Effect of seamed viscose fabrics on drape coefficient

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Drape is one of the most important fabric aesthetic properties and determines the adjustment of clothing to the human silhouette. Although there are many studies related to the drape structure of seamless fabrics, knowledge about the drape behavior of seamed fabrics is very limited. This study aims to examine the effect of seamed viscose fabric on the drape coefficient. For this purpose, 9 different viscose fabrics and 4 different stitch types like lock stitch, chain stitch, three-thread overlock and four-thread overlock stitch were selected. 2 different stitch densities were applied to seamed fabrics for determining the effect of changing stitch density on the drape coefficient (DC). Seam operations increase the DC of fabrics. This means that the fabric drape is decreased by seam operations. Increase in stitch density increases the DC. This effect is quite clear for light and medium weight viscose fabrics compared to the heavy weight viscose fabrics. The difference of the DC due to the changing of stitch density was found to be minimum in the fabric seamed with three-thread overlock except for the fabric 107 and 118 gm^{-2} in weight. The biggest differences of DC due to the changing of stitch density were observed in the fabrics seamed with chain and lock stitch, respectively. Strong correlation was found between the drape coefficient of unseamed fabric with fabric weight and thickness. Correlation coefficients (r) are 0,96 and 0,89, respectively. In like manner, values of the drape coefficient of seamed fabrics have a high correlation with fabric weight (r= 0,93) and thickness (r= 0,84).
Key words: *viscose fabric, drape, garment*

1. Introduction

Drape is an important property that decides the gracefulness of any garment as it is related to aesthetics and appearance of garments. It describes the way in which fabric hangs itself in specific shape according to its properties when part of it is supported by any surface and the rest is unsupported. Drape is of great importance for designing and development of garments and the selection of appropriate fabric for an intended garment [1].

In order to create a seam, a fabric is cut into pieces and sewn together with stitches. Various seams can be obtained by combining different fabric cutting, joining and stitching parameters and this will lead to substantial variation in fabric drape performance. Thus, investigation of the impact of a seam on fabric drape performance can help with understanding, evaluation and assurance of the appearance of the final garment [2].

Drape, along with color, luster and texture is an important factor affecting the aesthetics and dynamic functionality of fabrics. Drape is a critical textile characteristic in determining how clothing conforms to the shape of the human silhouette. It prescribes the fabric deformation produced by gravity when a part of the fabric is

directly supported. In use, this unique characteristic can provide a sense of fullness and a graceful appearance, which ultimately distinguishes fabric from other sheet materials [3].

According to British Standard Institute, drape is the extent to which a fabric will deform when it is allowed to hang under its own weight and the drape coefficient describes the way the fabric falls down, takes a special shape on a model or human body under gravitation [3, 4].

The drape of a fabric is a measure of the way in which it hangs down in folds. Bending stiffness and shear stiffness have a significant effect on fabric drape, and consequently, fabric construction factors of yarn count, fabric density, and weave are important. Heavy fabrics from coarse yarns and dense constructions may have poor drape characteristics (high bending and shear stiffness).Fabrics with long floats in the weave that permit the yarns to move freely have lower bending and shear rigidity, leading to better drape behavior [5].

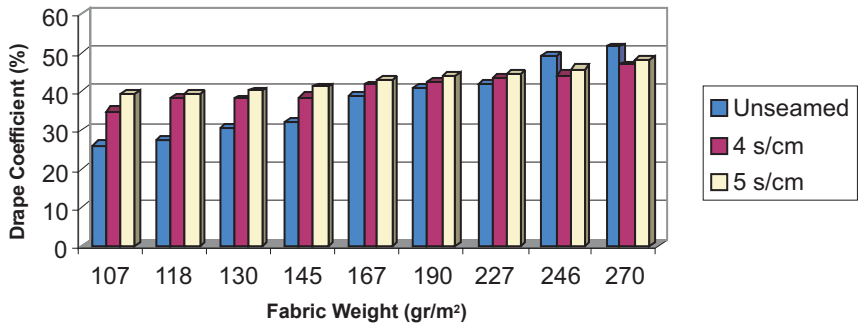

Fig.1 Effect of changing of stitch density to DC for lock stitch

There are many experimental and theoretical studies [6-11] on seamless fabric drape but studies on drape behavior of seamed fabric is very limited.

Sharma et al. [1] investigated the effect of sewing and fusing of interlining on drape behavior of men's suiting fabrics. Hu et al. [12] studied the effect of a plain seam on the drape structure of a woven fabric and showed that the drape coefficient (DC) increases with the number of seam, but it is slightly affected by increases in the seam allowance. Ucar

Tab.1 Properties of investigated viscose fabrics

Fabric weight (gm^{-2})	Yarn count (tex)	Ply	Yarn count (tex)	Ply	Yarn density		Fabric thickness (mm)	Weave
	Warp		Weft		Ends/cm	Picks/cm		
107	18.5	1	16.4	1	30	35	0.21	Plain
118	18.5	1	16.4	1	32	36	0.24	Plain
130	29.5	1	29.5	1	23	18	0.25	Plain
145	29.5	1	29.5	1	26	23	0.29	Plain
167	36.9	1	49.2	1	18	16	0.32	Plain
190	49.2	1	49.2	1	18	18	0.33	Plain
227	19.7x2	2	49.2	1	32.5	17	0.36	Plain
246	19.7x2	2	49.2	1	34	18	0.37	Plain
270	21.1x2	2	21.1x2	2	35	20	0.39	Plain

Tab.2 Drape coefficients for fabrics seamed with lock stitch

Fabric weight (gm^{-2})	Fabric drape coefficient DC (%)						
	Unseamed DC_1 (%)	CV (%)	Seamed				
			4 s/cm DC_2 (%)	CV (%)	5 s/cm DC_3 (%)	CV(%)	Difference (DC_3-DC_2)
107	26.27	0.83	35.03	1.02	39.29	1.22	4.26
118	27.39	1.13	38.15	0.99	39.45	0.88	1.30
130	30.36	0.95	38.10	1.07	39.91	1.16	1.81
145	32.10	1.15	38.65	1.01	41.16	1.10	2.51
167	38.91	0.96	41.58	1.15	43.10	1.22	1.52
190	41.10	1.04	42.65	0.84	43.92	1.15	1.27
227	41.90	1.18	43.59	1.20	44.67	1.20	1.08
246	49.15	1.11	44.19	1.14	45.88	1.18	1.69
270	51.66	0.84	46.81	0.97	48.02	0.96	1.21

et al. [13] analyzed the five-thread overlock seams on the drape behavior of heavy weight knit fabric to provide equations for drape. Jevsnik et al. [14] analyzed the influence of seam types and directions on fabric drape. Viscose fabric has a silky appearance and feel; it breathes like cotton and has a good 'drape.' It's relatively light, resulting in lightweight clothing. Although there are many studies related to the drape structure of seamless fabrics, knowledge about the drape behavior of seamed fabrics is very limited. This study analyzes the effect of seamed viscose fabric on drape coefficient.

2. Materials and method

In the present study, the Cusick Drapemeter was used for evaluating seamed and unseamed fabric drape in terms of the drape coefficient.

Cusick Drapemeter was designed and developed by Cusick and is widely used to measure the drape of the fabrics in the textile and apparel industries. DC is used as the main parameter to quantify fabric drape. The digital value of the drape coefficient enables objective assessment of fabric property. Drape is related to the rigidity. A low value of the drape coefficient is identified with a fabric which deforms easily. Very stiff fabrics have a drape coefficient close to 100 per cent, whereas soft fabrics have one close to 0 per cent. Values of drape coefficients ranged from 30 per cent for fabrics of loose weaves to 90 per cent for rigid fabrics with tight weaves [4].

In this study, 9 viscose fabrics having different properties were used. The weights of fabrics selected were 107, 118, 130, 145, 167, 190, 227, 244, and 270 gm^{-2}, respectively. Weights of fabric were measured with an electronic weighing balance. ASTM D-1059 test method was used in determining the yarn counts of fabric. Yarn densities of fabric were determined according to ASTM D 3775 test method.

Most of the seams are applied in warp direction in garments. Hence, the seam was done in warp direction of fabric along the diameter of a circular drape specimen. After seaming, samples were cut into round shapes 30 cm in diameter for the test.

Four different stitch types were applied to test samples. These stitch types were lock stitch (301), two-thread chain stitch (401) and three-thread overlock stitch (504) and four-thread overlock stitch (512). Stitch density was chosen as 4 stitches/cm and 5 stitches/cm for examining the effect of stitch density to the drape coefficients of fabrics used. Stitch tension was maintained constantly on both sides of the fabrics. Ten tests of drape were carried out for each sample. Seaming of the fabrics was done with industrial sewing machines. Sewing conditions are given below,

- Sewing machines: Siruba L818F (301), Juki MH-481-4-3U (401)
- Juki MO-6704S –OE4-40H (504), Juki MO-6914C–BE6-307 (512)
- Sewing thread: 2-ply polyester sewing thread (155 dtex x 2)
- Looper thread (for 401-chain stitch): 2-ply polyester sewing thread (dtex 115 x 2)
- Types of seams (ASTM D 6193) : SSa (301), SSd (401), Ssa-1 (504 and 512)
- Machine speed: 4500 stitches/min (301), 5500 stitches/min (401) 8000 stitches/min (504 and 512)
- Seam allowance: 1 cm (for 301 and 401)
- Seam width: 7 mm (for 504 and 512)
- Stitch density: 4 s/cm and 5 s/cm
- Number of seams on sample: Straight single
- Needle point form: Set point
- Needle size: Needle number 12 was used for viscose fabrics.

Specimens to be tested were conditioned for 24 hours in standard atmosphere conditions (20 °C, 65 % relative humidity).

Results of the test were statistically evaluated using the SPSS for Windows Version 11,0.

3. Results and discussion

The aim of this study was to examine the effect of seam to drape properties of viscose fabrics used widely for garments such as blouses, dresses, lingerie, shirts and jackets. For this purpose 9 different viscose fabrics and 4 stitch types were selected. The results on the dimensional properties of those viscose fabrics selected are given in Tab1.

In Tab.1, it can be easily seen that, all viscose fabrics have a plain weave and the fabric thickness increase together with areal density of the fabric. Increase in mass has been obtained by incorporating coarser yarn to fabric.

When the Tab.2-5 are examined, it can easily be observed that the DC is increased by the seam operations applied to the fabrics. This means that the fabric drape is decreased by the seam operations. The explanation of this state is as follows;

The application of any seam to the fabric increases its resistance to the fall against gravity. A sewn fabric is not one piece of fabric it is in two parts of same fabric which are joined by an additional sewing thread. This leads to the increase in fabric stiffness which can be due to the additional fabric as a result of a seam under the face side of drape specimen of sewn fabric. This additional fabric lies under the fabric as a second layer and supports the top layer of the specimen against hanging which leads to an increase in the drape coefficient of specimen. It can also be due to the sewing thread used to sew two pieces of fabric. When this thread traverses between the two fabric pieces it acts like forming a bridge between two fabric pieces and provides rigidity in the seam line which therefore increases its bending rigidity [1].

Further, it can be seen from Tab.2-5 that the value of DC of the fabric seamed with overlock stitch is higher than the values of DC of fabric seamed with chain and lock stitch. The higher values of DC were found in

four-thread overlock stitch. It may be due to the incorporation of more sewing thread in the seam line compared to lock stitch, chain stitch, and three-thread overlock stitch resulting in extra stiffness. The effect of lock stitch to the DC was found to be less compared to the other stitch types examined.

For each stitch type, increase in stitch density increases the DC but this increase is higher for light weight viscose fabrics (107, 118 and 130 gm^{-2}) compared to the medium (145, 167, and 280 gm^{-2}) and heavy weight (227, 246 and 270 gm^{-2}) viscose fabrics.

The difference of the DC due to the changing of stitch density was found to be minimum in the fabric seamed with three-thread overlock except for the fabric 107 and 118 gm^{-2} in weight.

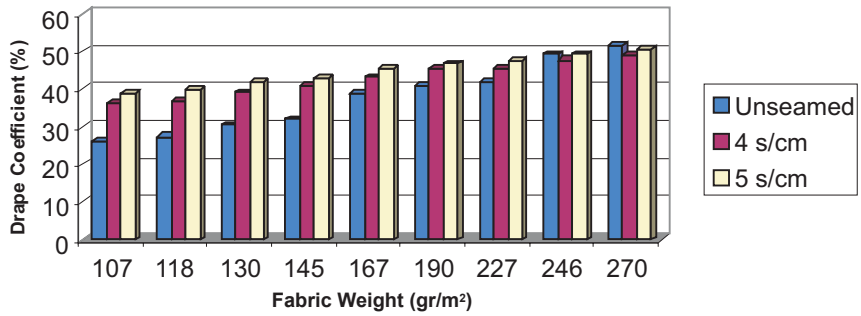

Fig.2 Effect of changing of stitch density to DC for chain stitch

The biggest differences of DC due to the changing of stitch density were observed in the fabrics seamed with chain and lock stitch, respectively. Especially, it attained the peak values in the light (107, 118 and 130 gm^{-2}) and medium weight (145, 167, and 280 gm^{-2}) viscose fabrics. Effects of changing stitch density for lock stitches and four-thread overlock stitches on DC reached maximum values in fabric 107 gm^{-2}. Graphic demonstrations for the effect of changing of stitch densities on DC were given in Fig.1, 2, 3 and 4.

According to the statistical analysis conducted at 95 % statistical confidence level, coefficients of variation

Tab.3 Drape coefficients for fabrics seamed with chain stitch

Fabric Weight (gm^{-2})	Fabric Drape Coefficient DC (%)						
	Unseamed DC_1 (%)	CV (%)	Seamed				
			4 s/cm DC_2 (%)	CV (%)	5 s/cm DC_3 (%)	CV(%)	Difference (DC_3-DC_2)
107	26.27	0.83	36.12	1.12	38.93	1.20	2.81
118	27.39	1.13	36.87	1.33	39.98	0.96	3.11
130	30.36	0.95	39.15	1.19	41.85	1.22	2.70
145	32.10	1.15	40.91	1.06	42.89	1.11	1.98
167	38.91	0.96	43.16	0.87	45.60	1.27	2.44
190	41.10	1.04	45.59	1.10	46.88	1.00	1.29
227	41.90	1.18	45.71	1.22	47.65	0.93	1.94
246	49.15	1.11	47.89	0.99	49.16	1.19	1.27
270	51.66	0.84	49.09	0.89	50.55	0.98	1.46

Tab.4 Drape coefficients for fabrics seamed with three-thread overlock stitch

Fabric weight (gm^{-2})	Fabric drape coefficient DC (%)						
	Unseamed DC_1 (%)	CV (%)	Seamed				
			4 s/cm DC_2 (%)	CV (%)	5 s/cm DC_3 (%)	CV(%)	Difference (DC_3-DC_2)
107	26.27	0.83	39.90	0.92	42.94	1.11	3.04
118	27.39	1.13	41.19	1.14	43.91	0.89	2.72
130	30.36	0.95	43.11	1.09	44.09	1.15	0.98
145	32.10	1.15	44.99	1.27	45.85	1.08	0.86
167	38.91	0.96	46.88	1.11	47.81	1.09	0.93
190	41.10	1.04	47.91	1.10	48.09	1.10	0.18
227	41.90	1.18	50.66	0.83	51.01	1.05	0.35
246	49.15	1.11	53.95	1.08	54.05	1.18	0.10
270	51.66	0.84	54.99	1.17	55.16	0.94	0.17

of DC values are situated in the 0.68-1.21 % rank. A strong correlation was found between the drape coefficient of unseamed fabric with fabric weight and thickness. Correlation coefficients (r) are 0,96 and 0,89, respectively. In like manner, values of drape coefficient of seamed fabrics have a high correlation with fabric weight (r= 0,93) and thickness (r= 0,84). Additionally to this, value of correlation coefficient (r) between viscose fabric weight and thickness was determined as 0.89.

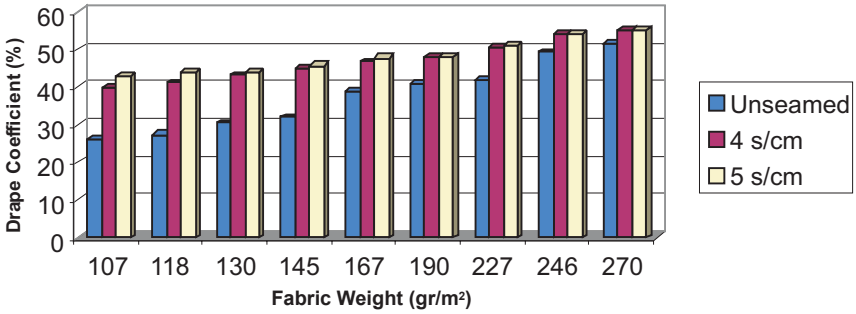

Fig.3 Effect of changing of stitch density to DC for three-thread overlock stitch

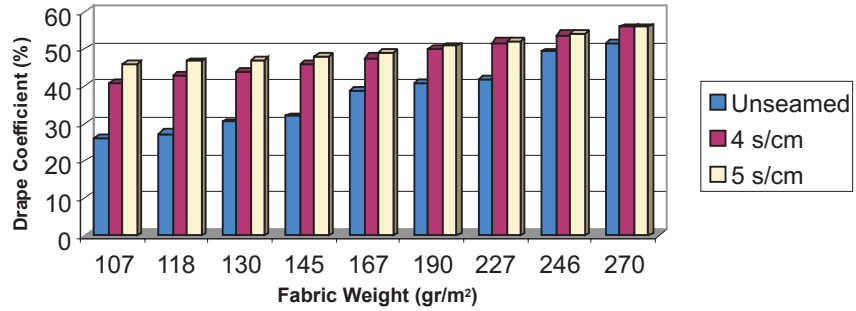

Fig.4 Effect of changing of stitch density to DC for four -thread overlock stitch

4. Conclusions

As it is known, garments are produced from fabrics seamed with various seam and stitch types. In this study, the effect of seam to drape coefficient of viscose fabrics which is widely used in garment manufacturing, in terms of different stitch types and densities was examined. For this purpose, 9 different viscose fabrics, 4 different stitch types and 2 different stitch densities were selected. Increase in fabric weight and thickness causes the increase in drape coefficient (DC) of fabric. In like manner, the DC of fabric increases with seaming operations applied to viscose fabrics. This means that seam operations cause the decrease of fabric drape. The value of the DC of fabric seamed with four-thread overlock stitch is higher than the values of DC of fabric seamed with chain, lock and three-thread overlock stitch. The effect of lock stitch to the DC was found to be less compared to the other stitch types examined.

For each stitch type, increase in stitch density increases the DC but this increase is higher for light weight (107, 118 and 130 gm^{-2}) and medium weight (145, 167, and 280 gm^{-2}) viscose fabrics compared to the and heavy weight (227, 246 and 270 gm^{-2}) viscose fabrics.

The difference of DC due to the changing of stitch density was found to be minimum in the fabric seamed with four and three -thread overlock stitches for heavy weight viscose fabrics. The biggest differences of DC due to the changing of stitch density were observed in the light weight viscose fabrics. The effect of changing stitch density for four-thread overlock stitch on the DC was found maximum value in fabric 107 gm^{-2}. High corre-

Tab.5 Drape coefficients for fabrics seamed with four-thread overlock stitch

Fabric weight (gm^{-2})	Fabric drape coefficient DC (%)						
	Unseamed DC_1 (%)	CV (%)	Seamed				
			4 s/cm DC_2 (%)	CV (%)	5 s/cm DC_3 (%)	CV(%)	Difference (DC_3-DC_2)
107	26.27	0.83	40.93	0.82	45.98	1.21	5.05
118	27.39	1.13	43.01	1.21	46.74	0.79	3.73
130	30.36	0.95	44.01	1.45	47.09	1.05	3.08
145	32.10	1.15	45.91	1.13	48.05	1.28	2.14
167	38.91	0.96	47.89	1.00	49.03	1.11	1.14
190	41.10	1.04	49.96	1.18	50.86	1.17	0.90
227	41.90	1.18	51.86	0.88	52.08	1.15	0.22
246	49.15	1.11	53.82	1.98	54.06	1.22	0.24
270	51.66	0.84	55.93	1.101	56.03	0.81	0.10

lation was determined between the drape coefficient of unseamed fabric and fabric weight (r= 0.96).

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