**Science and Technology of Weft and Warp Knitting**
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**Lecture-38**
**Swinging and Shogging Motions (Overlap and Underlap)**

Welcome participants to week number 9, in this particular lecture the topic is swinging and shogging motion. And in shogging motion we are going to describe overlap and underlap, so in most of the warp knitted structures which you will encounter in daily routine whenever they are produced on these machines swinging and shogging motions is actually responsible for making the loop in the warp knitted structures.

So if you understand swinging and shogging motion carefully then you would be able to analyze any warp knitted structures which you will encountered in life. So let's start this lecture, before we move on just a quick recap of what we covered in the previous classes, because this particular topic is actually linked with the previous one. So I hope you connect with the previous topics that will help you in understanding these 2 particular motions.

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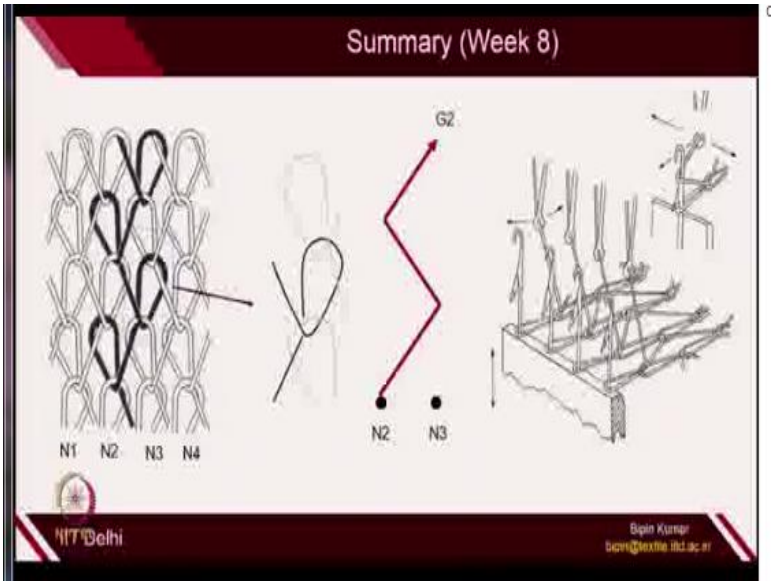


In the previous week we started a new structure which is the warp knitted structure which is completely different from a weft knitted structures. So in a warp knitted structure we have seen

the loops are generally in a tilted position which is not the case with a weft knitted structure. So why this particular loop in a warp knitted structure is tilted because the feet or you can say the sinker loop.

If you try to follow this particular loop the sinker component is actually connected with 2 different courses. While in case of a weft knitted structure if you see any particular loop the feet or the sinker loop of that particular loop was connected with the adjacent loop in the same courses. But unfortunately in the warp knitted structure if you see this loop it is sinker loop or the feet is actually connected with different courses and since the direction of this sinker loops are in the same directions.

Because of that the force which is created by these yarns resulted the loops in a tilted position. So if you carefully see the yarn movement in a warp knitted structures actually the yarn is moving from one column to another column. So if you follow the path of the yarn, so it first move to the column number 2 and then it is moving to column number 3, then it is moving to collar number 2 then 3.

So similarly all the yarns which is used in a warp knitted structures they actually follow the direction of length of the fabrics this is why this type of fabric is called a warp knitted fabrics. Because the yarn is moving in warp direction or the length direction of the fabrics. In the last class we also tried to understand how this is possible, this is possible because of the placement of guide which takes the yarn from one needle to another needle.

So the guide is responsible for feeding the yarn to different needles in alternating courses. So if you see the actual machine this is the schematic where the needles are placed on a bar and these are the individual guides which is shown here. And each guide is carrying one warp yarn and these guides actually feed the yarn to individual needles. So after feeding one yarn to one particular needle this guide actually changes its position from one needle to another needle in alternating courses.

So this is what we try to understand in the previous classes and this is the fundamental principle of a warp knit fabric production.

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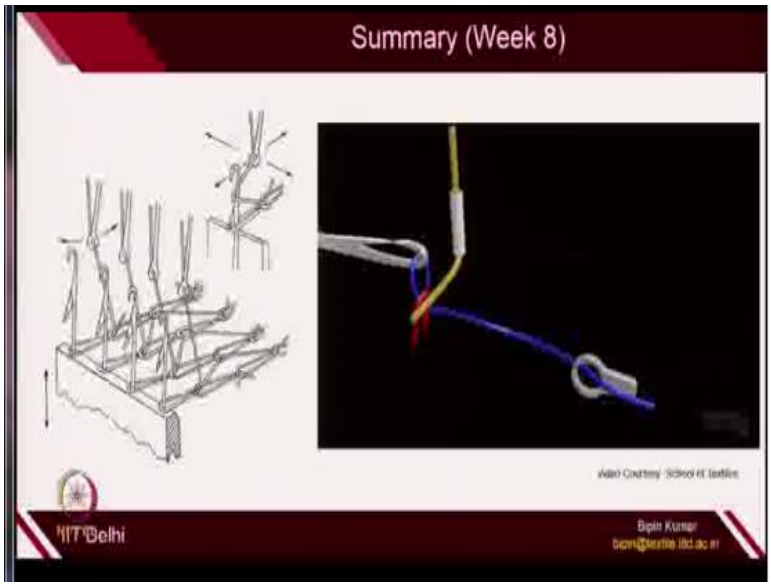


This is the schematic how the guide bar actually provides the yarn to the needle and loop is being formed. So here although you can see the 4 needles and 4 guide bars but in reality one guide bar is responsible for providing the yarn to one particular needle. So here I am showing the loop formation through one needle and one guide bar, so when they interact how the loop is being formed.

Similarly a series of needles and a series of guide bar will be doing exactly the same functions and the whole fabric will be generated, so let's see what exactly is being done.

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So the principle remains same the old loop comes out then the new yarn is feed and then old loop is knocked out from the surface. So the principle of loop formation in a warp knitted structure is no different than a weft knitted structure. So in a weft knitted structure if you remember the loop formation process first the old loop slides through the latch and then old loop is clear then the yarn was feed to the needle and after that the old loop slides through the latch and knocked out from the surface.

So the principle of loop formation is almost similar the only difference here is, now here the each needle is feeded by individual guides. So this is the guide which is shown here, so which is shown here also, so each needle will be getting yarn from one particular guide in a particular course. This is not the case in case of weft knitted structures, so in a weft knitted structure whenever we are making the entire course in a fabric the same feeder will be providing yarn to all the needles in one course.

But here when you want to create a entire course in the fabric structure, you need to have multiple guides depending on how many needles are operating on the machine. For example if you are using 100 needles on the machine.

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Then you need 100 warp yarns which will be attached to individual guides and that guide will be feeding yarn simultaneously for the entire course formation. So for making a course in a warp knitted structures you need multiple guides and they will be feeding yarn to their respective needles. So this is how the principle and the machinery is different in warp knitting technology and weft knitting technologies.

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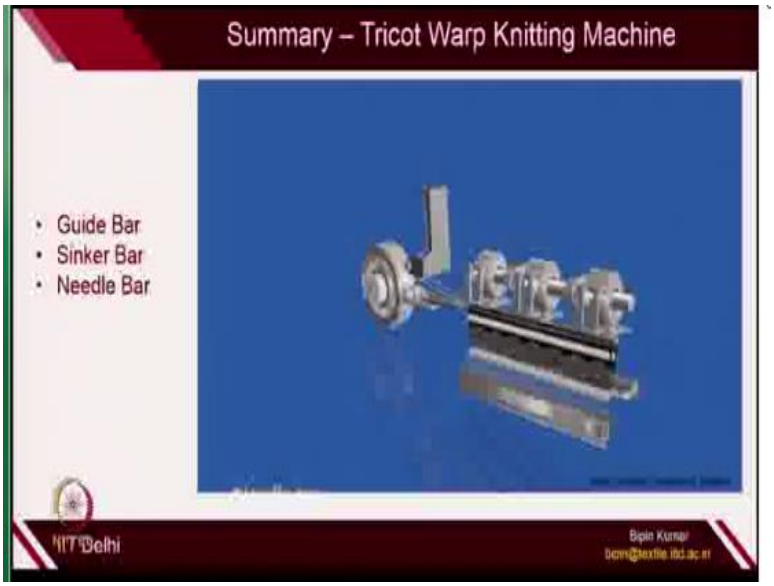


In the last classes I also introduced one simple machine which was tricot warp knitting machines. In that machine I showed you there was 3 bar, so bar is a long rod on which individual guides

sinkers and needles were placed. So any warp knitted structures probably when they are produced on a tricot machine they have the interaction of 3 basic elements on the machine which is the guide, sinker and needle.

So these 3 individual elements of the machines are placed on their respective bars, so this video will show you how these guide sinkers and needles are placed on the machine.

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So, so this is the first entire bar of sinker, sinker bar and sinker bar is collecting sinker blocks, so you can see this is one block of the sinker and in each of these blocks individual sinkers were placed ok. Similarly you have the entire bar of guide, guide bar, so this is the entire bigger rod and on this rod individual guides block were placed. So this is one block of guide and you can see multiple guides here, so each guide will be carrying 1 yarn.

Similarly you have the needle bar where needles are placed along the row, so whenever the machine is in running conditions these 3 bars will be interacting. Because of that the elements which is attached on these bars will be playing certain motions and that motion has to be synchronized for the formation of loop. So if you remember the weft knitting technologies there we have the cam profile and the needle butt, the motion was carefully designed.

So that the entire process of loop formations can follow a certain sequence. Similarly here the movement of all of these 3 bars are synchronized in such a way that they can generate multiple loops together.

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So here is the actual machines on which 1 block of sinker, 1 block of needle and 1 block of guide is being placed, so you can see this video also.

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So I showed this video in the previous class also, so you have the needle which is going up and down and this is the block of guide which is placed on guide bar and this is the block of sinker which is shown in by the arrow which is placed on the sinker bar. So there are 3 bars sinker bar, needle bar and guide bar and this is at very high speed these 3 movements are going on. So in this class we will try to understand how this movement was done and what is their function.

Because this motion of each of these bars is extremely important in loop formation, so we will try to understand these motions and with the help of these motions we would be able to analyze different fabric structure. So in this week you would be able to understand how those fabric structures are created and what is the role of this motions which you can see it in the video play a important role and this is the actual fabric which is being produced.

In reality when you stand in front of the machines it will be difficult for you to understand what exactly is happening. So ideally speaking you need to break down each of these movements of individual bars to understand the fabric formation. So in the entire week we will try to focus

more on these individual movements and then we will try to generalize different fabric structure out of it.

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So you will at the end of these weeks you will be able to understand how you can play with the designs of these motions through which you can generate multiple types of fabric structures.

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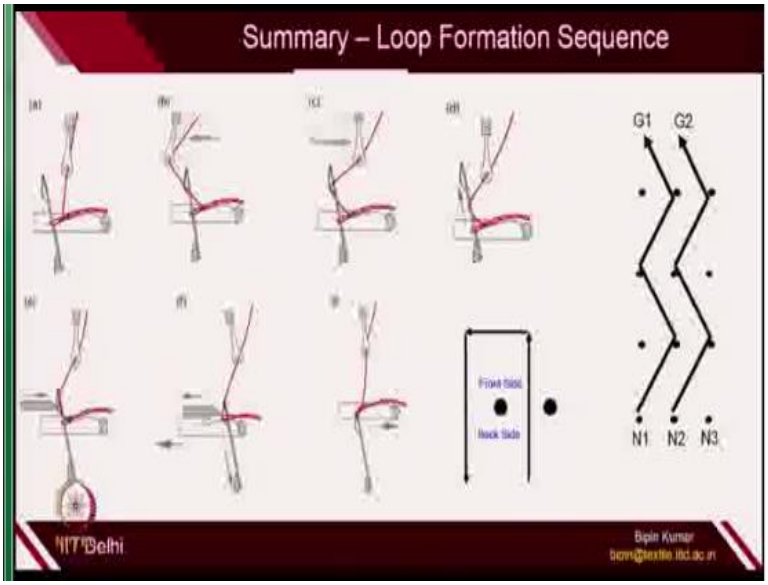


So in last class I give you a hint also, in the tricot machine how these 3 elements on the machines interacts. So you have the guide which is standing in the backside of the needle and then the guide moves from backside to front side. So this is the backside where the guide is standing, so each guide is standing in between the needle, so that it can swing from backside to front side.

So here you can see the guide is standing here and the guide can swing from backside to front side which is shown by the arrow. And after that after swinging it feeds the yarn to the needle, so for feeding the yarn it traverse along the needle bar and then it swings back to the original position. So this is how it provides the yarn, after that there is a roll of sinker, pressure bar that is also important. But for us in this particular week we will be trying to concentrate only on the movement of these guides.

Because these guides is very very important if you change the movement of these guides you can play with different structures. So you can see here like in the first course this G1 guide which is feeding yarn to N1. After that in the second course it is feeding yarn to N2 needle then it is coming back to N 1 and then N2. So in this way each guide bar is following its path and helping in feeding the yarn to the individual needles in loop formations.

So this is what we covered so far in the previous week, now we will try to break down each of these movements more carefully because the structures you have seen the warp knitted structure are very very complicated. So the complexities come because of this movement of guide bars, so we will try to focus more on this movement of guide bars.

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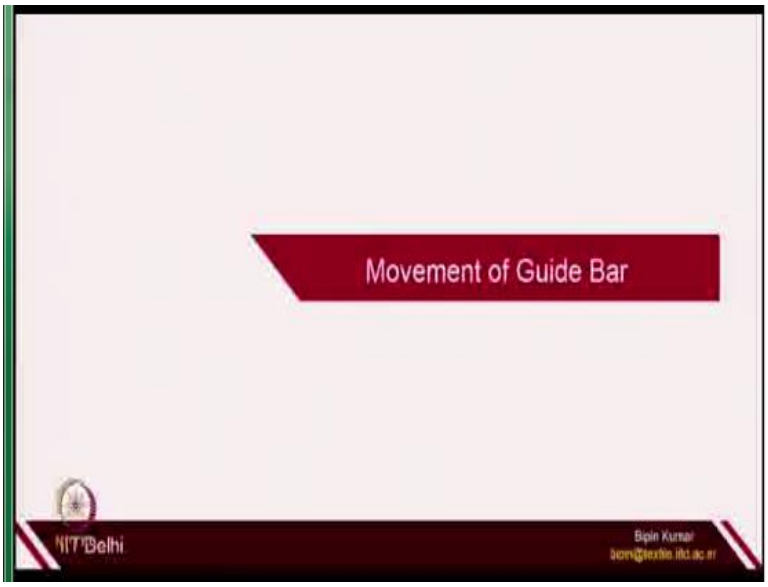


So let's break down the movement of guide bar once again because this is the fundamentals here and that's why I am emphasizing again and again on the movement of this guide bar.

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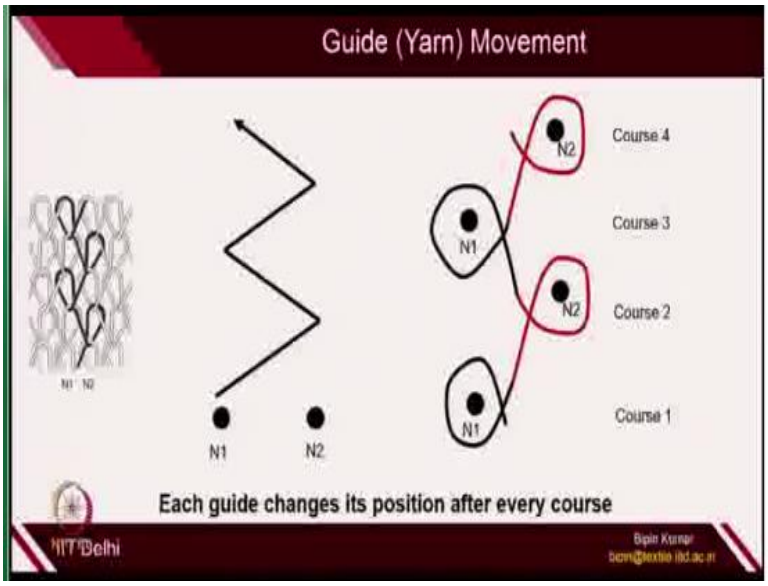


So this is the simplest structures through which I started last week, so here you can see if you follow the black color of the yarn you can easily see that the yarn is moving from needle N2 to then N1 then N2 then N1 in 4 courses. So in the first courses the black color of the yarn is with N2 needle, in second courses it is with N1 needle, in third course it is with N2 needle and in fourth course it is again with and N1 needle.

So this is how it is moving, so first it make the loops on N1 then it makes the loop on N2 then it makes the loop on N1 then again N2. This is how each individual guide which is attached to that guide bar will be following this sequence. So each guide on the machine will be switching from one needle to other needle in alternating courses. So in first course it is with N1, in the second course the same guide is moving to N2 needles.

So each guide changes its position after every courses, so this is with each guide and there are almost 1000 guides are there on the bar. So all guides will be doing exactly the same function, so if you understand the movement of 1 guide bar eventually you are understanding the movement of all the yarns in the fabric structures. So to express this fabric structures you don't need to draw all these complicated diagram, you can simply follow the path of one guide.

So the movement of guide bar is very very important because it will be very easy to express the entire fabric by the movement of simple 1 guide bar. Because all other guides which is there on

the same guide bar will have the same movement, so this is why the movement of guides are important.

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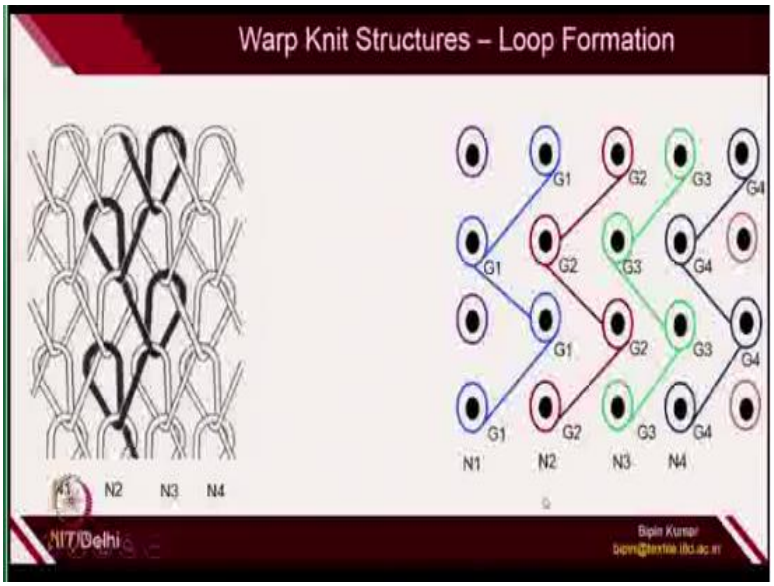


Other important thing which I already mentioned in the last class was when you are following all the guide bars you will realize that in the first course each individual guides will be giving yarn for the loop formation to each individual needles. But in the second course the needles will be receiving yarn from different guides ok. So in the first course G1 is giving yarn to N1 needle and in the second course the same guide is giving yarn to N2 needle.

Similarly if you go for third course this G1 will be giving yarn to N1 needle and in the fourth course again it will be giving yarn to N2 needles. But if you simply follow the movement of 1 needle, so if you see the vertical line here with N2 you will be finding that to provide the loops the N2 will be interacting with 2 guides individually. So the first guide is G2 and the second guide is G1 and these are repeating in alternating courses.

So, first course G2 is giving yarn to N2, second course G1 is giving yarn to N2, and third course G2 again, in fourth course G1 again. So first and third are repeating, second and fourth are repeating, so ideally speaking not only guide is shifting position from one needle to other. But also needle is receiving different yarns from different guides in different courses, so each needles actually interacts with different guides in different courses.

And this is how the fabric is getting formed, so to express this fabric you need to also understand how many guides will be interacting with each individual needle and how many needles will be interacted by each guide, so these 2 observations you have to follow very carefully. So in the previous slide your observation was with one guide, so one guide is moving to 2 different needles in the entire fabric structures.

And in this particular slide each needle is interacting with 2 guides ok, so these 2 observations is very very important.

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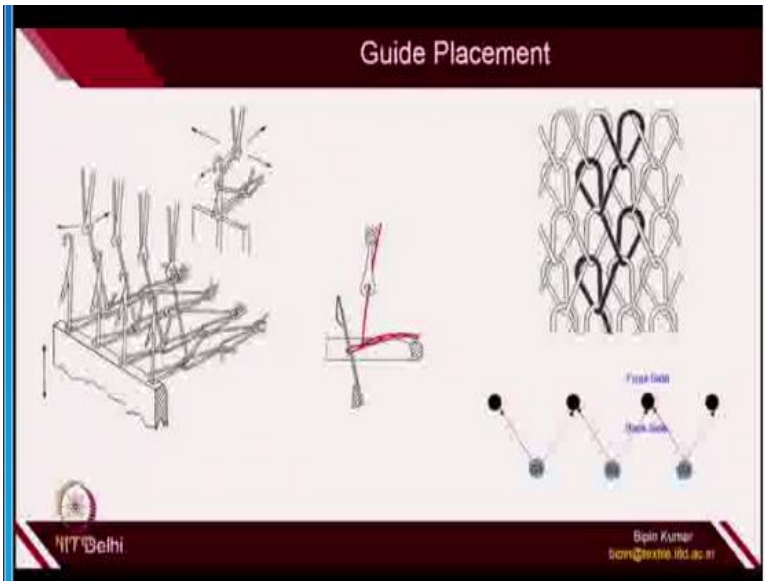


On the machine the placement of the guide is extremely important because whenever you start making fabric you need to first define which guide will be associated to which needle in the first course and how the movement of each guides will be there. So that in the second course which guide will be changing the locations to which needle, so definitely needle and guide interactions you have to carefully analyze.

So for example if you see there are 4 needles on this bed, so for each needles one guides will be associated. So for example this G1 is associated with first needle, G2 is associated with second needle and G3 is associated with third needle. So in the first course these 3 guides will be

providing yarn to 3 different needles, after that because the movement of guides are like that, first it provides yarn to the left needle and then it is providing yarns to the right needle.

So the first course this guide is providing yarn to this needle, in the second course the same guide is providing yarns to other needles, so they are switching the position. So this position is very very important that's why we need to observe the movement if you want to see in reality, so I have again with me the block of needle and block of guides.

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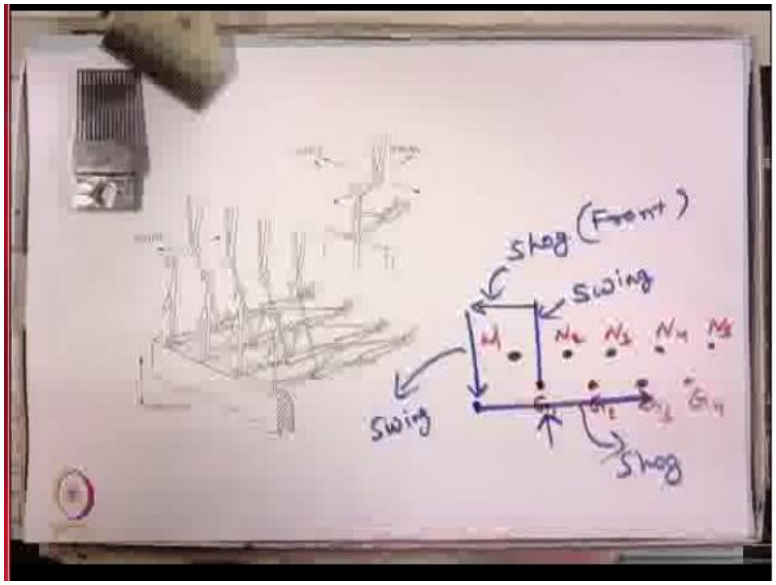


So let me show you the exact positioning,

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This is how one block of guide is there and in this block you have individual guides ok. So at present you have almost more than 25 guides on this block and this is one block of needle. So at present I can count almost 10 needles on this block, so this is the front side of the needle and this is the back side of the needle. So in reality if you see this diagram, so each needles can be represented by dot and the guides will be standing in between these needles.

So this will be the starting position of the guides, so this is G1, G2, G3, G4, this is N1, N2, N3, N4, N5. So for each needle you will have 1 guides associated for the loop formation in one course and this is how needles will be standing like this in reality. So it will be standing

vertically and the guides will also be standing vertically, so that it can make the movement across this needle block.

So this is how the yarns are provided to each individual needle, so the key take is the guide position. So if you see how the guides are located, so the guides are located in the distance between 2 needles. So between 2 needles there is one guides there, so that it can provide the yarn it can pass from one side to the other side through the space between these needles ok. This is how the placement of guides and needles are there on the machine.

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So now let's see the motion of those guides and needles.

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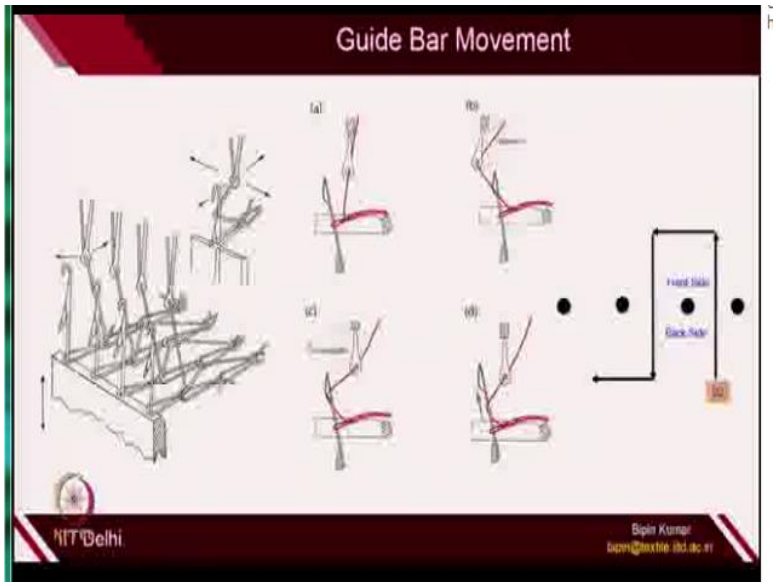


If you see the movement of one guide with respect to one needle, so here although there are 4 needles are there. But as I told if you understand the movement of one guide and one needle that will be more than sufficient to generalize the movement of all the needles and all the guides. Because all needles are associated with the same needle bar, so the movement of all needles will be exactly same similarly all the guides are associated with one guide bar, so the movement of all the guides will be exactly same.

So if you see the one needle, for example let's suppose I am focusing on this needle and one guide is associated which is feeding yarn to this particular needles. At present you need to define how the guides are standing whether on the back side or front side. So whenever loop is starting being formed the guide always stands at the back side carrying the yarn. So warp yarn is being carried out and the guides is actually standing at the back.

So here this is the back side which is the below side of this needle and the front side is on the upward side, so the guide is standing at the back side. So first thing the guide does is it swings from backside to front side ok, so from the back side to the front side it has to swing. So the guide will actually move from backside to the front side and that is possible when there is a space between these needles through which the entire block of guides can swing ok.

So this is how the swinging was done, so now the yarn comes to the front side and to supply the yarn to this particular needle this guide has to do 2 movements, one it has to move along this needle bar and also it has to swing back. So which is shown here in the figure, so there is 2 movements. If you see the direction of this arrow there are 2 movements, the first movement is it is switching from this point to towards the left point.

Because the guide has to supply the yarn, for supplying the yarn it has to move certain distance on the front side. So this is the distance that guide has to move on the front side and after that it has to supply the yarn. So once it moves certain distance and then when it swings back towards the backside through this, the yarn is now feed to the needle. And once the yarn is feed to the needle now the role of a sinker and pressure bar is important which I am not describing here.

Once this particular guide feed the yarn to this particular needle, now this guide has to change its position, change its position means as I told you like each individual guides will be switching needles in alternating courses. So this particular guide provides yarn to this needle in first course, then definitely this guide bar has to go to some other location for providing the yarn. So let suppose now it has to provide yarn to this particular needle.

So it again changes the position on the backside, so this motions is extremely important. If you carefully see there are 2 motions here, one motion on the front side and one motion at the backside which is along the needle bar. And they are 2 motions one from back to front and front to back, this is the across the needle bar. So these 4 motions are extremely important and it is always there whenever any course is being developed in the fabric structure.

So each individual guides during a course formation has to perform these 4 motions which is shown by the arrow. And what is the role of these motions how they are defined I am going to introduce in the next slide.

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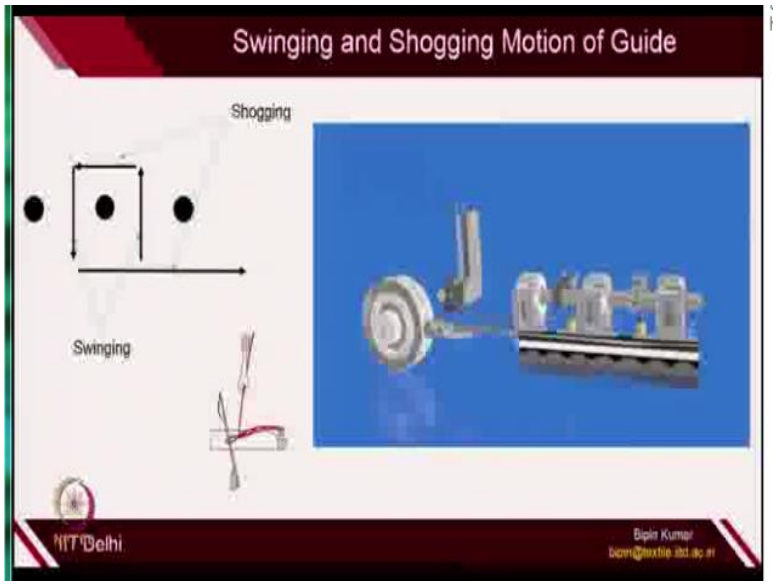


So these 4 motions are actually called swinging and shogging motions if you differentiate these 2 motions, so here is a small videos, where you can see.

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So the first motion is swinging motion, so you can see it is shifting laterally along the needle bar. So this motion and this motion and here it is swinging through the needles ok, so across the needles these are 2 swinging motion. So one from back to front other from front to back, so these 2 are swinging motions which is shown in the video also. So going from front to back and back to front.

And the 2 other motions one is in the front side of the needle and the second one is at the back side of the needle, so this is called shogging motion.

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So in all the warp knitted structures because the guide is responsible for providing the yarn, so this swinging motion and shogging motion is extremely important. And if you change the shogging motion then you can create different types of fabric structures that I am going to explain in few slides. So for you, you need to understand and give more importance to swinging and shogging motion. So for any course development in a fabric structure this 4 motion must be taken by individual guides.

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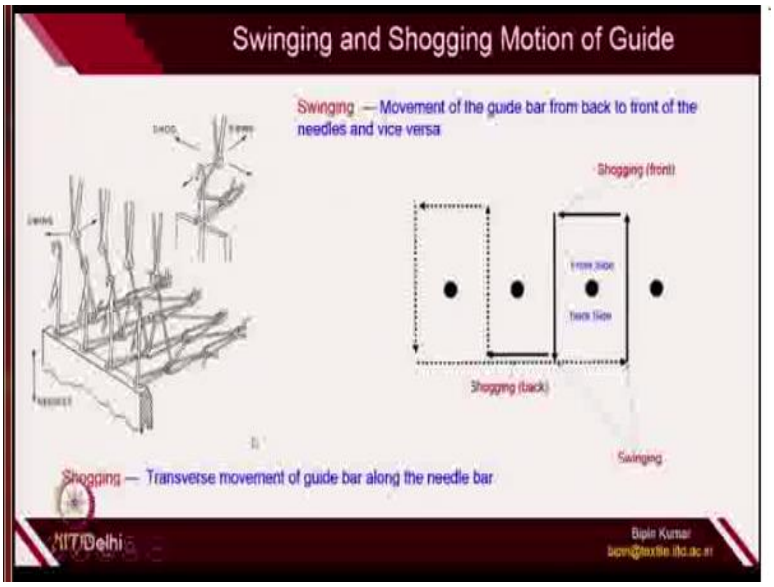


Again, so if you see here these are the 2 swinging motion from back side to front side, so the first thing is started is like the first motion is it is moving from backside to front side which is swinging motion. And then it is doing shogging in the front side of the needle which is the lateral displacement and then again it is doing swinging and then finally it is doing shogging to change the needle position.

So swinging motion is actually the movement of guide bar from back to front of the needle and vice versa. So which you can see it by the arrow and shogging motion is the transfer movement of guide bar along the needle bar, so these are the 2 shocking motions. So 2 shogging motion

depending on the position, so one on the front side of the needle, other is the back side of the needles, so if I want to explain by the needle blocks let me show you.

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So this is the needle block, this is the guide block, so this for example if you see this is how on the backside the guide bar is there and needle bar is there. So the first thing it does the guide changes its position from one side to other side ok. So this is now it comes to the front side of the needle, so this is called first swinging, so initially it was here and then it moves through the space which is there in between and it goes towards the other side.

So one it goes towards the other side, then this needle bar actually shift the position ok, so this is called lateral shift in the direction of needle bar. So it shift which is on the front side this is called shogging motion on the front side and then it comes back which is again a swinging motion and then again it changes the position laterally, so this is the lateral motion ok. So this is how shogging and swinging are defined.

So shogging motion if you see the arrow, so the shogging motion is along the needle bar, so this is the needle bar where needles are placed. So in the direction of needle bar the movement is called shogging motion and swinging motion is across the needle bar. So this is the needle bar and the swinging motion is across the needle bar, so you can see it here. So if you start from here, so the first thing the guide bar has to do.

Guide bar swings from backside to front side ok, so this is swinging motion, swing after that it let's suppose if this guide bar is providing yarn to this needle. So it has to then shog this is shogging motion on the front side ok, after shogging it has to again swing back, so that the needle can catch the yarn. So this is again swinging motion ok, so after swinging shogging again swinging, then this guide bar position has now here.

But after reaching to this position this guide bar has to decide that which needle it wants to provide yarn. So it basically its changes it is position to some other needle position let suppose if it wants to provide yarn to N4. So it moves from this point to this point, so this is the movement

of G1, so again this one is shogging motion. So in any course formation we always start from swinging then shogging on the front side.

Then again swinging towards back side and then shogging on the back side to change the needle position, so each guide bar will be doing exactly same functions. So if you keep rotating this the structure will become more and more complicated. So ideally speaking in warp knitting if you really want to understand you just follow the movement of one guide bar or one yarn that will be more than sufficient to describe the structure.

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Now let's see again this is what I just described here, so we started from here. So this is 2 swinging motion, so first swinging then shogging on the front side, then swinging towards the back side, then shogging on the back side. And after that it changes the positions, so the same guide which was standing here after formation of first course it is now starting from this point in the second course.

So now in the second course it is starting from here and it is providing yarn to this particular needle in the second course. Again swinging shogging on the front side, then swinging and then shogging on the back side. So now in the second course after completing second course the guide bar reached to its original position and then it the whole process is repeated. So this is how a particular guide bar motion is described and it can keep providing the yarn to 2 different needles.

So if you see the guide bar here one needle and 2 needles, so 2 needles are getting yarn alternatively by same guide. So that's why swinging and shogging is extremely important in fabric development, for any difference in the fabric structure the most important thing is the shogging movement.

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So the shogging movement is actually further divided into 2 categories, first is overlap and underlap. So if you want to play with different designs on the same machines if you can control the shogging movement then you can generate different types of warp knitted structure, let me explain how.

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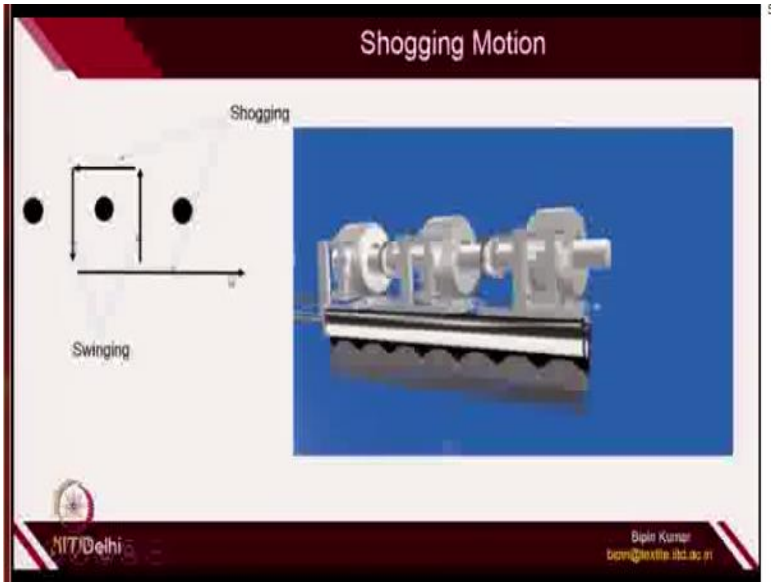


So this is the shogging motion which is shown here.

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So the bar is attached with some pattern disc which will be rotating and which will be giving some kind of lateral movement to this particular guide bar. So you can see because of this lateral

movement the entire guide bar will be shifting, so which you can see it here. So you can see it is shifting along the needle bar ok, so this shogging motion is extremely important and you can see there are more than 1000 guides which can be attached on the guide bar and all the movements of guides which is attached on this bar will have exactly same movement.

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So as I mentioned already swinging and too shogging is very very important, so one is one shogging is always on the front side, the other shogging is on the backside.

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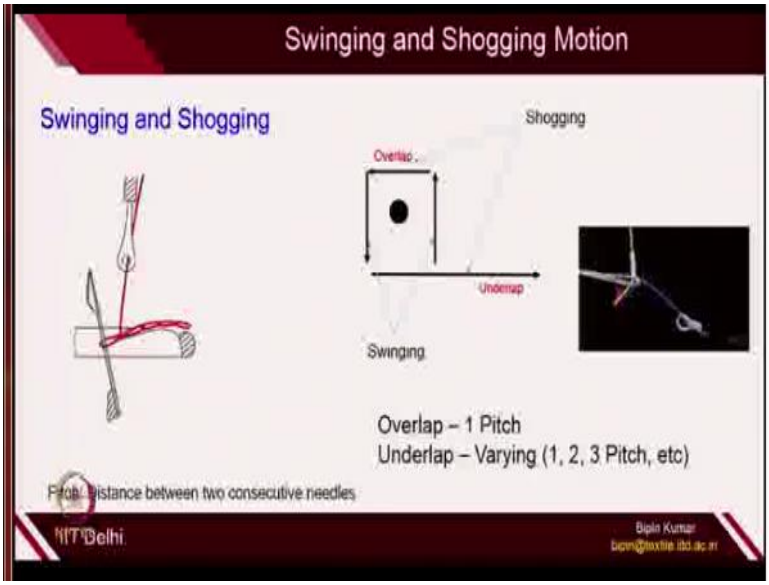


Swinging and shogging motion is very very important, so first shogging motion which is on the front side of the needle is called overlap and the second shogging motion which is at the back side of the needle is called underlap.

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So you can see it in the figure, so after swinging the guide bar swings and then it is shogging on the front side. So this is shown here in this animation, so this part can be observed in this particular animation, so it first goes swings and then shog and then again swing backs, after that it is doing the motion at the back side. So if you observe the shogging motion specially the overlap and underlap the distance which the guide bar can move is different.

So, on the front side since it is giving yarn to the needle, so always the overlap this distance will be one pitch and if you remember the pitch is actually defined as distance between 2 consecutive needles. So overlap distance or overlap distance of the guide in the front side of the needle will always be one pitch either from right to left or left to right underlap which is at the backside can vary.

So you can have 1 pitch, you can have 2 pitch, you can have 3 pitch depending on the fabric structures. So you can now realize if you can keep changing the underlap you can generate different types of fabric structures. So every time if the guide bar changes the position or changes the directions you will generate a new type of fabric structures.

**(Video Ends: 37:33)**

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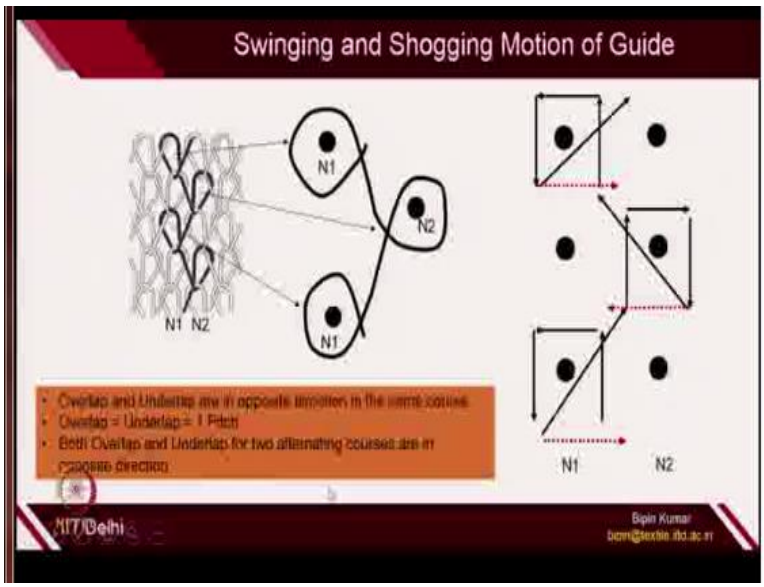


So let me show how, so for example here if you see the first needle is getting the yarn it consists of overlap 2 swinging motion and then underlap, after that so it has swinging then overlap and this is the underlap. So after completion of loop in one of the course then it is moving to the second course to needle number 2, so this is needle number 2. So for moving to needle number 2, it started from this position the guide started from this position it first swings then do the shogging which is overlap.

Then again swinging after that it has to change position, because in the second course this guide bar has to provide yarn to this needle. So definitely this guide bar has to come to this location, so that it can provide yarn to this particular needle, so this is how the underlap has been done. Now the guide bar is starting from this position it will be providing yarn to this particular needle, so again it provided yarn to this particular needles, overlap on the front side underlap on the back side.

So do not get confused with the diagonal line the guide bar is not actually moving in the diagonal directions since we are changing the course in vertical direction that's why just to express that the guide bar will be starting from this position. I am just showing that actually the guide bar is standing here but since I have to make loop in this particular course. So here is the position of guide, so after reaching to this position it again makes the loop and this is how the sequence has been done.

So, both shogging on the front side and back side is important, so front side for providing the yarn, back side for changing the location of guide after each course. So if you carefully see some of the observation here, so overlap and underlap are in opposite direction in the same course. So if you see any particular course. So first overlap is from right to left, you can see the direction of arrow and the second overlap is from left to right this is the underlap ok.

So overlap on the front side, underlap on the back side, and they are same overlap and underlap are 1 pitch because it is just moving one needle distance but the directions are opposite also the positions are opposites. So overlap on the front side of the needle, underlap on the backside of the needle. Both overlap and underlap for 2 alternating courses are in opposite directions, so if you see because the guide is repeating after every 2 courses.

So the first underlap if you see the direction is from left to right, the second underlap after finishing second course it is from right to left. So this is how they are changed, similarly if you see the direction of overlap the first overlap is from right to left and second overlap is from left to right. So this are the some of the observations which is very very important from the designing point of view ok.

So now you can understand why swinging and shogging is so so important in understanding the fabric structures.

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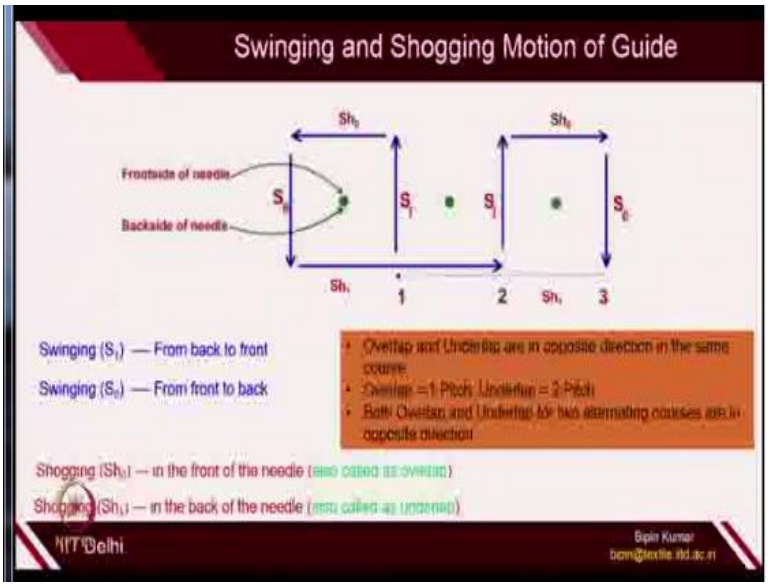


Let's see another example, let suppose if you want to create a course here you are starting from the first position which is shown here. So first swinging then shogging on the front side, then swinging and then shogging on the back side. So swinging from back to front, swinging from front to back, shogging in the front of the needle this is called overlap and shogging on the backside of the needle this is called underlap. So the diagram shows that one loop is being formed by one guide bar interacting with this needle ok.

So after its interactions the guide reaches to this position, so guide started from at this position after finishing the part it is reaching to this position, position number 2 and in the second course. Now it let suppose it is providing yarn to this particular needle which is shown in the arrow. So this is how it provided, so it swings then shoggs on the front side then again swings, now the yarn is being provided, now let's suppose the guide is switching from this needle to this needle.

So in after completion of second course the same guide has to reach to it is original position, so which was this one because the guide started from this particular position. So this is the shogging on the backside after completion of second course, so this is how the same sequence will be

repeated. So if you try to observe again overlap and underlap are in opposite direction in the same course, so if you see the same course.

So first overlap from right to left, first underlap from left to right, so they are in opposite direction. So the direction of arrow is different, overlap is one pitch which is always has to be one pitch because you cannot provide yarn to 2 consecutive needles that will be not possible because knitting will not be possible. So overlap will always be one pitch but here the underlap is actually you are moving from one needle position to third needle position ok.

So 2 pitch you are shifting at the back side and if you see both overlap and underlap for 2 alternating courses are in opposite direction. So this was the first course where the loop was being formed, so the shogging motion from right to left, the overlap motion was from left to right ok. So these 2 arrow are opposite direction, if you see at the back side also first arrow is from left to right and the second arrow is from right to left.

So both overlap and underlap for alternating courses are in opposite directions, in this way the loop will be getting formed and the guide will be repeating its motion.

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So let's summarize I know this class looks repetitive but it is very very important because I need to give little bit pause here once you completely understand swinging, shogging, overlap and underlap for each courses then only it is advisable to go for analyzing different structures.

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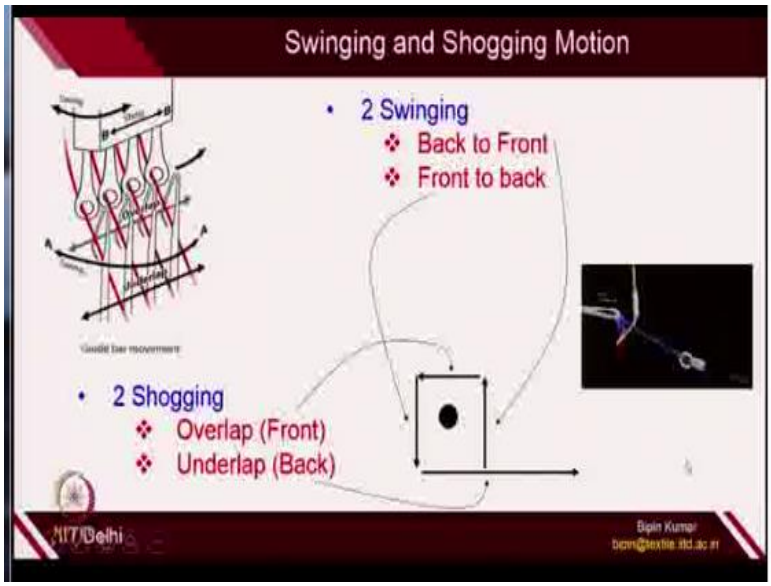


So again this is the summary of swinging and shogging motion, so this is the guide bar and this is the needles, so the guide bar actually swings from one side of the needle to other side and also it laterally shift from along the needle bar, so there are 2 swinging motion in each course.

**(Video Starts: 44:58)**

So this is first swinging motion, then this is the second swinging motion front to back and this is back to front. And there are 2 shogging motion one is overlap which is on the front side. So on overlap there is always one pitch it shift just by one needle distance and underlap on the back side which can be varying. So you can have 1 needle shift, you can have 2 needles shift, you can have 3 needles shift and that is called underlap.

So if you see here this is just simple animation, so overlap can be easily visible, so which is on the front side and you are moving one pitch. So 2 swinging and 1 overlap is visible in this animation, so first it swings then shogg and then again swings, so this 3 movement is visible in this animations.

**(Video Ends: 45:55)**

So this is the swinging and shogging motions, so once swinging and Shogging motion is clearly understandable then we will start analyzing different fabric structure from the next class. So thank you very much for the listening in the next class I will be describing some more fundamentals regarding shogging and swinging motion, thank you.