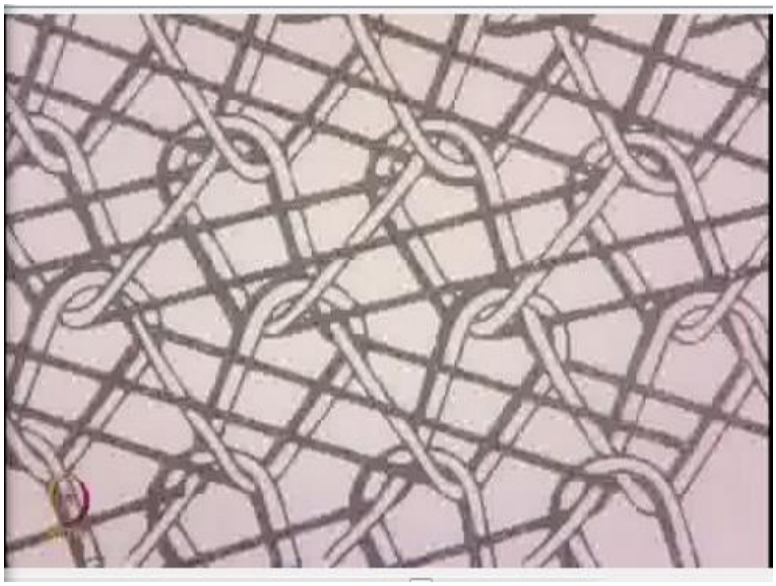

If you see carefully, so after making each loop there are 2 floating yarns. So one is white floating yards and one is black floating yarn, so the moment if you see 2 floating yarns from one loop to other loop you can clearly identify this must be definitely a double bar structure ok.

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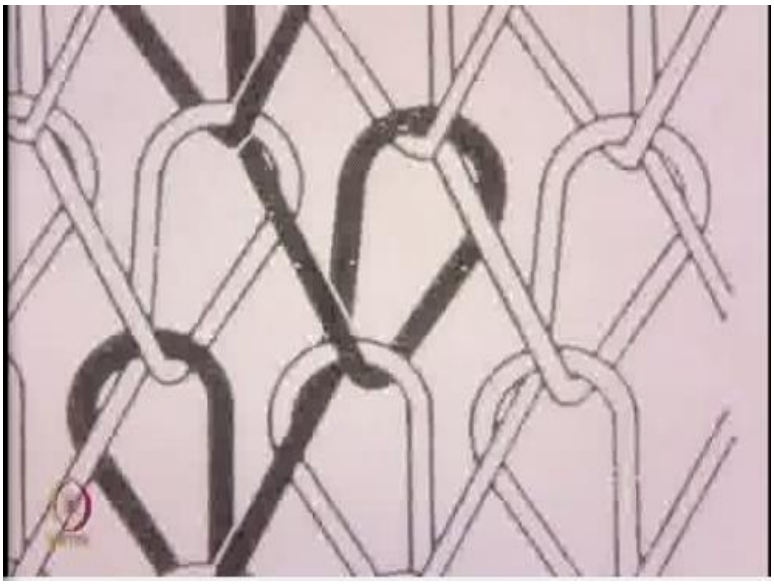

And if you see just one floating yarn between 2 loops if you see between 2 loops if you see just 1 floating yarn, you can clearly indicate this is single guide bar so warp knitted structure. So this is how you can make some distinctions, I know this is little bit complicated, but at least if you magnify and try to analyze you can describe many things about a particular fabric structures.

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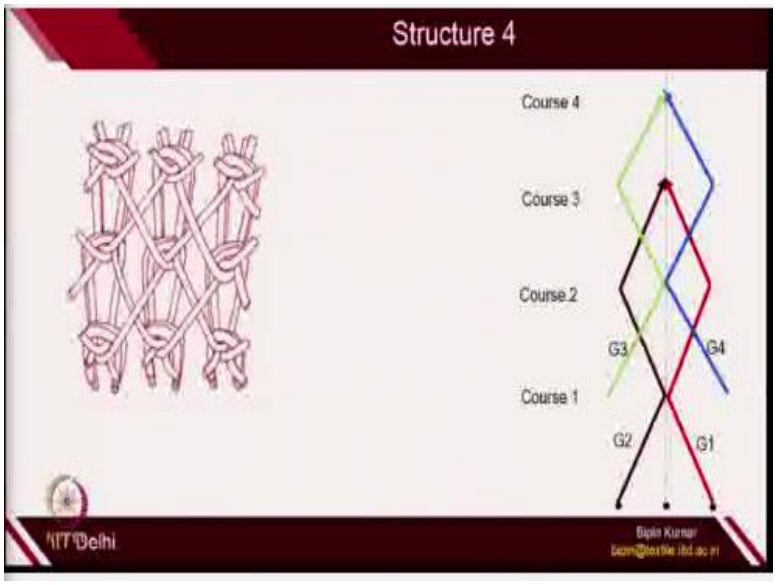

I have some other examples also if you see this particular structures again there are 2 floating lengths between these 2 loops, so definitely it must be 2 bar structure. In the first course if you follow this particular loop, so one yarn is coming from left side another yarn is coming from right side, so for example if you follow this loop. So one yarn is coming from right side other yarn is coming from left side, so for this particular loop.

So let's suppose if this particular needle is making loop 2 guides is coming 1 from right side 1 from left side so in this particular course. After that in course number 2 another 2 guides will be coming one from left side one from right side, so G3 and G4. After that in the third course again G1 and G2 will be making, in course number 4, G3 and G4 will be coming. So if you want to describe some of these features of this particular structure.

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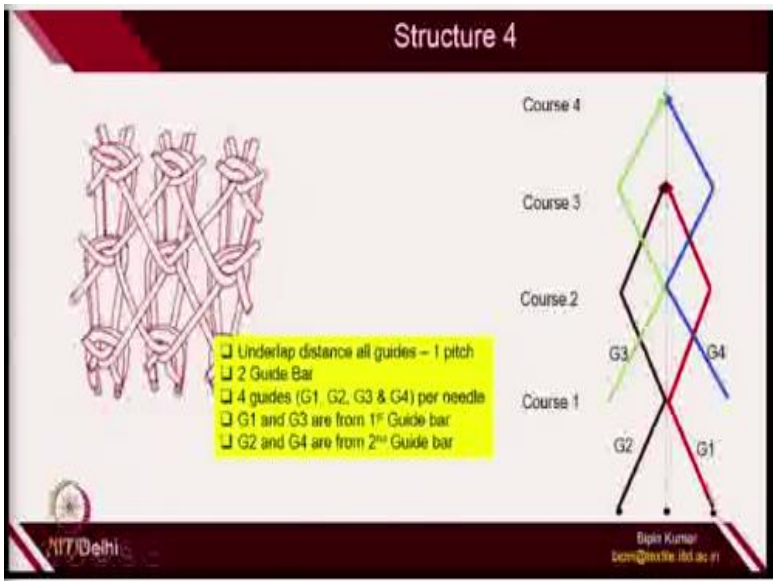

So here the underlap distance of all guides is just 1 needle, so you can carefully see. So all guides are just moving by 1 pitch, its a 2 guide bar structure the direction of movement is different. So for example if this guide bar is moving from right to left this one is moving from left to right. So this is not possible if the guide is attached with the same guide bar, so definitely G1 and G2 must be attached with different guide bar.

And for each particular needles 4 guides are interacting during the fabric formation G1, G2, G3 and G4 which is shown by different color. So G1 and G3 are from first guide bar, so G1 and G3 because they have same movement so if you follow the red one and green one they have same movement. And G2 and G4 if you follow the black and blue one they have the same movement, so it must be from second guide bars.

So, these features sometimes are very very useful for describing any warp knitted structure.

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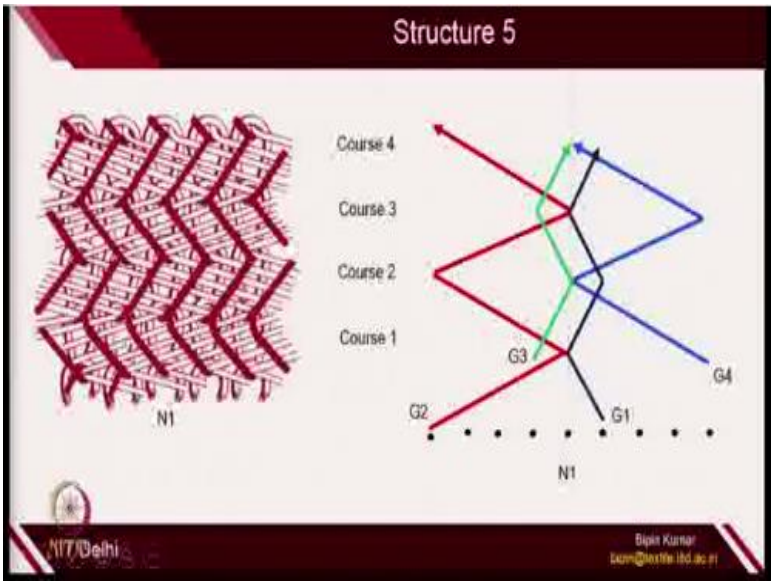

Again this is another one if you carefully see one guide bar is moving from one needle to other needle and the second guide bar is moving 4 pitch. So in the first course the first yarn is coming from right side which is from G1, second yarn is coming from left side from G2 and the pitch is different. So the underlap here is up to 4 needle and here is just 1 needle, so after making first course, in the second course to another guide is coming, so one from G3 another from G4.

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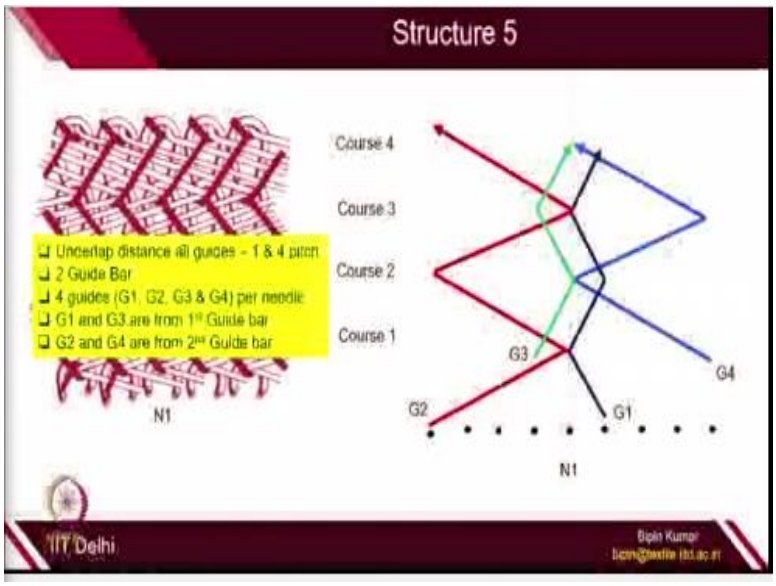

So this is also one of the structure, so underlap distance of all guide is 1 pitch and 4 pitch and this is definitely a 2 guide bar structure. And there are 4 guides for each needle there are 4 guides, G1

and G3 if you see they have the same movement. So they are from the same guide bar and G2 and G4 have the same movement, so they must be having from different guide bar.

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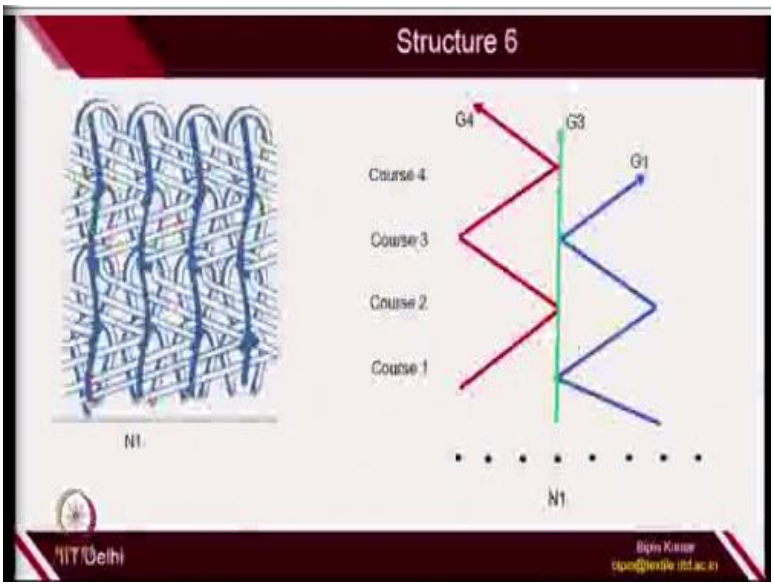

Finally the last structure, structure number 6 which is also made from 2 guide bar structure but there is some basic fundamental difference here. So if you see here if you follow the blue yarn it is just moving in the same needle. So it is just making loop in the same needle and the white one is shifting from one position to other position. The white one is going from first column to fourth column, so so one guide bar is moving from first column to fourth column and one guide is just giving yarn to the same needle.

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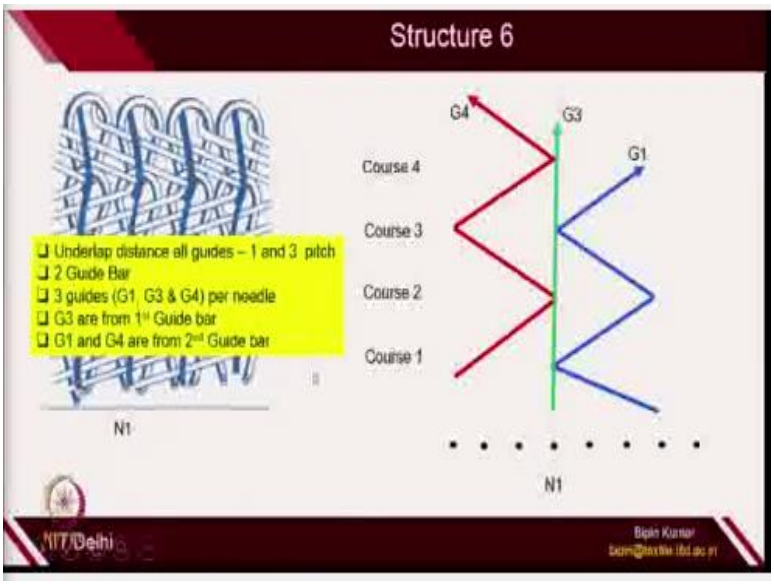

So this particular structures we have 3 guides G1, G3 and G4, underlap distance is 1 and 3 pitch, 2 guide bar. Because G3 movement is different and G1 G4 movement are same, so G1 and G4 must be attached with the same guide bar, G3 must be attached with the first guide bar. So this is how this structure is created, I also have the fabric with me for showing you this structure.

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So let me show you, so this is the actual fabric where black yarn is actually moving in the same needle. If you see this black yarn, so it is moving in the same needle ok same line and the green yarn is actually switching. So the green yarn is having underlap of one needle position and the black yarn is the guide which is providing the black yarn to that needle remains on the same needle and making the loop.

So this is how these structures of warp knitted can be analyzed, I know this is a little bit difficult but obviously the warp knitting is slightly difficult than weft knitting. But understanding of swinging, shogging, overlap and underlap is very very important for analyzing these structures.

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So with this I am ending this particular lecture, so let's summarize it.

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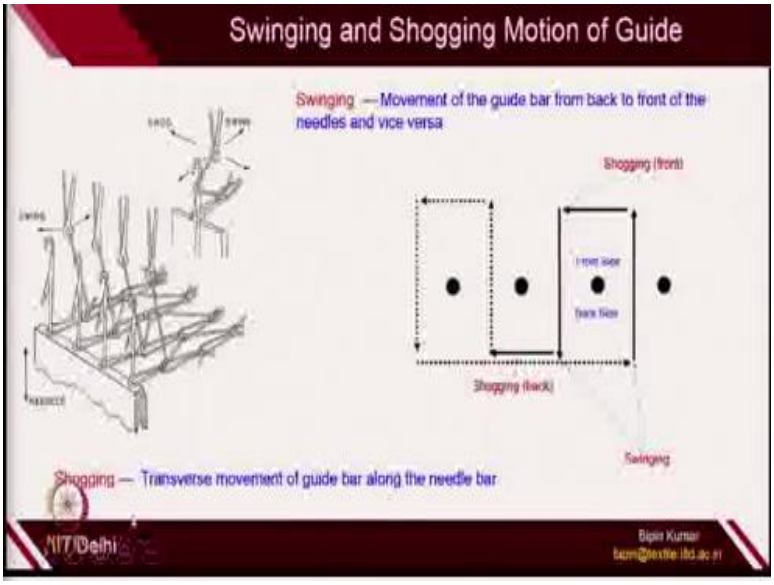

So swinging and sawing you need to very very carefully understand especially the shogging motion at the backside which decides the different types of fabricate structure. In this particular lecture I already showed you 5 to 6 type of different fabric structures and single bar structure, double bar structures, I also give emphasis on how one needle is interacting with different guides during different courses.

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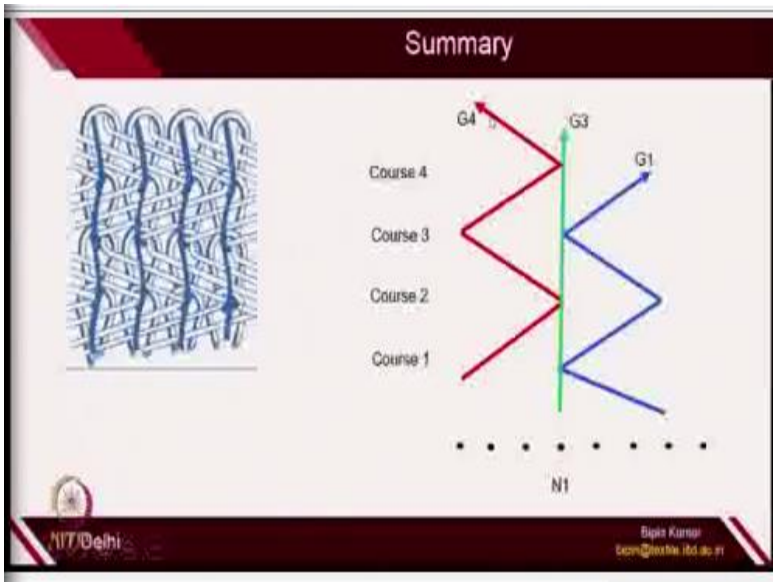

I also explained you some of the basic structure how you can define this, in each different courses, different guides is interacting with same needle. So for example if you see this particular needle, so first time for making 2 loops the yarn is coming from guide number 3 and guide number 1. In second course the yarn is coming from guide number 4 and guide number 3, in third course the yarn is coming from guide number 1 and guide number 3.

So in this way you can at least analyze like this is a double bar structures because the underlap movement is different. And also it is a 2 guide bar structure and 3 guides per needle is required to make this fabric structure. So in the next class I am going to help you in describing the fabric notations because if you carefully see all of these structures can be just explained by these simple lines which is shown by the movement of guide bars.

So if you just describe this fabric with the movement of guides you would be able to represent the fabric structure. So that I am going to explain in the next class, thank you very much stay tuned.