Asian Journal of Research № 1-3, 2025 ISSN 2433-202x
IMPACT FACTOR JOURNAL DOI 10.37057/2433-202x
www.journalofresearch.asia
Impact factor 9 info@journalofresearch.asia

Research on the Production of Striped Fabrics from Cotton Yarn.

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Abstract. This article examines the problem of forming a longitudinal or transverse striped pattern on the surface of fabrics. Longitudinal and transverse stripes were formed on the surface of cotton fabrics using various weaves. The products of longitudinal fabrics were based on satin 5/2, twill 2/2 and satin 5/3 weaves. When this fiber was rotated 90 degrees, a transverse pattern was formed on the surface of the fabric. The effect of the direction of the striped pattern on the deformation properties of the fabric was also studied. For this purpose, test samples were made from plain, twill and satin weaves. The fiber composition of the warp and weft yarn consists of cotton fibers. Comparative analysis of samples obtained by placing fabric in the longitudinal and transverse directions showed that the direction of the pattern does not matter in relation to the structure of the fabric and some of its properties.

Keywords: Textile industry, fabric, warp, weft, weave, plain, twill, satin, sateen, deformation, stripe patterns, longitudinal or transverse stripes

INTRODUCTION

In the range of fabrics, each type of fabric differs from the other in its appearance. From absolutely smooth and glossy textures to relief patterns, the surfaces do not duplicate each other in relief [1].

Striped fabrics occupy a special place in the assortment of fabrics from different fibers. The stripes can be located at a certain angle to the longitudinal, transverse or reverse direction, primarily in the direction.

Striped patterns can be applied to the surface of the fabric using colored warp or weft yarn, distinguishing the weave (plain and twill, warp or weft twill, satin and sateen weave, etc.) and in other ways. The patterns of the longitudinal or transverse pattern differ not only in direction, but also in the technology of their formation and the assortment capabilities of the weaving machine. There are some features of the manufacture of fabric with longitudinal or transverse stripes on weaving machines [2-4].

The creation of longitudinal and transverse patterns from multi-colored threads begins with warping, and the process becomes a little more complicated. That is, to perform complex calculations, special calculations and grouping of multi-colored spools by color report are required. In this case, the number of warping rollers in a batch with a color report must be in a certain proportion.

ISSN 2433-202x
JOURNAL DOI 10.37057/2433-202x
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If this proportion is not met when selecting colored yarns, the method of tape warping is used, rather than sectional warping. As a result, the productivity of the warping process is reduced.

To obtain a transverse stripe from colored yarn, the weaving machine must be equipped with a special "multi-shuttle" mechanism. On shuttle less weaving machines [5-7], creating a transverse stripe using colored weft threads requires a multi-color mechanism.

The complexity of forming longitudinal patterns on the surface of the fabric due to interlacing leads to an increase in the number of shafts installed on the machine in accordance with the weave's rapport. The complexity of the threading of the warp threads into the shafts leads to a decrease in the productivity of the weaver.

When forming longitudinal and transverse patterns on the surface of the fabric through weaving, a group of geometric patterned weaves of the combined weave subclass is widely used [8-11].

When forming these stripes, different weaves are placed next to each other, longitudinal stripes are formed, and transverse stripes are also formed. There are also differences in the technology of manufacturing stripes formed by this method on the surface of the fabric. To produce fabrics with longitudinal stripes, a combined interrupted draw-through of the warp threads into the harness is used. The number of draw-throughs in this draw-through is usually equal to the number of stripes from different weaves. The number of warp threads in each strip should be a multiple of the rapport along the base of the strip weave. This has a negative effect on labor productivity due to the complication of work in the production of such fabrics.

The size of the weft rapport is equal to the smallest common multiple of the size of the weft rapports of the combined types of weaving.

There is a possibility of a sharp decrease in the number of heddles when forming transverse stripes due to weaving. Also, transverse stripes can be formed in the fabric due to variable density by the weft [12,13].

METHODS

In general, the concept of longitudinal and transverse is related to the production of fabric on a loom. For consumers of fabric, it does not matter how the pattern in the form of stripes is formed on the loom. What is important for them is how the pattern is placed on the fabric, vertically or horizontally on the clothes, depending on the size of the clothes.

If the striped pattern is placed along the length of the garment, its length depends on the height of the person, while the length of the striped fabric should be 1.5-2.5 m (for example, for young women). Since narrow machines have a working width of 100-140 cm, it is impossible to obtain the desired pattern along the weft and place it vertically on the garment.

Since the appearance of a garment is greatly influenced by the direction of the warp threads of the fabric, the main parts of the garment are placed in the direction of the warp thread.

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JOURNAL DOI 10.37057/2433-202x
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When placing a pattern of clothing items on fabric, it is necessary to take into account not only the longitudinal direction of the fabric, but also its pattern and the nature of the surface, since the surface of the fabric can be pile and shiny of any color or otherwise.

Patterns can be placed in any direction on pile or non-pile, plain, striped, symmetrical checkered fabrics and materials. When modeling striped and checkered fabrics, it is necessary to pay attention to symmetrical color details.

his means that the longitudinal or transverse placement of the strip pattern does not matter to the seamstress. It depends on the width and assortment capacity of the weaving machine.

The production of combined weaves, including the rib of patterned weaves, on modern machines requires special studies by placing longitudinal strips in the transverse direction. Several weaves were analyzed in the course of the study.

The rapport of weave pattern of fabrics with longitudinal stripes is determined depending on the width of the stripes, the density of the fabric on the warp in stripes and the type of weave of the stripes [13,14].

$$R_{wf.} = n_{1wf.} + n_{2wf.} + n_{3wf.} + ...n_{nwf.} \quad (1)$$

$$n_{1wf.} = P_{wf1} \cdot a_1; \qquad n_{2wf.} = P_{wf.2} \cdot a_2; \qquad n_{3wf.} = P_{wf.3} \cdot a_3; \qquad n_{nwf.} = P_{wf.n} \cdot a_n \quad (2)$$

Where:

$n_{1wf.}, n_{2wf.}, n_{3wf.},....n_{nwf.}$ - quantity of weft yarns in each strip

$P_{wf.1,} P_{wf.2}, P_{wf.3},...P_{wf.n}$ - fabric density by weft, yarns/cm

$a_1, a_2, a_3,.....a_n$ - strip width, cm

In the loom, the weft density can be varied using modern electronic take-up drive, with the ability to provide individual weft density for each cross strip. [15,16]

The number of yarns in each strip should be equal to the number divided by the ratio of the accepted base deformations. Because the total number of yarns in each strip is equal to the ratio of the number of yarns to the ratio of the warp of the weave, i.e.

$$t_1 = \frac{n_{1wf.}}{R_{1wf.}}; \qquad t_2 = \frac{n_{2wf.}}{R_{2wf.}}; \qquad t_3 = \frac{n_{3wf.}}{R_{3wf.}}; \qquad ..... \quad t_n = \frac{n_{nwf.}}{R_{nwf.}} \quad (3)$$

When creating a weaving pattern of longitudinal stripes in a rapport on the base, each weaving base is designated by one or two rapports, and their number of repetitions is specified in the weaving program.

The number of weft threads in each strip must be a multiple of the weft pattern repeat of the strip.

RESULTS AND DISCUSSION

Fig. 1 shows a weave with longitudinal stripes, produced by satin 5/2, twill 2/2, sateen 5/3. The width of the stripes is determined by the number of repetitions of the rapport of the basic weave along the warp.

The width of the first, second and third longitudinal strips is a_1=2.5 cm, a_2=2 cm, a_3=2.5 cm.

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The quantity of warp threads in the first strip: $n_{1wp.} = P_{wp.} \cdot a_1 = 26 \cdot 2{,}5 = 65$ threads;

The quantity of warp threads in the second strip: $n_{2wp.} = P_{wp.} \cdot a_2 = 26 \cdot 2 = 52$ threads;

The quantity of warp threads in the third strip: $n_{3wp.} = P_{wp.} \cdot a_3 = 26 \cdot 2{,}5 = 65$ threads;

The rapport on the warp of weave pattern: $R_{wp.} = n_{1wp.} + n_{2wp.} + n_{3wp.} = 65 + 52 + 65 = 182$ threads;

The quantity of repetitions of basic weaves:

$$t_1 = \frac{n_{1wp.}}{R_{1wp.}} = \frac{65}{5} = 13 \qquad t_2 = \frac{n_{2wp.}}{R_{2wp.}} = \frac{52}{4} = 13 \qquad t_3 = \frac{n_{3wp.}}{R_{3wp.}} = \frac{65}{5} = 13$$

This, in turn, requires the installation of 15 heddles, the rapport of the drawing depends on the number of longitudinal stripes in the fabric and the number of warp threads in each strip. The warp threads of each type of weave are draw into their heddles in rows.

In the production of this weave, the density of the fabric on the warp is 260 threads / 10 cm, the width of first strip is 3 cm, the quantity of threads in first strip is 65. And the width of second strip is 2,5 cm, the quantity of threads in first strip is 52, and the width of third strip is 3 cm, the quantity of threads in first strip is 65, the rapport of the draft is 75. It turned out that simplification of the production of fabrics from the studied weaves can be achieved by turning them by 90 degrees [17,18] .

Experimental studies were conducted to examine the influence of stripe direction on the fabric structure and some of its properties.

In a comparative analysis of the results of experimental samples with a longitudinal stripe weave and samples obtained by turning them 90 degrees. The longitudinal or transverse direction of textured patterns is of great importance when cutting out fabric parts according to a pattern. Using the width of the fabric as the length of the main parts of the product requires studying the effect of the transverse or longitudinal arrangement of the pattern on the fabric on its deformation properties.

ISSN 2433-202x
JOURNAL DOI 10.37057/2433-202x
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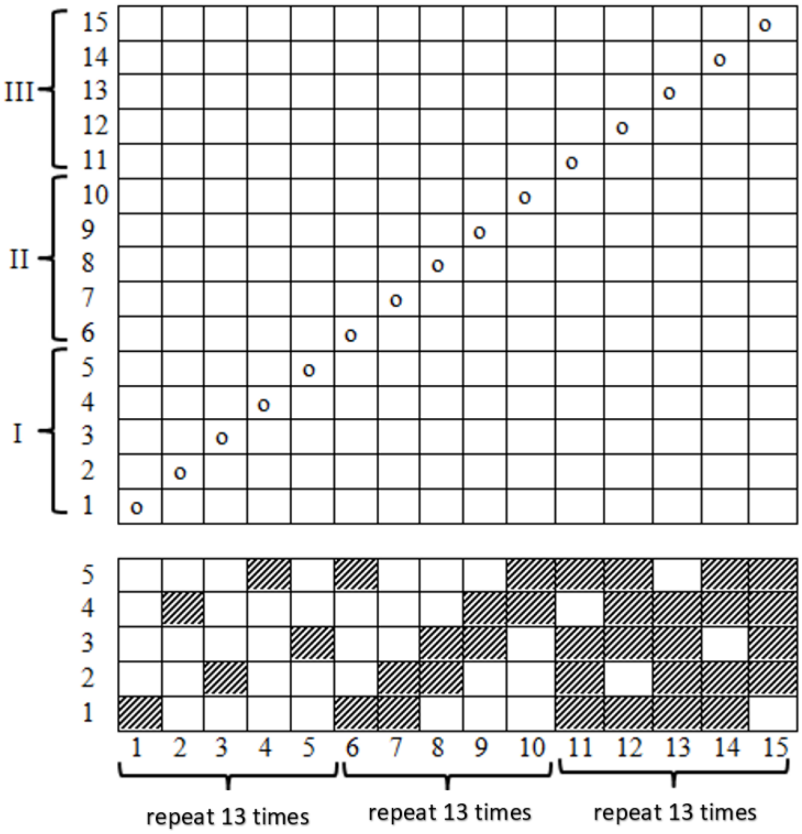

FIGURE.1 Weave of longitudinal stripes

Studying the relaxation characteristics of fabrics under tension is very important for assessing their dimensional stability. It is known that the quality of fabric largely depends on the ratio of the proportions of quickly reversible, slowly reversible and residual deformation.

If the proportion of elastic deformation of the fabric is higher, wrinkles do not occur, and the wrinkles that do appear in it disappear quickly. Some fabrics are more difficult to wet and iron, but products made from them retain their shape well. If the plastic part is a large proportion of the total deformation of the fabric, the folds that appear when wearing the product will disappear more slowly. If the residual part is a large proportion of the total deformation of the fabric, such fabrics are strongly wrinkled, which is why clothes made from them quickly lose their shape. The value of the total deformation of the fabric and the proportion of elastic, plastic and residual parts in its composition depend on the factors that determine the structure of the fabric and its finishing.

The elasticity of fabrics with the same fibrous threads depends on their structure, i.e. the linear density of the warp and weft yarn, the density of the fabric. Fabric deformation is important at all stages of sewing. The share and proportions of deformation should be taken into account when creating a new model and design of the product.

On a weaving machine, the yarn is deformed under the action of force and eventually returns to its original position.

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In order to study the influence of the type of weave on the deformation properties of the fabric in the direction of the warp and weft, studies were conducted. The main weave is the basis of all types of fabric weaves. Therefore, the studies were conducted on the basis of plain, twill and sateen weaves.

All woven samples were made of cotton yarn with a linear density of 20 tex for the warp yarn and 25 tex for the weft yarn. The density of the fabric samples on the warp is 260 threads / 10 cm, and the density on the weft is 220 threads / 10 cm.

TABLE 1.

Average values of components of various fabric deformations from different weaves

№	Type of weave	Direction of test samples	Total deformation,%	The components of the deformation and their share in the total deformation		
				quickly returning, %	slowly returning,%	residual,%
1.	Plain	on the warp	12,5	0,28	0,12	0,6
		on the weft	12,5	0,2	0,12	0,68
2.	Twill 2/2	on the warp	3,5	0,28	0,14	0,57
		on the weft	6,5	0,23	0,15	0,61
3.	Satin 5/2	on the warp	4,5	0,22	0,22	0,56
		on the weft	7	0,21	0,21	0,58

In the plain weave fabric sample, the warp quickly returning deformation is 4% higher than the weft, and it can be seen that the proportion of slowly returning deformations is the same. The proportion of residual deformation in the weft is 1.3% higher.

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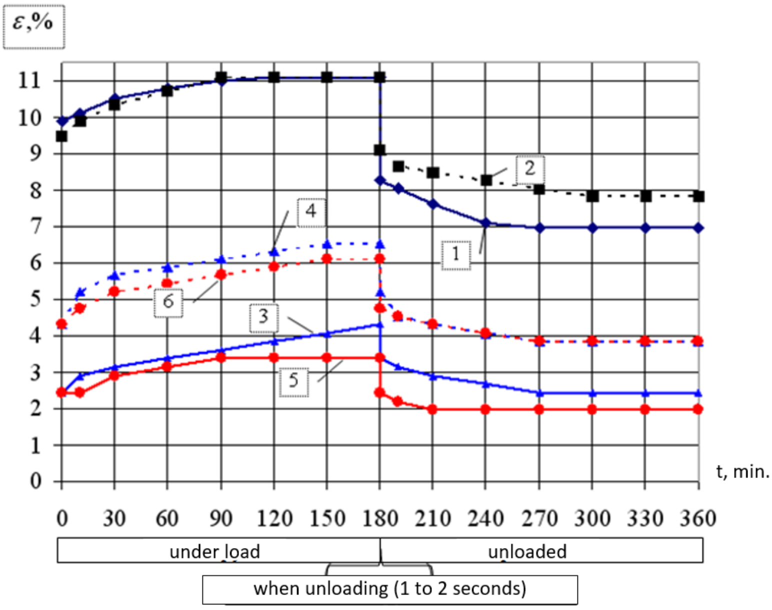

FIGURE.2 Graph characterizing the relaxation of deformation in samples of fabrics of different weaves

1,2- deformation of fabrics (with plain weave) by warp and by weft
3,4- deformation of fabrics (with twill weave) by warp and by weft
5,6- deformation of fabrics (with sateen weave) by warp and by weft

In the test sample with 2/2 twill weave, the total deformation by the warp was 3.5%, and by the weft - 6.5%. In this sample, the proportion of quickly returning deformation was 0.28 by the warp and 0.23 by the weft. The proportion of quickly returning deformation by the warp exceeded 2%. There was almost no difference in the ratio of slowly returning and residual deformations.

In the 5/2 satin weave fabric sample, the total deformation on the warp is 4.5% and the deformation on the weft is 7%. It can be found that the proportions of slowly returning and residual deformation of the fabric are 5% higher in the weft than in the warp, and the proportion of residual deformation is practically indistinguishable in both directions.

A comparative analysis of the first samples obtained by longitudinal and transverse placement in the fabric showed that the direction of the pattern had no relation to the texture structure and some of its properties.

CONCLUSION

Comparative analysis of samples obtained by placing fabric in the longitudinal and transverse directions showed that the direction of the pattern does not matter in relation to the structure of the fabric and some of its properties. To study the effect of the direction of the pattern on the deformation properties of the fabric, the indices of single-cycle deformation of elongation in the direction of the warp and weft of the fabric with the main weave were analyzed.

Using the assortment capabilities of modern weaving machines, it is recommended to produce transverse, replacing longitudinal patterns on the surface of the fabric.

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