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Formulating Equations for Warp Knitted Structures (Fabrics) Notations Design Area

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***Abstract*— this formula is developed to solve the problems of repeated mistakes during the notations of warp knitted structures. Notation of warp knitted fabrics is not easy like that of weft knitted fabrics. The degree of shifting, design areas, numbers of overlaps are the main things considered during warp knitted fabrics designing. The formula was developed by considering degree of wale shift and number of overlaps in one line in the knitted fabrics/structure. The formula will help warp knit designers particularly for those designing without software. The formulation was done by analyzing different types of warp knit structures.**

Keywords—Warp knit, design area, pattern height, pattern width, formulating equation, warp knit notations

1. INTRODUCTION

Warp knitting is a method of making a fabric by normal knitting means, in which the loops made from each warp are formed substantially along the length of the fabric. It is characterized by the fact that each warp thread is fed more or k2less in line with the direction in which the fabric is produced. Each needle within the knitting width must be fed with at least one separate and individual thread at each course. It is the fastest method of converting yarn into fabric, when compared with weaving and weft knitting

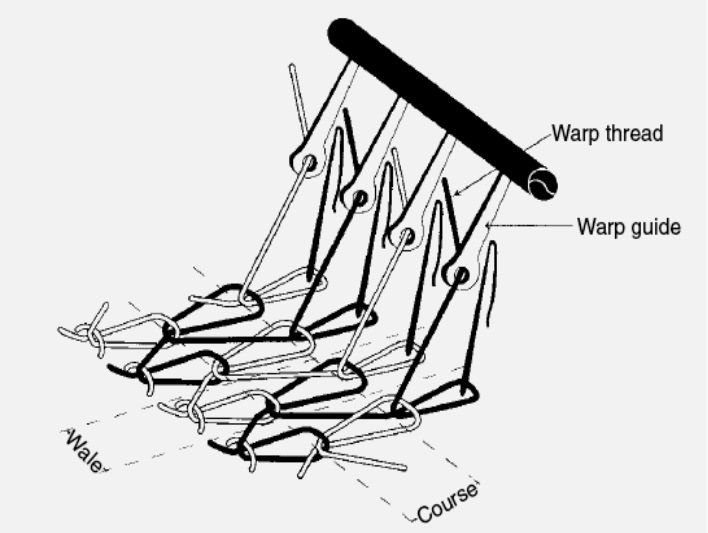

Figure 1: Tricot warp knitted fabric with wale shift 1 and course shift 1 design area 1x1

In warp knitting the fabric is produced by the developments of lap instead of loop in weft knitting for it is formed by lapping movement of warp yarn guide. The lappings are two types depending of the movement of guide bar with yarn relative to needle surface and termed as overlap and underlap. Overlap is the lateral movement of the guide bars on the beard or hook side of the needle. This movement is normally restricted to one needle space. Underlap is the lateral movement of the guide bars on the side of the needle remote from the hook or beard. This movement is limited only by the mechanical considerations. It is the connection between stitches in consecutive courses in a warp knitted fabric. The length of under lap is determined by the degree of wale shifts in warp knit structure.

2. WARP KNIT STRUCTURE NOTATIONS

Notations are symbolical representation of objects, structures, designs and fabrics. Warp knitted fabrics notation is an important part of fabric manufacturing. Notations of warp knitted fabrics are graphical representation of the designs using dot notations and elements of notations. Elements of warp knitted structure notations include mainly degree of wale shift, number of overlaps in one line, numerical record graph, sides of under laps and design area representation.
These elements collaborate all together for full symbolical representation of warp knitted structures/fabrics. Degrees of wale shift, number of overlap in one line and design area are the determining elements for the others.
Many teachers, students, designers, warp knit technologists faced the problems of putting dots repeatedly by trial and error system for denoting warp knitted structures/fabrics. Problems of repeated erasing/adding dots arise mainly from the warp knitted structure/fabric notation element called design area. In these paper, formula for design area representation of warp knitted structures/fabrics is formulated to solve the notation problem for those who denote warp knitted structures using paper, pencil, pen, markers especially for those listed above.

2.1. Steps of warp knitted fabrics notation

- Prepare rows and columns of dots that represent overlaps/needles
- Use points to designate the needles of one bed, and crosses-the needles of the other bed (for two-bed machines).
- Write the rows number on the left side (courses) from bottom to top as it is on the structure

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- Give numbers to the empty spaces between two consecutive needles from right to left whole numbers for single bed even number for double bed
- Draw the path of a yarn in a design area only. Use closed loop for closed loops and open loop for open loops

3. TERMINOLOGIES RELATED TO ELEMENTS OF DESIGN ELEMENTS AND THEIR SYMBOLIC REPRESENTATION

3.1. Degree of shifting

It is represented by Wx1. In which **W** is the number of wales shifted to form second loop/between two consecutive overlaps and **1** is the number of courses shifted is one. In warp knitted structures wales can be shifted for designing purpose but courses are constant i.e. **1**.

3.2. Number of overlaps in one direction

The number of needles a single warp is being knitted on and represented by N. For basic tricot structures the number of overlaps in one direction is always two whereas for basic atlas there should be minimum of three.

3.3. Sides of under laps

The under laps (the ingoing and outgoing under laps) of a given overlap can be single sided or double sided relative to wale lines. Loops in a given side of a fabric can therefore be single sided, double sided or combination of the two and determines the inclination of the overlaps.

3.4. Numerical record graph

It is the representation of warp knitted yarn movement in overlapping, under lapping or both relative to needles. In a dot paper representation yarn parts lying on the needle (o) and under the needle (u) has to be shown. This can be two stages or three stages. When names are given for the yarn laying on the needles (o) two stages is used and when names given to yarn both laying on the needles and under the needle three stages numerical record graph is used. Assign two numbers for 2 stage and three numbers for 3 stage and start from bottom end of yarn and go towards up (i.e. in the knitting direction).

3.5. Design Area representation

It is represented by DwxDh. This represents the area in which the number of courses and wales are put in the paper for denoting the repeat of the fabric/structure. It has two main parts termed as pattern height and pattern width. Pattern height is number of courses where pattern looping over on a yarn path whereas Pattern width is number of wales where the single thread passes. The design area determines the other elements of warp knitted fabric notation.

4. MATERIALS AND METHODS

Different warp knitted structures are analyzed and identified using magnifying glass, Tape meter, cutting dies, Paper, pencil and pen. Tricot, crochet, atlas with their derivatives is analyzed for using it as an input in determining the design area and other notation parameters. The formulation was begin with structural analysis, then grouping according to the type of machines these structures are produced from, and notation of each identified structures are done.

5. FORMULATING EQUATION FOR WARP KNITTED STRUCTURE DESIGN AREA

Using the main elements of warp knitted structures notation element such as degree of shifting and number of overlaps in one direction the formula can be developed easily. Let W represents the number of wales shift between consecutive overlaps, N represents number of overlaps in one direction, and Dw represents pattern width and Dh for pattern height.

Design area is the product of pattern height and pattern width. Let we find pattern width and pattern height separately.

5.1. Pattern height

Pattern height is determined by number of overlaps in one direction. As the number of overlap increases pattern height increases and reduced when number of overlap reduces. So,

Dh = 2N-2

= 2(N-1) ---------- (1), where N is the number of overlaps in one direction, 2 is the full movement of thread direction in the whole pattern (to the right then back to the left) and 1 is the course shift.

5.2. Pattern width

Pattern width depends on degree of shifting and number of overlaps in one direction. Both number of overlaps and degree of wale shifting affects the pattern width of warp knitted structures notations.

Dw = (WxN) – W + 1

= W x (N-1) + 1---------- (2)

Where Dw is pattern width, W is degree of wale shift and N is the number of overlaps in one directions.

5.3. Pattern Area

Pattern area is determined by multiplying pattern width and pattern height but it does not mean that pattern area has constant value rather it has two values those managed separately.

DwxDh = multiplication of equation 2 and equation 1.

= (Wx (N-1) + 1) x (2(N-1)) ---------- (3).

With this formula we can determine the optimum number of dots for the different type of warp knitted structures notations. The design area is measured in number of dots in the vertical (courses) and horizontal (wales).

5.4. Advantages of the formula

Before this formula we were face many problems in the notation of basic warp knit structures for those produced on single bed and double bed warp knitting machines with different number of degree of shifting and number of overlaps in one line using crochet, tricot and raschel warp knitting machines. With this formula related problems like repeated erasing and putting of dots are solved.

Other notation parameters of warp knit structures such as sides of underlap and numerical record graph are easily determined from the design area.

With this formula designing of warp knitted structures are more economical in that it saves both time and money by

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providing accurate number of dots in the vertical and horizontal directions the design area for the required warp knitted structures.

5.5. Applications

The formulated equation is applicable to warp knitted structures such as crochet with its derivatives, tricot with its derivatives, atlas with its derivatives and other structures with up to two needle bars and more guide bars. But it has limitations for structures such as double rib tricot fabrics.

6. CONCLUSION

Textile industries are vital for serving one of human being need called clothing especially for developing countries. These countries use more of hand operated, mechanical machines and manual designing tools and materials. In developing countries using designing software is not common since it is expensive and not available easily. Rather we use pen, pencil, paper and little extent computer Microsoft excel and word. With these material if designers made mistake they drop the wrong material or try to erase which will reduces the quality and neatness. For these and other reasons this developed formula is provided.

With further research, hopefully the limitations of this formula will be eliminated and well defined formula for all types of warp knitted structures can be developed.

Finally I would like to thank my students those helping me by practicing this equation in different structures for the success of this work.

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