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Analysis the Effect of Weave Structure, Fabric Width and Fabric Weight on Skewness and Shrinkage of Denim Fabric

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Abstract: *This experiment was to analysis the effect of weave structures, fabric width and fabric weight of the denim fabrics on the skewness and shrinkage properties. The work showed that how these above factors affect skewness and shrinkage of the fabric. Fabric of different weave design such as 2/1 Right hand twill, 3/1 Right hand twill, 4/1 Satin and 2/2 Right hand twill with same width and same weight were analyzed to investigate the effect of the weave design. And fabric of 3/1 RHT design with different weight but same width and different width but same weight were also investigated under the same condition to find the effect of fabric weight and fabric width respectively on the above properties. The investigation developed a way so that it can forecast the resulting skewness with different weave design of the fabric and width and weight variation of the same fabric. The research emphasized on the adjustable points on which the skewness depends. The skewness of denim fabrics were different for various weave design and at the same time the fabric with same weave design showed different shewness due to variation on their width and weight. The shrinkage of the denim fabric was also greatly influenced by the above factors. The skew (%) was highest for the fabric having 3/1 RHT weave structure and the shrinkage (%) was highest for 4/1 satin structure among the analyzed structures.*

Key Words: *Ozs/yd², weave Design, Skew, Fabric width, Twill, Shrinkage, Denim fabric.*

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I. Introduction

Skewness:

Woven fabric is any textile formed by interlacement of many warp and weft yarns at right angles to one another [1]. Skewness of the fabric is defined by the angular displacement of the warp and weft yarn. When one end of weft yarns at one selvedge gradually run at a lower or higher than 90 angles with the warp yarns of the fabric at the other selvedge then the condition is known as skew effect [2]. Skewness in woven fabric is a condition where the warp and weft yarns, although straight, are not at right angles to each other [3]. Skewness is an inherent problem of twill weave. Twill fabric is the weave characterized by diagonal lines on the face and often on the back of the fabric and every warp shows an angular displacement with the previous warp yarns which is responsible for the skew effect. Besides, the problem can occur during the process of fabric manufacturing; warping, weaving and finishing because of tension variations across the width of the fabric [4]. On weaving machine skewness can also be caused by uneven let-off or take-up speeds, causing un-equal tension on the two sides of the cloth being woven [5].

Shrinkage:

Shrinkage is the process in which a fabric becomes smaller than its original size, usually through the process of laundry. Cotton fabric suffers from two main disadvantages of shrinking and creasing during subsequent washing. There are two types of shrinkage occur during washing:

1. Length wise
2. Width wise

Denim Fabric:

Denim is a strong, durable fabric constructed in a twill weave with indigo and white yarns. The blue or indigo yarns are the lengthwise or warp threads which are parallel to the selvage and the white yarns i.e. weft threads run across the fabric width. As a result of warp-faced twill weaving, one side of the textile shows the blue warp threads and the other side shows the white weft threads [6].

II. Materials And Measurements

2.1 Materials

13 samples of the following were produced on the same machine and under the same weaving tension. The weaving was carried out under the same weaving and finishing condition to maintain uniformity. Fabric of four different weave deigns 2/1 RHT, 2/2 RHT, 3/1 RHT and 4/1 SATIN were produced with same weight and width on the same machine. Besides, four fabrics of 3/1 RHT weave design with different width but same weight were produced and another five fabrics of the same weave having different weight but same width were also produced under the same weaving condition. The details of the materials are given below:

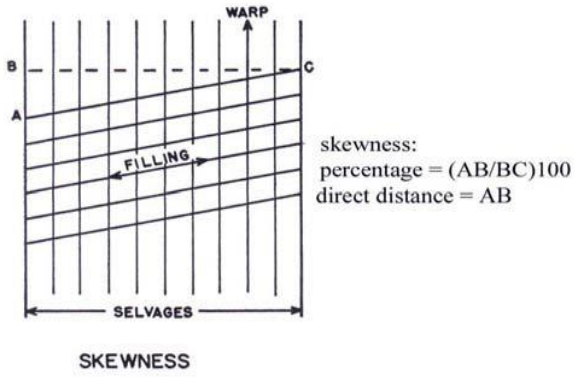
Table 1.1: Details of the materials

Sample No.	Weave structure	Fabric Width (Inch)	Fabric Weight (Ozs/yd^2)
1	**2/1 RHT**	54	8.91
2	**2/2 RHT**	54.2	8.96
3	**3/1 RHT**	54.3	8.88
4	**4/1 SATIN**	54	8.94
5	3/1 RHT	**47**	7.98
6	3/1 RHT	**48**	7.96
7	3/1 RHT	**52.9**	8.00
8	3/1 RHT	**53.2**	8.01
9	3/1 RHT	51.6	**8.38**
10	3/1 RHT	52	**9**
11	3/1 RHT	52	**9.58**
12	3/1 RHT	51.8	**9.64**
13	3/1 RHT	52.2	**9.93**

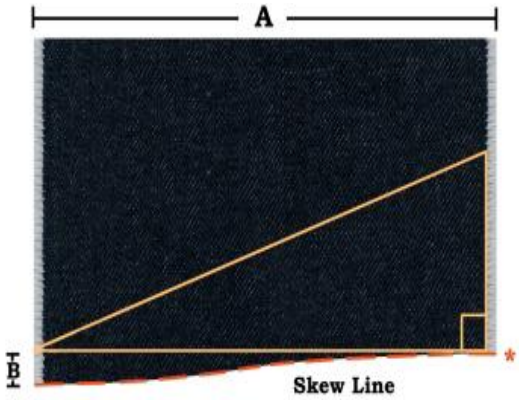
2.2 Measurements of skewness:

The skewness of the denim fabric is calculated by the following formula.

Skew (cm)= Angular Displacement on the fabric measured by before and after wash straight line



SKEWNESS



In the figure, Skew (cm)= AB, which is the maximum displacement of the weft yarn from the shortest filling path

And Skew (%) = $\left(\frac{AB}{BC}\right) X100$ [7]

Where,

AB= Maximum displacement of the weft yarn from the shortest filling path
BC= Width of the fabric after washing

Procedure of measuring Fabric Skew

- Before wash the fabric is marked by a large angular scale on the opposite side of the fabric.
- After wash the fabric is again marked by the angular scale and the displacement of the weft yarn can be measured from the above two positions.
- The width of the fabric (after wash) is also measured by measuring tape.
- By using the above formula we can calculate the skew %. It should be noted that de-sizing is done during washing through acid de-sizing.

2.3 Measurements of Shrinkage:

Shrinkage is a problem that hampers the dimensional stability of a fabric. Shrinkage is one of the leading quality problems. Shrinkage of the fabric is calculated by the following formula

Shrinkage (%) = $\frac{before\ wash\ measurement - afterwash\ measurement}{before\ wash\ measurement} x100$ [8]

Procedure of measuring Fabric Shrinkage:

- Before wash the fabric is marked by a template on the opposite side of the fabric.
- After wash the fabric is again marked by the template and the displacement of the warp and weft yarn can be measured from the above two positions.
- By using the above formula we can calculate the shrinkage % in lengthwise or widthwise direction.
- Here the shrinkage is calculated on widthwise direction only from before and after wash width. It should be noted that de-sizing is done during washing through acid de-sizing.

III. Result And Discussion:

Weave Structure: The following table shows the skew (%) and shrinkage (%) of the denim fabrics with 2/1 RHT, 2/2 RHT, 3/1 RHT and 4/1 SATIN weave structures.

Table 3.1: Effect of Weave Structure on Skewness and Shrinkage of Denim Fabric

Fabric Weight (Ozs/yd^2)	Weave Structure	Before Wash Width (inch)	After Wash Width (inch)	Skew (cm)	Skew (%)	Shrinkage (%)
8.91	**2/1RHT**	54	49	6.5	5.2	9.26
8.96	**2/2RHT**	54.2	54	0	0	0.37
8.88	**3/1RHT**	54.3	49.7	13	10.3	8.48
8.94	**4/1SATIN**	54	47	4	3.4	12.96

Weave structures affect the skewness of woven fabric. It was found by **A. Alamdar-Yazdi** that for 3/3 RHT the skewness was highest and for the zigzag twill it was the lowest among his investigated weave structures [9]. In this experiment the skewness was highest for 3/1 RHT and lowest for 2/2 RHT among the four structures. Different weave structures show different warp and weft interlacement and different angle of warp displacement which is responsible for different skewness although the width and weight of the fabric was almost same for all the weave structures. Weave structures also affect the shrinkage of denim fabric. The shrinkages was highest for 4/1 Satin fabric and lowest for 2/2 RHT structure.

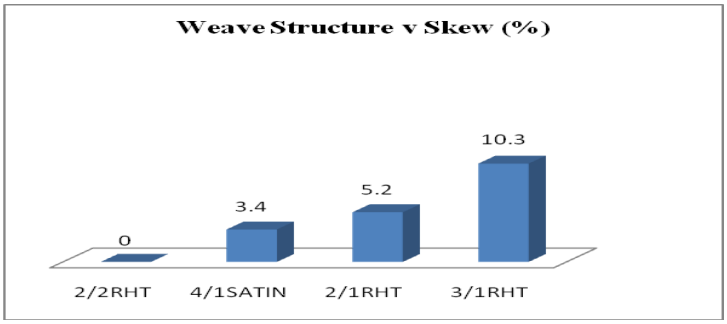


Figure 3.1: Weave Structure versus Skew (%) of Denim fabric

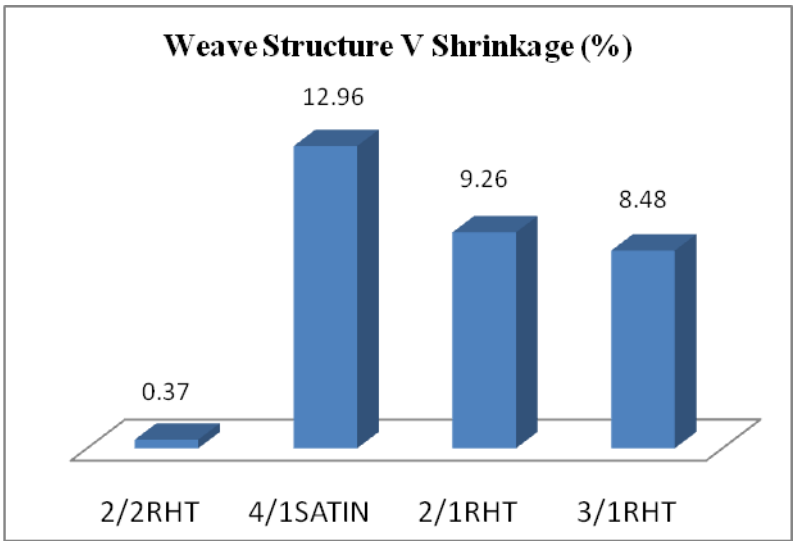


Figure 3.2: Weave Structure versus Shrinkage (%) of Denim fabric

Fabric Width: The following table shows the skew (%) and shrinkage (%) of the denim fabrics of 3/1 RHT weave structure with different width but the same weight.

Table 3.2: Effect of Fabric Width on Skewness and Shrinkage of Denim Fabric

Weave Structure	Fabric Weight (Ozs/yd^2)	Before Wash Width (inch)	After Wash Width (inch)	Skew (cm)	Skew (%)	Shrinkage (%)
3/1RHT	7.98	**47**	41.8	9.5	8.95	11.1
3/1RHT	7.96	**48**	43.3	10	9.09	9.8
3/1RHT	8	**52.9**	48.1	13	10.64	9.1
3/1RHT	8.01	**53.2**	48.5	15.7	12.74	8.8

It was observed from the graph that skewness of denim fabric was affected by the width. For the same weave structure and almost same fabric weight the skew (cm) and skew (%) was different for different fabric width. Fabric having smaller width showed lower skew (%) although it was higher for the fabric with larger width. But the shrinkage of fabric was highest for lowest width and lowest for highest width fabric.

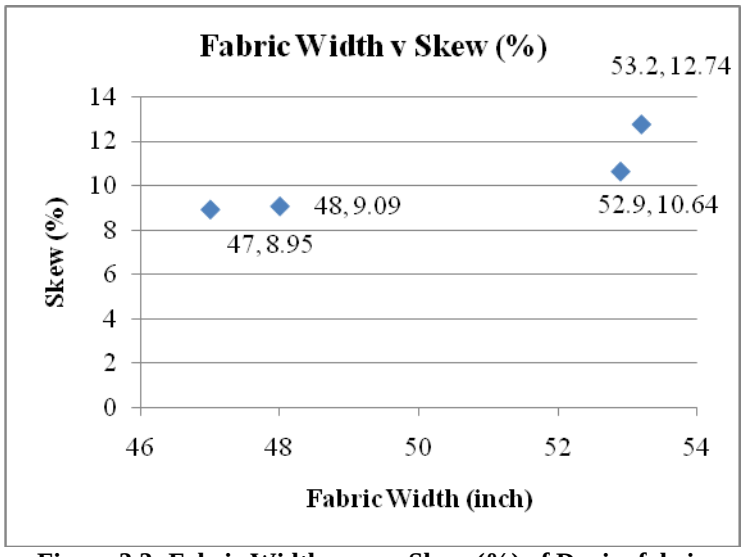


Figure 3.3: Fabric Width versus Skew (%) of Denim fabric

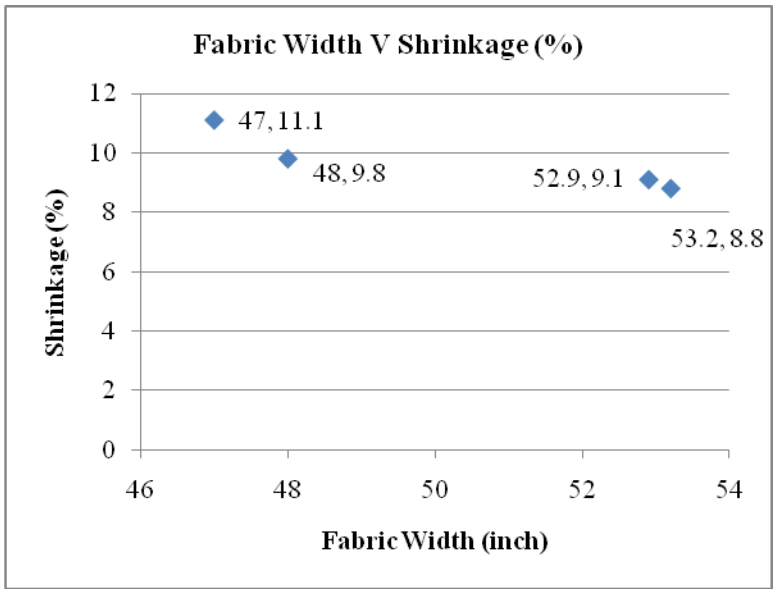


Figure 3.4: Fabric Width versus Shrinkage (%) of Denim fabric

Fabric Weight: The following table shows the skew (%) and shrinkage (%) of the denim fabrics of 3/1 RHT weave structure with different weight but the same width.

Weave Structure	Fabric Weight (Ozs/yd^2)	Before Wash Width (inch)	After Wash Width (inch)	Skew (cm)	Skew (%)	Shrinkage (%)
3/1RHT	**8.38**	51.6	48.2	12	9.80	6.6
3/1RHT	**9.00**	52	48.1	13	10.64	7.5
3/1RHT	**9.58**	52	47	13	10.89	9.6
3/1RHT	**9.64**	51.8	46.5	13.5	11.43	10.2
3/1RHT	**9.93**	52.2	46	15.7	13.44	11.9

Table 3.3: Effect of Fabric Weight (Ozs/yd^2) on Skewness and Shrinkage o Denim Fabric

It was clearly seen from the graph that the weight of the fabric also affect the skewness of denim fabric although the weave structure and the width of the fabric were same. For the same weave structure and same fabric width the skew (%) of fabric was increased with increasing the fabric weight. Similarly the shrinkage (%) also increased with the increasing of fabric weight.

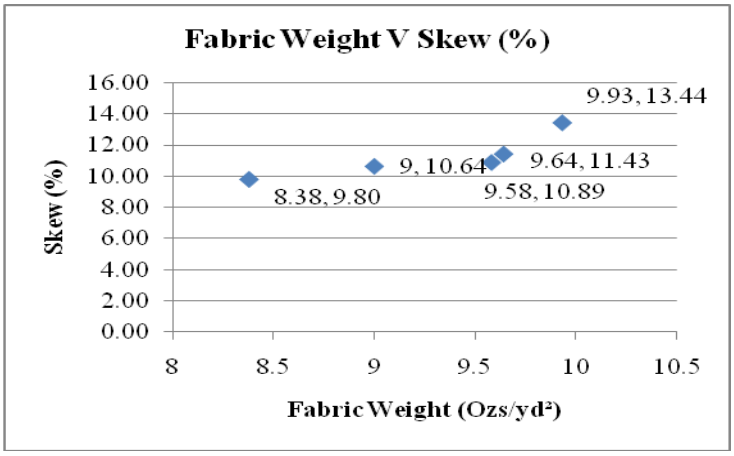


Figure 3.5: Fabric Weight versus Skew (%) of Denim fabric

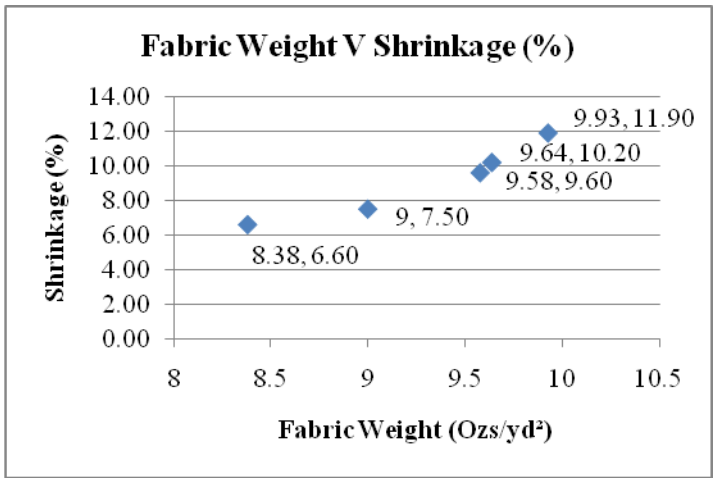


Figure 3.6: Fabric Weight versus Shrinkage (%) of Denim fabric

IV. Controlling of Skewness of Denim Fabric:

Skewness or leg twist in jeans made of twill fabrics may be avoided by skewing the fabric clockwise or counterclockwise depending on the twill direction before making the garment so that when the garment is laundered the positions of the warp and filling yarns will remain unchanged with respect to each other [10]. For denim an 8% skew based on fabric width introduced in manufacturing the denim gives straight seams throughout the life of the garment.

V. Conclusion

Skewness of woven fabric is an alarming problem which may arise due to weave construction, tension variation during fabric manufacturing or during garment manufacturing. The tension variation which is responsible for fabric skewness can be eliminated by careful processing. But the causes like weave design, fabric weight and fabric width are the inherent problems for skewness of woven fabric. Among the analyzed three factors the weave design affects the skew (%) and shrinkage (%) of the fabric most. But the effect of fabric width and fabric weight on these properties can not be neglected. There is a linear relationship between the fabric width with skew (%) and shrinkage (%). Similarly, the skew (%) and shrinkage (%) of the fabric is proportional with fabric weight..

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