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Research Paper

Comparison of seam puckering between light and medium weight woven cotton apparels: A study on lapped and edge neatening seam

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■ **ABSTRACT :** Evaluation of seam pucker is one of the most significant aspects for quality control in garment manufacturing. Seam puckers lead to aesthetically undesirable garments and may also cause inconvenience in wear. The purpose and objective of this study was to explore and scrutinize the impact of sewing parameters and seam angle on seam puckering for cotton fabric. An experimental design was prepared for the study which included two types of stitch and seam class and suitable sewing parameters like: sewing needle size, sewing machine type, sewing thread size, stitch density and seam angle on the seam pucker of light weight and medium weight woven cotton fabrics. In this study, fabric sample were sewn at 45°, 60° and 90° angles with two different stitch and seam class. The 90° signifies that the fabrics were sewn in weft direction, where as 45°, 60° means the fabrics were sewn in the warp direction. Seam puckering was estimated by objective method, by measuring the thickness of both the seamed and unseamed fabric. Seam puckering depends upon the warp and weft yarn covered in the seam and yarn linear densities, which can be represented as effective relative cover. It was observed that seam puckering was the lowest at seam angle 90° (to the weft direction) in combination of lock stitch and overedge chain stitch in light weight fabric. Puckering percentage is higher at seam angle 60° for chain stitch in lapped seam for light weight fabric. The findings of this study revealed that sewing parameters have a significant influence on woven fabric in relation to seam pucker. The study has also brought to light the behaviour of seams in the different stitch and sewing parameters on cotton fabric. The analyzed results will help manufacturers of apparels to select sewing parameters, to decide on stitch types for least pucker in the finished garment which would help to achieve quality seams to meet consumers' desire.

■ **KEY WORDS:** Seam puckering, Woven cotton fabric, Seam angle, Stitch, Seam, Effective relative cover

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Recently, as awareness in the quality of clothing fabrication has risen, the performance and appearance of garments and sewing practices especially seam pucker problems have become important. Seam pucker is defined in the Oxford English Dictionary 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 together twopieces of cloth". Seam puckering can be classified into three types.

Displacement pucker:

It is produced by the insertion of sewing thread in the fabric. When needle thread is inserted in the fabric, it tries to displace the yarns near the stitch hole. This result in a tensions and leads to puckering.

Relaxation pucker:

It is caused due to high machine thread tension. When sewing thread has been inserted with high tension, get elongated or stretched, as the stitch is being set, this thread in seam recovers to its actual length over time. It also occurs by change in temperature and humidity while stitching.

Transportation pucker:

This type of puckering occurs mainly due to friction between two layers of the fabric. During stitching of the fabric, bottom layers of the fabric moves frontward with the movement of feed dog and due to friction between two layers of fabric, bottom layer of fabric tries to take top layer of the fabric along with it. But top layer of fabric is held against the pressure foot, which impedes the forward movement of the top layer. Hence, the bottom layer of fabric resting on feed dog moves little faster than the upper layer, which cause puckering. (Kaur and Chanchal, 2016).

Puckering is more common in sewing light and medium weight woven fabrics as compared to heavy weight and knitted fabrics and it is noticeable on compactly woven fabrics. Such defects reduce the appearance and overall quality of particular product. To overcome this problem, seamless garments and special sewing threads have been tried but they are not suitable for all types of garments and therefore, several studies have been carried out to discover the cause of seam puckering, to quantitatively evaluate andcontrol it (Midha and Kumar, 2015). In woven plain fabrics, puckering occurs due to displacement of fabric threads, so angled seams have been suggested to reduce the chances of seam puckering. However, till date there is no study to suggest the angle of seam that gives the lowest seam puckering. In this study, comparison between light and medium weight fabric at different seam angles has been studied on the seam puckering by producing seams with different stitch and seamson light and medium weight cotton woven fabrics and the purpose of this study was to explore and scrutinize the impact of sewing parameters and seam angle on seam puckering for cotton fabric.

The number of warp and weft yarns covered in the seam are different at different angles, which can be calculated by eq. (1) and (2) using trigonometrical calculations. However, while comparing fabrics with different yarn densities and yarn linear densities, it is the number of yarns covered in the seamand their linear density, which contributes to yarn displacements during sewing. These quantities can be represented by effective relative cover in the seam calculated using eq. (3)

$n_{11} = n_1$ (cos ¯), ...(1)

$n_{22} = n_2$ (sin ¯), ...(2)

$K_k = [(d_1 n_1 + d_2 n_2) - (d_1 n_1 \times d_2 n_2)]$, ...(3)

where, n_{11} - number of warp yarn covered in 1 cm of angled seam, n_1 – warps per centimeter, n_{22} – number of weft yarns covered in 1 cm of angled seam, n_2 - wefts per centimeter, K_k effective relative cover in the seamd_1- diameter of warp yarn (cm), d_2 – diameter of weft yarn (cm), θ - angle of seam (Midha and Kumar, 2015).

■ RESEARCH METHODS

Fabric:

In the course of this study, 100 per cent woven cotton light and medium weight fabrics were used. Table A shows the characteristics of fabrics used.

Table A : Properties of selected cotton fabric

Fabric	Weight (g/m^2)	Thick-ness (mm)	Stiffness (cm)				Yarn count (Thread per inch)		Cover factor		
			Warp		Weft						
			Face to face	Back to back	Face to face	Back to back	Warp	Weft	Warp	Weft	Fabric
Light weight	60	0.17	4.3	4.4	2.7	2.7	116	99	12.51	11.36	19.34
Medium weight	115	0.19	3.6	3.9	3.6	3.1	128	106	14.59	12.16	20.42

Table B : Sewing conditions for testing of seam puckering

	Sewing machine/ type of machine	Single needle lock stitch	Feed of the arm	Over lock
Light weight fabric	Type of stitch	Lock stitch	Chain stitch	Overedge chain stitch
	Class	301	401	504
	Speed(rpm)	5000	4000	7000
	SPI	14	14	14
	Seam	Superimposed seam	Lap felled seam	Edge neatening seam
	Needle	DB×1	TY×64	DC×27
	Needle size	10	10	10
	Thread size (Tex)	21	21	21
Medium weight fabric	Type of stitch	Lock Stitch	Chain stitch	Overedge chain stitch
	Class	301	401	504
	Speed(rpm)	5000	4000	7000
	SPI	12	12	12
	Seam	Superimposed seam	Lap felled seam	Edge neatening seam
	Needle	DB×1	TY×64	DC×27
	Needle size	14	14	14
	Thread size (Tex)	40	40	40

Sewing parameters:

Sewing parameters were selected after data collection from local and export apparel manufacturers of Ahmedabad, Gujarat. The selection of sewing machines, machine speed, stitch and seam are described in Table B and also seams were selected which are normally used in armhole and side seam of the upper garments. Seam puckering was estimated by the increase in the fabric thickness between seamed and unseamed fabrics using eq. (4).

$$\text{Seam puckering \%} = \frac{X - Y}{Y} x\,100 \qquad ...(4)$$

where, X – seamed fabric thickness (mm), Y – unseamed fabric thickness (mm).

■ RESEARCH FINDINGS AND DISCUSSION

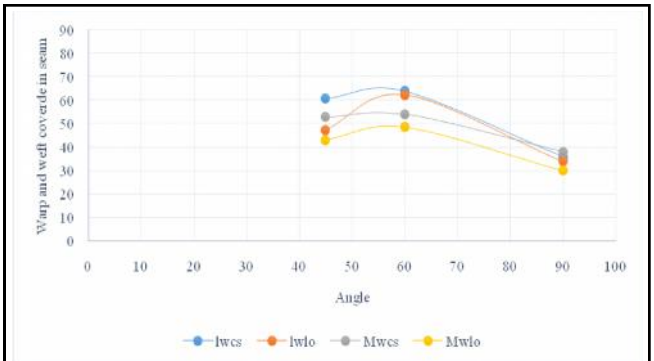
Seam puckering (%) for medium and light fabric samples at different seam angles is given in Table 1. It was observed that seam puckering was the highest in both chain stitch and combination of lock stitch and overedge chain stitch, both seams produced at 60° to the warp direction in light weight fabric. Seam puckering reduces when the seams were produced along the weft direction at 90° angle. This was due to the reason that the displacement in the yarns is shared by several warp and weft yarns during angled sewing. Seam puckering increases and then decreasesas the angle of seam increases at both stitches and seams. This was due to

Table 1 : Seam puckering per cent of light and medium weight fabric

Fabric	Stitch	Seam	Angle of seam (degrees)	Seam thickness (mm)	Seam puckering %
Light weight	Chain stitch	Lapped	45°	0.72	148.27
			60°	0.75	158.62
			90°	0.68	134.48
	Lock stitch and overedge chain stitch	Edge neatening	45°	0.52	79.31
			60°	0.54	86.2
			90°	0.48	65.51
Medium weight	Chain stitch	Lapped	45°	0.86	132.43
			60°	0.87	135.13
			90°	0.83	124.13
	Lock stitch and overedge chain stitch	Edge neatening	45°	0.77	108
			60°	0.79	113.51
			90°	0.73	97.29

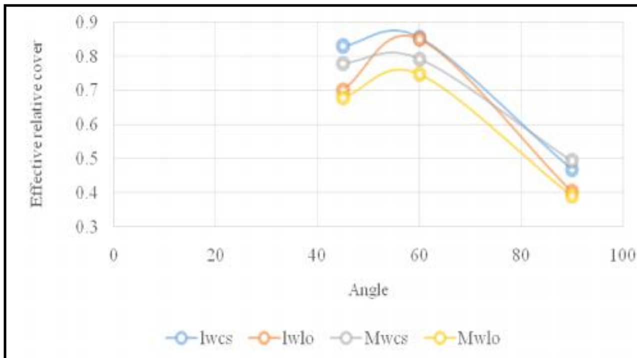
the corresponding change in the number of warp and weft yarns covered in the seam. The trends were similar for both fabrics.

Seam puckering is the lowest in seams produced at 90°. It is important to note that among light and medium weight fabrics, it is the number of yarns covered in the seam and their linear density, which contributes to the distribution of yarn displacement during sewing. These two quantities have been represented as an effective relative cover in the seam as calculated by the equation (Table 2). At 90° seam angle for the light weight fabric (Chain stitch) the number of warp covered by 1 cm of seam was 0 where as weft covered were 36. This results in the effective relative cover of 0.468. Further, it was observed that the effective relative cover for the lapped seam and combination of lock stitch and overedge chain stitch is higher in light weight fabric compared to medium weight fabrics. Fig. 1 shows the warp and weft covered in light and medium weight fabric. Whereas Fig. 2 represent the effective relative cover of both the fabrics. It has been found from this study that seam puckering in light and medium is dependent on the effective relative cover in seam. Higher effective relative cover helps the yarn displacement to be better distributed among the yarns covered in the seam. Similar work related to the present investigation was also conducted by Choudhary



Lwcs-light weight chain stitch, lwlo- light weight lock and overedge chain stitch, Mwcs-medium weight chain stitch, Mwlo-medium weight lock and overedge chain stitch

Fig. 1 : Warp and weft covered of light and medium weight fabrics



Lwcs-light weight chain stitch, Lwlo- light weight lock and overedge chain stitch, Mwcs-medium weight chain stitch, Mwlo-medium weight lock and overedge chain stitch

Fig. 2 : Effective relative cover of light and medium weight fabrics

Table 2 : Effective relative cover for light and medium weight fabric

Fabric	Stitch type	Seam type	Angle of seam (Degrees)	No. of warp covered in 1 cm of angled seam n_{11}	No. of weft covered in 1 cm of angled seam n_{22}	warp and weft covered in 1 cm of seam (n_{11}+ n_{22})	Effective relative cover of seam (K_K)
Light weight	Chain stitch	lapped	45	33.23	27.5	60.73	0.831
			60	21.5	42.4	63.9	0.856
			90	0	36	36	0.468
	lock stitch and overedge chain stitch	Edge neatening	45	24.04	23.33	47.37	0.701
			60	22.5	39.8	62.3	0.851
			90	0	34	34	0.403
Medium weight	Chain stitch	lapped	45	27.5	25.4	52.9	0.779
			60	18.5	35.5	54	0.792
			90	0	38	38	0.494
	lock stitch and overedge chain stitch	Edge neatening	45	23.33	19.7	43.03	0.679
			60	17.5	31.1	48.6	0.747
			90	0	30	30	0.390

and Goel (2013); Hati and Das (2011); Nassif (2013) and Sular *et al*. (2015).

Conclusion:

In this study, the seam puckering phenomenon for light and medium weight woven fabrics was studied for two types of stitches and seams (lapped and edge neatening) produced at different seam angles. It was observed that the seam puckering was higher in warp direction for light weight fabric. Seam puckering reduces when the seams were formed at an angle to the weft direction due to the number of warp and weft yarns covered in the seam. Seam puckering in different fabric samples was dependent on the effective relative cover in the seam. Effective relative cover was higher in chain stitch with lapped seam in light weight fabric at warp direction.The sewing parameters also influence the seam quality and causes seam puckering, therefore, it is recommended to use suitable needle size, thread size, stitch density etc. to maintain the quality of the seam.

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