OPENING MINDS: RESEARCH FOR SUSTAINABLE DEVELOPMENT

Investigating the Effect of the Variation of Stitch Density on Seam Puckering

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1 INTRODUCTION

Cut fabric panels can be assembled using various techniques such as sewing, thermal bonding and using adhesives. Sewing is the most common method of joining fabric panels in the apparel industry. For the construction of seams, different sewing parameters are used. One of the important sewing parameters is the stitch density. Stitch density may significantly affect the quality of the seams of garments due to the occurrence of seam pucker.

The term seam pucker can be defined as a ridge, wrinkle, or corrugation of the material or a number of small wrinkles running across and into one another, which appear in sewing cut fabric panels together to make appropriate seams (Zadah and Najjar, 2015). It is usually caused by the improper selection of sewing parameters, factors related to sewing machines and material properties, which results in unevenness on fabric surfaces being stitched together, thus impairing their aesthetic value. In severe cases, seam pucker could appear like a wave front, originating from the seam and extending to the entire garment (Hati and Das, 2011). The problem of seam pucker may occur during sewing, after sewing or after washing (Maarouf, 2015). For a good appearance of a garment, the seams should be free from seam puckering. The customer generally pays attention to the appearance of seams in order to determine the overall quality of the garment. Therefore, the seams of garments must be free from seam puckering. The major causes of seam puckering are the incorrect feeding of cut fabric panels, incorrect sewing thread tension, sewing thread shrinkage, fabric shrinkage, mismatched patterns and structural jamming (Choudhary and Geol, 2013). The structural jamming of the fabric is possible due to the incorrect selection of stitch densities in seam constructions.

The main objective of the research is to investigate the effect of stitch densities on seam puckering.

2 METHODOLOGY

The methodology of the research is described under the sub-topics of designing the experiment, preparation of the samples and the evaluation of samples.

2.1 Designing the experiment

Experimental work is designed to test the selected woven fabric type with specific sewing parameters. A selected range of stitch densities spans the range covered in industrial practice. Though the stitching can be performed at different sewing speeds, 2500 rpm was selected for this experiment because this is the average speed used in the industry. The experiment is designed to test samples prepared with seam parallel to the warp direction and the seam parallel to the weft direction. During the designing phase of the experiment, the necessary materials, machines, equipment, stitching parameters and a suiTable testing standard were selected.

The fixed parameters of the experiment are given in the Table 1.

Table 2 gives the details of the variable parameters used for the experiment. Ten different stitch densities in the range of 5 spi to 14 spi with an increment of one stitch per inch were selected.

Table 1: Selected fixed parameters for the experiment

Fixed parameters for the experiment	
Fabric	Fibre type: 100% Cotton, Fabric structure: Twill weave, Weight: 224.7 g/m^2, Ends per inch: 72, Picks per inch: 45
Sewing thread	100% Polyester, Ticket Number: 30
Sewing machine	Single needle lock stitch machine, Maximum sewing speed 5000 rpm
Needle	Size: 110Nm
Testing Standard	IS 15312: 2003
Standard conditions	Temperature: 27± 2C$^{\circ}$, Relative Humidity: 65± 2%
Seam type	Plain seam
Stitch type	301
Operating speed of the sewing machine	2500 rpm

Table 2: Selected stitch densities for the experiment

Selected stitch densities for the experiment	
Stitch densities (spi)	5,6,7,8,9,10,11, 12, 13 and 14

2.2 Preparation of the samples

The dimension of a cut panel is 500 x 90 millimetres as per the testing standard IS 15312: 2003. The total number of cut panels required to perform the experiment was 200. Out of these 200 cut panels, 100 panels were cut to prepare samples with seam parallel to warp direction, whereas the other 100 panels were cut to prepare samples with seam parallel to weft direction. As the seam was applied in the lengthwise direction, a measuring length of 300 millimetres was marked in the middle of all the cut panels prior to sewing. When stitching samples, two similar cut panels were kept on top of each other and a row of stitches was applied to the middle in a lengthwise direction. The total number of samples prepared was 100. For each of the chosen stitch densities, ten samples were sewn. Of these ten samples, five were sewn with seam parallel to the warp direction and the other five with seam parallel to the weft direction.

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2.3 Evaluation of samples

By using a scale of 0.5mm accuracy, actual distance between the marked measuring points was measured in all sewn samples. The values were obtained for both face and back sides. The percentage of seam pucker for both face and back sides was calculated for each chosen stitch density by using the following formula.

Seam pucker =
{(300 – Measured length) x100}/ 300

3 RESULTS AND DISCUSSION

Tables 3 and 4 give the average seam lengths of five samples sewn in warp and weft directions for the selected range of stitch density with reference to the face and back side of the samples. The relevant standard deviations and coefficient variations have also been given in the Tables.

Table 3: Seam parallel to warp direction

Stitch density (per inch)	Face side			Back side		
	Average seam length	Standard deviation	Coefficient of variation (%)	Average seam length	Standard deviation	Coefficient of variation (%)
5	300.8	0.96	0.31	299.4	1.74	0.58
6	300.6	0.48	0.15	299.2	0.97	0.32
7	300.6	1.01	0.33	298.8	0.74	0.24
8	300.8	0.74	0.24	300.0	1.78	0.59
9	301.0	0.89	0.29	299.0	1.26	0.42
10	300.0	0.63	0.21	298.0	1.05	0.35
11	301.2	0.74	0.24	300.2	1.83	0.60
12	300.6	0.48	0.15	300.4	0.48	0.15
13	300.8	0.74	0.24	299.8	0.74	0.24
14	301.2	0.74	0.24	300.8	0.97	0.32

Table 4: Seam parallel to weft direction

Stitch density (per inch)	Face side			Back side		
	Average seam length	Standard deviation	Coefficient of variation (%)	Average seam length	Standard deviation	Coefficient of variation (%)
5	300.0	1.87	0.62	299.6	1.95	0.65
6	299.2	1.46	0.48	299.6	0.80	0.26
7	298.8	1.60	0.53	299.8	0.97	0.32
8	300.2	0.74	0.24	299.2	0.97	0.32
9	299.2	1.72	0.57	297.8	1.60	0.53
10	297.2	1.72	0.57	296.4	1.95	0.65
11	298.4	1.85	0.61	296.4	1.95	0.65
12	301.0	0.63	0.20	300.4	0.48	0.15
13	300.8	0.74	0.24	299.6	0.48	0.16
14	301.0	0.63	0.20	299.6	0.48	0.16

The average seam lengths of the samples of chosen stitch densities do not show significant deviation in all four cases mentioned in Tables 3 and 4. Considering the low values of the standard deviations and coefficient of variations, it can be concluded that the stitch densities do not influence the average seam length of sewn samples. The highest value of standard deviation is 1.95 and the highest value of coefficient of variation is 0.65%. Therefore, the data sets of chosen stitch densities have very low level of dispersion around the mean seam length values. As the coefficient of variation is less than 5% in all four cases, the change of the average seam length can be considered as insignificant under 95% confidence level.

The minus values in Table 5 indicate the increase of seam lengths, whereas the positive values indicate the decrease of seam lengths.

Table 5: Seam Pucker in both sides of the samples in warp and weft directions

Stitch density	5	6	7	8	9	10	11	12	13	14
Warp- Face side %	-0.26	-0.20	-0.20	-0.26	-0.33	0.00	-0.40	-0.20	-0.26	-0.40
Warp-Back side %	0.20	0.26	0.40	0.00	0.33	0.66	-0.66	-0.13	0.06	-0.26
Weft-Face side%	0.00	0.26	0.40	-0.66	0.26	0.93	0.53	-0.33	-0.26	-0.33
Weft-Back side%	0.13	0.13	0.06	0.26	0.73	1.20	1.20	-0.13	0.13	0.13

Figure 1 shows the seam pucker variations with the stitch densities as per calculations shown in Table 5.

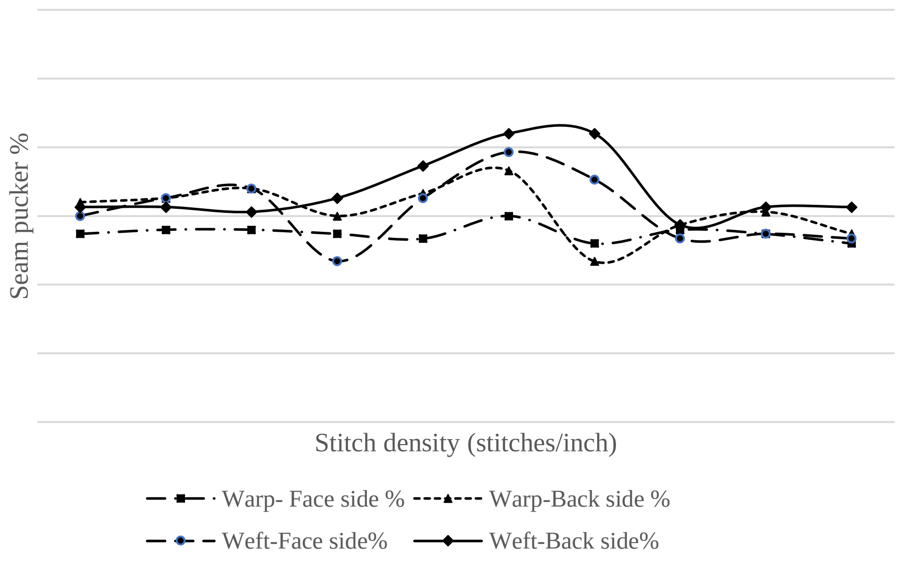

Figure 1: Variation of the seam pucker against different stitch densities

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Based on the data given in Table 5 and the 1, it can be seen that the seam pucker in the weft back side is positive for all the stitch densities, except the stitch density 12. The seam pucker of the warp face side is negative for all the chosen stitch densities. In the case of warp back side, it can be seen that the seam pucker is positive between the stitch densities 5 and 10. The variation of the seam pucker in the weft face side does not show any regular pattern. However, for all the four cases, the stitch density 10 shows the highest seam pucker.

4 CONCLUSIONS

It can be concluded that there is a slight increase in the seam pucker from the stitch density 5 to 12 of the samples tested. The highest seam pucker has occurred at and around the stitch density 10. Though the percentage values of the seam pucker is relatively low, the effect will be significant for the long seams, whereas the effect will be insignificant for short seams. Therefore, care must be taken when selecting stitch densities in seam construction of garments. Further research is needed to validate the findings of the research.

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