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Effect of Seams on Drape of Fabrics
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Sukumar Nachiappan - Lecturer, Textile Engineering Department, Faculty of Engineering, Bahir Dar University, Bahir Dar, Ethiopia.
Email: sugumaraan@yahoo.com

Gnanavel. P. - Lecturer, KSR College of Technology, Tiruchengode–637 215, TamilNadu, India

Ananthakrishnan, T. - Professor and Head, Department of Textile Technology, Government Sri Krishna Rajendra silver jubilee Technical Institute, Bangalore – 560 001, India

Abstract
Drape of the fabric is its ability to hang freely in graceful folds when some area of it is supported over a surface and the rest is unsupported. Drape is a unique property that allows a fabric to be bent in more than in one direction, When two-dimensional fabric are converted to three-dimensional garment form. In the present study, the effects of sewing of different seam were selected on different fabric and their behaviors were studied. In this study drape of ten fabrics are analyzed with three types of seams and three stitch densities. Sample without seam is a control sample and drape of seamed samples are compared with control sample to analyse the drape behavior of seamed fabrics. This paper presents a fundamental drape analysis of seamed fabrics using drape meter. Drape behavior is determined in terms of drape coefficient. The effect of seams on the drape coefficient and Drape profile has been made. Drape coefficients significantly differs between the fabrics and also between the seam stitch density combinations. Investigating drape on seamed fabrics can improve fabric end use application.

Key words: drape, computer aided design, seam, stitch density, Design of Experiments

Introduction

Drape is an important property that decides the gracefulness of any garment as it is relates to aesthetics of garments (Kaushal Raj sharma and B.K. Behera. 2005). The mechanical properties of fabrics were first studied during the late 19th century by German researchers working on developing airships (Postle, 1998). Drape ability has been regarded as a quantitative characteristic of cloth, and several devices as well as virtual systems have been developed to measure it (Booth, 1968; Jeong, 1998; Stylios and Wan, 1999). Instruments for measuring drape ability have been developed by Chu et al. (1950) and later by Cusick (1965, 1968) using a parallel light source that reflects the drape shadow of a circular specimen from hanging disc into a piece of ring paper at present numerous instruments, ranging from a simple cantilever bending tester to a dynamic drape tester developed for measuring fabric drape. During recent years, the investigation of fabric drape has attracted the attention of many researchers because of the attempts to realize the clothing Computer aided design (CAD) system by introducing the fabric properties, in which fabric drape is the key element. It is obvious that fabrics have to be sewn together for a garment to be formed. The seams of a garment affect the fabric drape greatly (Matsudaira, M. and Yang, M. 2000). It is unrealistic to realize the appearance of a garment system without the consideration of seams and the methods of assembling of fabrics into garments (Jinlian Hu et al, 1997).

When a fabric is draped; it can bend in one or more directions. Curtains and drapes usually bend in one direction, whereas garments and upholstery exhibit a complex three-dimensional form with double curvature. Hence, fabric drape is a complex mathematical problem involving large deformations under low stresses (Postle and Postle, 1993).

A plain seam the most typical seam found extensively in apparel is the simplest type in which a single row of lock stitches joins two pieces of fabrics together. Thus, investigating the effect of a plain seam on fabric drape has a significant value for both the textile and clothing industries. The quantified drapeability of a fabric into a dimensionless value called a "Drape coefficient", which is defined as the percent of the area from an angular ring of fabric covered by a vertical projection of the draped fabric (Brand R.H.1964). "Drape co efficient (DC)" the main parameter used to quantify fabric drape (Narahari Kenkare and Traci May-Plumlee. 2005). Though useful, it is insufficient to characterize complex forms such as garments. Stylios and Zhu, 1997 considered that the drape coefficient by itself did not capture the full aesthetic quality of the drape of a fabric.

Drape profile of fabrics with seams provide guidance for garment designs and producers in the apparel industry and improve the understanding of drape properties corresponding to different seam features (Fourt.L and Hollies.N.R.S.1970). Furthermore, we expect that the results will be useful in predicting garment drape with clothing CAD systems.

Different types of seams are used in garment making and also wide stitch densities are employed. Once the fabric is joined with seams possibly its drape configuration would vary.

The product range of textile industry has extended to the garments. Mass production of operational systems and automated sewing is making more and more presence, it is very essential to understand to the change in properties the fabric under goes once it is seamed. This study is an attempt to understand the effects of seams on the drape of fabrics, which is one of key characteristics for apparels and certain draperies.

Methodology

The sample is cut and Stitch like (Radial), '+' mark with 3 different types of seams and 3 different stitch densities. The method of experiment is shown in the flow chart figure 1.

Sewing Thread

Polyester sewing thread is employed to put seam and its quality particulars are,

Thread count (Tex) Ne : (2 x 10) 2/60
Direction of Twist : Z

Types of Seam

The types of seams were selected and in each type, three stitch densities were employed. Fabrics were sewn along the warp and weft direction on a 35cm square side. Control sample for the test is a piece with no seams. This resulted in 9 treatment combinations.

(1) Plain Seam (S1)

This is the most common seam used in the garment industry. This is easy to make and pliable. It is normally suitable for all types of garments. And, it is suitable for curved locations like armhole. To make this seam we have to place two pieces of fabrics to be joined together right sides facing, matching the seam lines, and we should stitch the seam exactly on the seam line.

(2) **Welt Seam (S2)**

For constructing this, we should stitch the plan seam and press both seam allowances to one side. Then the inside seam allowance is trimmed to ¼". Then top stitching is done on the right side of the garment by catching the wider seam allowance. This type is normally used on heavy coats.

(3) French seam (S3)

The French seam is stitched twice once from the right side and once from the wrong side. It is the classic seam for sheers and looks best if the finished width is ¼" or less. To form this seam, with wrong sides of the fabric together, we should stitch 3/8" from the edge on the right side of the fabric. The seam allowance in trimmed to 1/8" and the seam is pressed well. Then the right sides are folded together with stitched line exactly on the edge of the fold and pressed again. Then the stitches are made ¼" from the fold.

Stitch Density

Three stitch densities employed are 5, 4 and 3 stitches per Cm.
Stitch was done on an industrial sewing machine.
Type: Plain Stitch Machine
T1 → Stitch Density (5 St/cm)
T2 → Stitch Density (4 St/cm)
T3 → Stitch Density (3 St/cm)

Testing

Drape test in carried out on cusik's model drape tester. The drape meter is an optical instrument. It is shown diagrammatically in figure 2. The sample holder consists of flat plates, circular in shape, mounted on a shaft coming through the base of the tester. The plates and the shaft are raised until the overhanging the overhanging portions of the sample no longer touches the base. The image of this draped pattern is cast onto a sheet by means of a lens system. This pattern is then traced on a thin piece of paper.

Figure 3 shows typical drape diagrams traced on paper sheet. The smaller circle indicates the area of supporting disc, and the larger circle indicates area of the specimen profile indicates the area of draped fabric. The term drape coefficient is used which is defined as the percent of the annular ring area covered by the draped sample.

$$\text{Drape coefficient} = \frac{A_s^2 - A_d^2}{A_D^2 - A_d^2} \text{ X } 100$$

Where A_s^2 , A^2_D and A^2_d are the area of the vertical projection of the draping sample fabric (cm^2), the area of the round sample holder (cm^2), and the area of the sample (cm^2), respectively.

2.6 Radii measures

The radii are measured for the draped patterns at the interval of 20^0. This would help to trace a nodal graph of draped patterns. Identify the shift in profiles, which may not be evident by comparing only the drape coefficients.

Design of Experiments

A null hypothesis is setup stating that there is no significant difference of the drape weft between the fabrics no significant difference exists between treatments. A two-way analysis of variance is proposed for the same.

Multi variant analysis is proposed to setup multiple regression equations for the Drape coefficients with basic parameters of the fabric.

Results and Discussion

Drape Coefficient

Table 2 shows the percent drape coefficients of samples.

Instruments and Fabrics

Ten different fabrics are chosen for the work and the following Table 1 shows fabric particulars. Considerable differences are seen in the Drape coefficients by looking at Table 2. Tables 3, 4, 5 show the results of Anova.

Results of ANOVA

The Drape coefficient significantly differs between fabrics and treatments, when control sample is included. Excluding the control sample, treatments has no effect on drape coefficients which indicates that drape coefficient changes when it's seamed but is not significant for seam type and stitch density selected.

Multiple Regressions

The table 6 is showing multiple correlation coefficients regression co-efficient for the drape co-efficient with basic fabric properties. Looking at the table it is evident that basic properties of the fabrics samples is largely governing that the drape of fabrics.

A small reduction in the drape coefficient is only indicating that the seams would slightly affect the drape coefficient.

The yarn count has a very large effect followed thread density.

Conclusion

A study on effect of seams on the drape coefficient Drape profile is been made. Three types of seams namely three stitch densities 5, 4 and 3 per centimeter has been employed. Ten fabric verities containing different fibres weaves are analyzed. Drape coefficients significantly differs between the fabrics also between the seam stitch density combination.

The Drape Coefficient alone may not give a clean idea of real drape. For this purpose the drape profiles were generated with the help of radii measures. The drape profile has clearly indicating shapes that takes place with the seams put on. Seamed fabrics have generally shown more stabilized pattern compared to control samples.

Sateen weave followed by BHC MAT weave has shown highly symmetrical patterns. The seam has markedly improved drape profile of honeycomb fabric. Polyester, Polyester/Viscous fabrics have registered better drape profiles than Polyester/Cotton fabrics. Both the cotton gray casement has shown agreeable drape profiles.

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Figure 1: Procedure flow chart

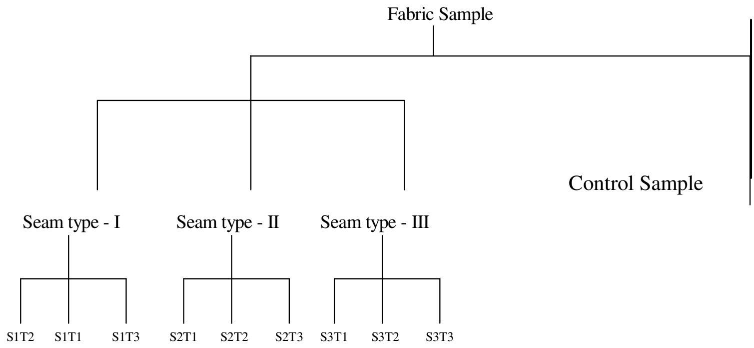
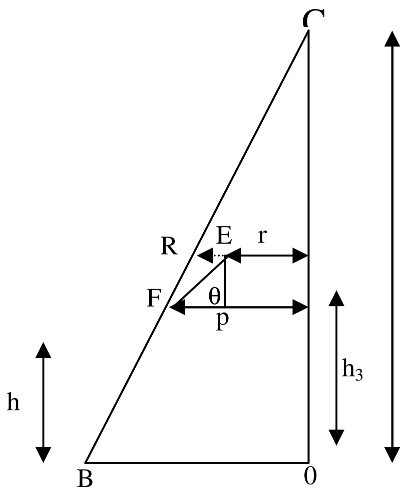


Figure 2: Nodal length



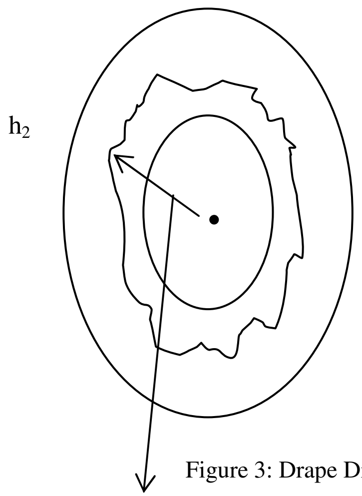


Figure 3: Drape Diagram

Table 1: Fabric Particulars

S.No	Fabric material	Warp Count	Weft Count	EPI	PPI	GSM	Weave
01.	100% polyester	5.4	6.7	48.8	26.8	51.7	Plain Weave
02.	Polyester/cotton	9.8	8.4	33.1	26.0	58.9	Plain Weave
03.	Polyester/viscose	6.7	10.9	48.8	26.8	70.4	Plain Weave
04.	Grey fabric/colon	14.1	13.4	27.6	25.2	81.7	Plain Weave
05.	Cotton (casement)	15.4	14.8	26.0	22.8	82.3	Plain Weave
06.	Cotton	16.4	16.4	18.1	18.1	65.3	Mat weave
07.	Cotton	12.8	12.8	33.9	21.3	76.7	Twill Weave
08.	Viscose	6.6	7.0	34.6	33.1	52.5	Sateen weave
09.	Cotton	29.5	29.5	16.5	11.0	88.9	Brighten honey comb
10.	Cotton	19.5	29.5	34.6	26.0	189.2	Honey comb

Table 2: Drape Coefficient

S3 -> Plain Seam T3 -> Stitch Density (3St / cm)

DRAPE CO-EFFICIENT										
Fabrics	**Control**	**S1**			**S2**			**S3**		
		T1	**T2**	**T3**	**T1**	**T2**	**T3**	**T1**	**T2**	**T3**
PET	60.2	61.3	62.7	66.0	63.9	68.7	69.4	67.3	65.6	61.2
PC	86.1	87.8	91.5	86.3	94.6	92.5	92.9	85.1	96.5	93.4
PV	60.5	69.8	70.0	73.7	74.2	76.2	76.9	73.7	79.3	72.6
Grey	70.7	67.0	73.7	70.0	70.5	70.1	72.6	75.6	72.4	73.0
Casement	82.4	80.0	78.3	83.8	87.4	86.6	85.5	78.9	78.3	82.9
Mat	61.3	75.8	73.0	59.5	73.0	69.4	67.5	67.7	67.0	69.6
Twill	75.1	78.0	77.6	82.7	82.0	82.5	76.4	83.3	83.5	75.6
Sateen	51.1	47.9	59.5	61.7	62.7	57.1	50.3	63.4	59.3	58.8
BHC	76.9	77.4	80.2	85.7	79.8	90.4	82.2	89.8	81.4	84.4
HC	81.3	87.2	88.5	87.8	82.0	85.3	79.8	79.4	76.2	83.1

S1 -> Plain Seam T1 -> Stitch Density (5St / cm)

S2 -> Plain Seam T2 -> Stitch Density (4St / cm)

Table 3: ANOVA (With control)

ANOVA (With control)						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Fabrics	9337.78	9.00	1037.53	69.06	0.00	2.00
Treatments	385.74	9.00	42.86	2.85	0.01	2.00
Error	1216.95	81.00	15.02			
Total	10940.47	99.00				

Table 4: ANOVA (Without control)

ANOVA (Without control)						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Fabrics	8229.54	9	914.39	60.10	0.00	2.01
Treatment	133.68	8	16.71	1.09	0.37	2.06
Error	1095.27	72	15.21			
Total	9458.49	89				

Table 5: Result of ANOVA

Source of Variation	**With control samples**		**Excluding control samples**	
	F-ratio	Significance	F-ratio	Significance
Fabrics	69.05	Yes sig.	60.10	Yes Sig.
Treatment	2.85	Yes Sig.	1.09	Not Sig.

Table 6

	Control	S1T1	S1T2	S1T3	S2T1	S2T2	S2T3	S3T1	S3T2	S3T3
Multiple R	0.90795	0.90355	0.87076	0.84551	0.79649	0.86908	0.81126	0.88700	0.79570	0.78674
R Square	0.82438	0.81642	0.758219	0.71488	0.63440	0.75531	0.65815	0.78677	0.633146	0.61895
Intercept	87.555	120.673	96.613	70.250	115.864	92.328	102.425	84.615	110.395	97.430
Epc	1.0854	0.7787	0.6469	1.3330	0.6697	1.3672	1.3673	1.0044	1.2294	0.7759
Ppc	-2.2717	-3.1195	-1.9211	-1.854	-2.390	-2.529	-2.884	-1.748	-2.833	-2.027
N1,Tex	7.147	3.849	4.408	5.879	4.210	5.907	5.627	4.594	4.983	4.719
N2,Tex	-7.952	-5.780	-5.413	-5.798	-5.774	-6.136	-6.565	-4.437	-6.210	-5.421
GSM	0.2116	0.4035	0.2560	0.0981	0.2701	0.0980	0.1767	0.0103	0.1764	0.1721