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Some Aspects of Fabric Drape

Abstract
Drape is one of the important factors influencing the aesthetics and functionality of fabrics. Therefore, investigation into drape parameters is important for analysing its behaviour. Drape parameters were investigated from different aspects using the Cusick Drape meter and Image Analyser. Firstly, the influence of time on the drape coefficient and number of folds was studied over 24 hours. Usually, drape is considered as a static, time-independent problem. However, this investigation shows that the drape coefficient of a fabric changes significantly over a longer time period. Furthermore, the comparison of drape parameters is shown using samples with two different diameters. The larger samples have smaller drape coefficient than those with smaller diameters, and their drape is less changeable over time. Basically, the three-dimensional fabric drape is not an independent fabric property, therefore, the connection between bending rigidity and drape coefficient was studied. The last aspect of this investigation was the repeatability of drape measurements, and the establishment of the required number of measurements for drape coefficient and fold numbers.

Key words: *fabric drape, drape parameters, time-dependence, bending rigidity, measurement repeatability.*

Introduction

Drape is an important factor when presenting the aesthetics and functionality of both, the fabric and the created garment. In general, drapeability is described as a phenomenon of fabric-fold formation, which arises when a fabric hangs down without the influence of external forces. Basically, fabric drape is not an independent fabric property. It depends on the fabric's parameters such as structure, yarn type, fibre content, as well as its finishing treatments. In addition, we have to take into account that each time a fabric is draped, it hangs in a slightly different configuration. The reasons for this unpredictable shape of fabric drape are the above-mentioned fabrics' parameters, including non-homogenous fabric structure, the shape of the object over which the fabric is draped, as well as the environmental and other conditions.

The drapeability of textile materials can be evaluated subjectively and objectively. Subjective evaluation includes the rating of drape profile, but the results depend on the person evaluating, and the prevailing fashion [1]. Subjective drape is also affected by the length of draping fabric on the pedestal [2]. Objective evaluation of a fabric's drape includes the measurements of drapability in terms of: drape coefficient and folds depth together with their number and distribution. The results gained depend on the measurement equipment used [2 - 5].

The progress of evaluating fabric drape was begun by Peirce. He developed a cantilever method for measuring the bending length of two-dimensional fabrics [6], Figure 1.

This measuring method has been modified over past decades [7 - 9]. The important parameters that describe two-dimensional drape are bending length and bending rigidity. The first bending rigidity equation for fabrics was written by Peirce [6]:

$$B = wc^3 \qquad (1)$$

where:
B - bending rigidity,
w - surface weight of fabric,
c - bending length of fabric.

A significant contribution to the practical evaluation of a fabric's three-dimensional drape, Figure 2, was the development of the F.L.R. drape meter by Chu [4] and, later, Cusik [10]. The development of new measuring techniques allows the evaluation of larger numbers of quantitative values for drape parameters. Drape coefficient is still valid as the primary attribute for explaining drape, but on the other hand, it is insufficient for completely describing it. Two fabrics, for instance, with the same drape coefficient, could have completely different drape shapes. The drape coefficient is calculated as [10]:

$$DC = \frac{S_p - \pi r_1^2}{\pi r_2^2 - \pi r_1^2} \qquad (2)$$

where:
DC - drape coefficient,
S_p - projection area of the draped specimen including the part covered by the horizontal disc, mm^2,
r_1 - radius of horizontal disc, mm,
r_2 - radius of the specimen before draping, mm.

However, the drape parameters are considered as the number of folds on a tested sample, the fold amplitude length, which represents the length of a wave between two folds, the minimum fold amplitude $I_{G_{min}}$, which means the smallest distance between the circle's centre and the curve of the draped sample, and the maximum fold amplitude $I_{G_{max}}$, denoting the biggest distance between the circle's centre and the curve of the draped sample (Figure 3), all these parameters are still not enough for completely describing drape phenomena.

Fabric drape is related to a fabric's mechanical properties. The important influential factors are bending, shear, formability, fabric weight and thickness. Different authors proclaim different connections between the physical

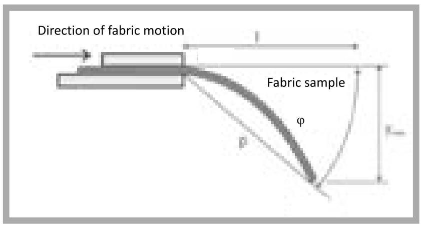


Figure 1. *Two-dimensional fabric drape.*

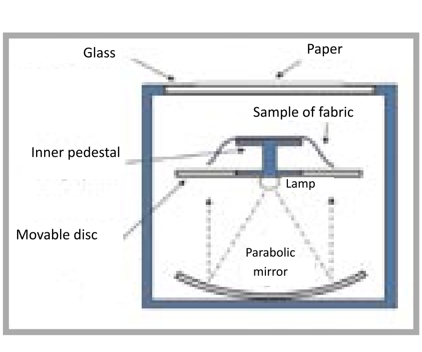


Figure 2. *Three-dimensional fabric drape.*

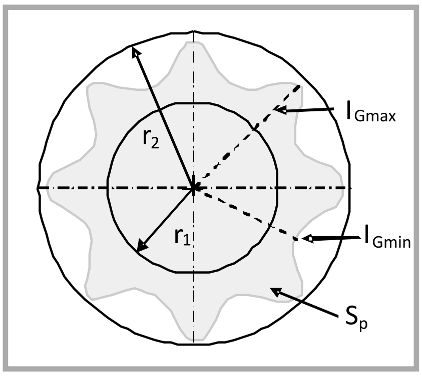


Figure 3. Projection of the draped sample of fabric.

or mechanical properties, and the drape coefficient, and which of these properties is most significant for predicting drape coefficient [1, 2, 8, 11 - 13]. Mooraka and Masako [13], and Niwa & Seto [14] introduced some relationship between drape coefficient and mechanical properties. In general, fabric drape is closely related to fabric stiffness [1]. Very stiff fabrics have high drape coefficient values but very limp, loose fabrics have lower values.

Furthermore, the shape of the fabric drape changes over time because gravity has an influence on the sample. Examples from real life when this has to be considered are, for instance, clothes on dummies in shop-windows, curtains and tablecloths. Changes in fabric drape over time should be considered by those researchers who deal with the construction of mechanical fabric models, and the prediction of their drapeability. Investigations into the time-dependence of fabric drape have been seldom. The experiments were conducted only over a shorter time period (10 min), and it was found that the drape coefficient decreases exponentially over time [15]. In addition, some Japanese researchers investigated dynamic drape behaviour [16, 17], in which they found that when the dynamic drape coefficient (D_d) is large the draping shape is easily changed by a small force such as light wind or the swinging motion of the human body.

Evaluating a fabric's drape parameters is important not only for textile and clothing producers but also for experts in the area of computer graphics. For a virtual computer simulation of fabric drape behaviour, it is necessary to create a reliable model of the fabric. The establishment of physically-based numerical models, which can enable efficient and accurate simulation of the drape and other complex deformations of the fabric, is still a great challenge for researchers. Over the last ten decades several computer techniques have been developed or used for the simulation of fabric behaviour such as the finite-element method, the finite-difference method, the particle-based method, the continuum approach and so on [2, 11, 18, 19, 20, 21]. It is well-known that it is impossible to produce identical shapes of fabric drape even when the repetitional conditions are the same. The question then arises as to whether the simulation of fabric drape is good. Pandurangan et al. [22] determined the region of acceptance for simulated drape fabric shape using real measurements (drape coefficient, number and the dimensions of the folds).

The aim of our investigation was to analyse changes in drape parameters such as the influence of time, bending rigidity, sample diameters and measurement repeatability, from different aspects over a longer time period. Understanding drape phenomena over measured parameters can help to evaluate and ensure the appearance of the final clothes in real life, as well as improving computer simulation of fabric drape.

Methodology

Drape parameters from several aspects were analysed within our research framework, Figure 4.

We carried out an investigation of eight weave fabrics with the presented in Table 1.

Measuring the drape coefficient and other drape parameters: number of folds and the maximum and minimum folds amplitude of three dimensional drape, was accomplished using the Cusick Drape Meter with a Drape Analyser. Measurements were carried out over four time periods: 2, 4, 6 and 24 hours after the first measurement.

The standard diameter of samples, d_1=30 cm, for drape measuring [23] was used for all eight fabrics. To establish the influence of a sample's size, the longer diameter was chosen, d_2 = 36 cm, which is, according to standard DIN 54306 [23], commonly meant for testing nonwoven samples. Samples with a longer diameter were prepared for the first three fabrics: F1, F2 and F3. The diameter of the inner pedestal on the Cusick Drape Meter is, in both cases, the same (d_p = 18 cm), so the hanging parts of the fabric samples with different diameters are different; for sam-

Table 1. Specification of fabric samples.

Fabric	Raw material	Weave type	Linear density, tex		Yarn density, thread/cm		Fabric weight, gm^{-2}
			Warp	Weft	Warp	Weft	
F1	100% wool	Broken Twill	180	170	7.5	8.5	277.8
F2	100% cotton	Hopsack	38	38	25	22	183.9
F3	100% cotton	Plain	10	14	52	46	109.9
F4	100% polyamid	Cirkas batavia twill	19	11	69	41	198.2
F5	100% linen	Weft rib	52	52	30	24	294.2
F6	63% polyester 37% viscose	Twill	35	41	27	25	226.0
F7	100% cotton	Satin	9	15	100	46	179.5
F8	100% wool	3-end warp twill	62	62	36	24	223.5

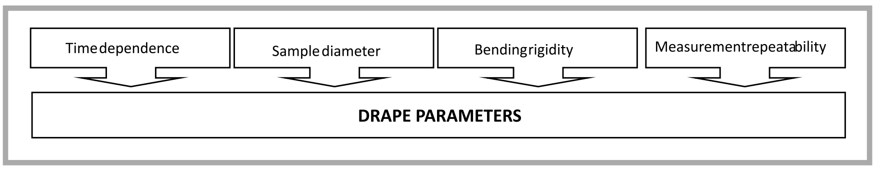


Figure 4. Aspects for analysing drape parameters.

ples with d_1 = 30 cm it is 6 cm and for samples with d_2 = 36 cm it is 9 cm.

The fabric's bending length and bending rigidity were determined using the FAST system, namely the FAST-2 component [9].

All measurements were carried out under standard testing conditions, i.e. temperature of 20 ± 2 °C and 65 ± 2% relative air humidity.

According to standard DIN 54306 [23], the least three samples must be measured to determine drape coefficient, while no rules are available for the measurement of fold numbers. When considering facts in the theoretical part, it is difficult to obtain repeatability of fabric drape measurement, even though the conditions are the same, so we carried out some investigations in the required measurement repetition, in order to obtain satisfactory results for drape coefficient and fold numbers. We chose two fabrics, F2 and F3 (diameter d_2), for this investigation because they are of the same fibre composition, but strongly differ in bending rigidity and drape parameters. The needed number of observations (n) can be calculated from the requested half-width: $z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$ of the confidence interval with limits $\bar{x} \pm z_{\frac{\alpha}{2}} \cdot \frac{s}{\sqrt{n}}$. Here the critical value $z_{\frac{\alpha}{2}}$ corresponds to the confidence level 1 - α,

$$\bar{x} = \frac{1}{n} \sum x_i \qquad (3)$$

is an estimate of the mean and

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2} \qquad (4)$$

is an estimate of standard deviation. For a needed half-width p from the request $z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}} \leq p$ it follows:

$$n \geq \left(\frac{z_{\frac{\alpha}{2}} \cdot s}{p} \right)^2 \qquad (5)$$

Similary to the request for relative error p_r $\frac{z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}}{\bar{x}} \leq p_r$ it follows:

$$n \geq \left(\frac{z_{\frac{\alpha}{2}} \cdot s}{p_r \cdot \bar{x}} \right)^2 \qquad (6)$$

We performed 31 observations for each sample. The chosen confidence level 1 - α was 0.95, critical value $z_{\frac{\alpha}{2}}$ 1.96, and for relative error p_r we chose two values p_{r1} = 2 % and p_{r2} = 5 %.

Results

The analysis of time-dependence for fabric drape is based on investigating any changes in drape coefficient, number of folds, amplitude length, minimum amplitude and maximum amplitude over four time periods: 2, 4, 6 and 24 hours after the first measurement, for both diameters of the samples (Table 2 and 3).

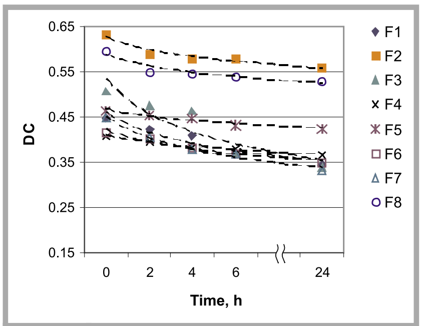
The changes in drape coefficient of the fabric samples for both diameters over time, are shown in Figures 5 and 6. In these figures the trend lines and correlation coefficients R^2 are also given.

Table 2. *Drape parameters for the analysed fabrics with diameter d_1=30 cm.*

Fabric	Drape parameters	Time, h				
		0	2	4	6	24
F1	Drape coefficient	0.448	0.424	0.410	0.370	0.344
	Fold numbers	8	8	8	8	8
	Minimum amplitude, cm	10.31	9.99	10.02	9.40	9.17
	Maximum amplitude, cm	13.80	13.70	13.64	13.53	13.33
F2	Drape coefficient	0.632	0.589	0.578	0.578	0.559
	Fold numbers	5	5	5	5	5
	Minimum amplitude, cm	10.57	10.14	10.05	10.03	9.85
	Maximum amplitude, cm	14.85	14.76	14.73	14.77	14.67
F3	Drape coefficient	0.506	0.474	0.463	0.371	0.34
	Fold numbers	7	7	7	7	7
	Minimum amplitude, cm	10.78	10.54	10.29	9.74	9.57
	Maximum amplitude, cm	14.17	13.92	13.98	13.75	13.62
F4	Drape coefficient	0.408	0.395	0.383	0.379	0.365
	Fold numbers	6	6	6	6	6
	Minimum amplitude, cm	9.12	9.05	9.03	9.12	9.11
	Maximum amplitude, cm	14.12	14.12	14.07	14.1	14.12
F5	Drape ratio	0.463	0.454	0.448	0.431	0.423
	node number	7	7	7	7	7
	Minimum amplitude, cm	9.99	9.77	9.92	9.80	9.71
	Maximum amplitude, cm	13.94	13.96	13.02	13.92	13.93
F6	Drape coefficient	0.415	0.402	0.383	0.368	0.349
	Fold numbers	7	7	7	7	7
	Minimum amplitude, cm	10.45	10.39	10.15	10.10	9.92
	Maximum amplitude, cm	13.61	13.71	13.52	13.68	13.5
F7	Drape coefficient	0.447	0.404	0.38	0.369	0.33
	Fold numbers	8	8	8	8	8
	Minimum amplitude, cm	10.07	9.90	9.69	9.69	9.74
	Maximum amplitude, cm	13.83	13.68	13.71	13.63	13.68
F8	Drape coefficient	0.596	0.551	0.545	0.538	0.529
	Fold number	7	7	7	7	7
	Minimum amplitude, cm	10.39	9.94	9.87	9.43	8.21
	Maximum amplitude, cm	14.31	14.23	14.25	14.25	14.18

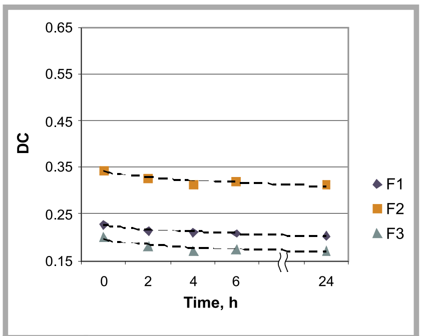
Table 3. *Drape parameters for the analysed fabrics with diameter d_2=36 cm.*

Fabric	Drape parameters	Time, h				
		0	2	4	6	24
F1	Drape coefficient	0.226	0.213	0.21	0.209	0.202
	Fold numbers	6	6	6	6	6
	Minimum amplitude, cm	8.95	9.01	9.12	9.14	9.07
	Maximum amplitude, cm	15.82	15.87	15.84	15.85	15.73
F2	Drape coefficient	0.343	0.326	0.313	0.318	0.312
	Fold numbers	6	6	6	6	6
	Minimum amplitude, cm	9.75	9.65	9.61	9.47	9.39
	Maximum amplitude, cm	16.68	16.45	16.31	16.37	16.3
F3	Drape coefficient	0.199	0.179	0.172	0.173	0.172
	Fold numbers	6	6	6	6	6
	Minimum amplitude, cm	8.93	8.85	8.83	8.94	8.85
	Maximum amplitude, cm	15.88	15.75	15.57	15.63	15.7



Fabric	Function	R^2
F1	$y = 0.4615\ x^{-0.1560}$	0.87
F2	$y = 0.6271\ x^{-0.0695}$	0.83
F3	$y = 0.5358\ x^{-0.2399}$	0.79
F4	$y = 0.4104\ x^{-0.0647}$	0.95
F5	$y = 0.4676\ x^{-0.0551}$	0.88
F6	$y = 0.4226\ x^{-0.1036}$	0.91
F7	$y = 0.4524\ x^{-0.1710}$	0.94
F8	$y = 0.5897\ x^{-0.0703}$	0.94

Figure 5. *Time-dependence of drape coefficient for samples with diameter d_1 = 30.*



Fabric	Function	R^2
F1	$y = 0.2250\ x^{-0.0628}$	0.95
F2	$y = 0.3406\ x^{-0.0580}$	0.89
F3	$y = 0.1951\ x^{-0.0914}$	0.87

Figure 6. *Time-dependence of drape coefficient for samples with diameter d_2= 36 cm.*

The change of drape coefficient over time as a percentage is given in Table 4, for samples with diameter d_1, and in Table 5 for samples with diameter d_2.

Data in Table 6 present differences in weight of sample parts which are draped, regarding two different diameters of samples.

The comparison between the drape coefficients of the samples with different diameters in connection with the different weight of the draped part (m_1, m_2) is presented in Figure 7.a. Figure 7.b gives the comparison of the change in drape coefficient of the draped part after 6 hours (t_1), and after 24 hours (t_2).

Further results present the differences in shape of the draped specimens with different diameters for three compared fabrics, Figure 8.

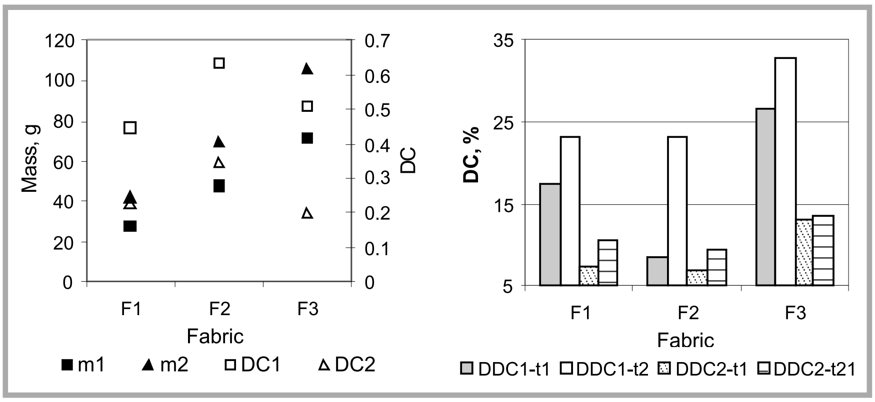


Figure 7. *Differences in drape coefficient between samples with two different diameters (d_1, d_2); m_1 - weight of draped part of sample with d_1 = 30 cm, in g, m_2 - weight of draped part of sample with d_2 = 36 cm, in g, DC_1 - drape coefficient for sample with d_1 = 30 cm, DC_2 - drape coefficient for sample with d_2 = 36 cm, ΔDC_{1-t1} - the change of drape coefficient of sample with d_1, after t_1 = 6 h, in %, ΔDC_{1-t2} - the change of drape coefficient of sample with d_1, after t_2 = 24 h, in %, ΔDC_{2-t1} - the change of drape coefficient of sample with d_2, after t_1 = 6 h, in %, ΔDC_{2-t2} - the change of drape coefficient of sample with d_2, after t_2 = 24 h, in %.*

Table 4*. Time-dependent decrease in drape coefficient (ΔDC_1), d_1 = 30 cm.*

Fabric	$\lvert\Delta DC_1\rvert$, %							
	Time, h				Time interval, h			
	2	4	6	24	0 to 2	2 to 4	4 to 6	6 to 24
F1	5.36	8.48	17.41	23.21	5.36	3.13	8.93	5.80
F2	6.80	8.54	8.54	11.55	6.80	1.74	0.00	3.01
F3	6.32	8.50	26.68	32.81	6.32	2.17	18.18	6.13
F4	3.19	6.13	7.11	10.54	3.19	2.94	0.98	3.43
F5	1.94	3.24	6.91	8.64	1.94	1.30	3.67	1.73
F6	3.13	7.71	11.33	15.90	3.13	4.58	3.61	4.58
F7	14.99	5.37	17.45	26.17	14.99	9.62	12.08	8.72
F8	7.55	8.56	9.73	11.24	7.55	1.01	1.17	7.72

Table 5. *Time-dependent decrease in drape coefficient (ΔDC_2), d_2 = 36 cm.*

Fabric	$\lvert\Delta DC_2\rvert$, %							
	Time, h				Time interval, h			
	2	4	6	24	0 to 2	2 to 4	4 to 6	6 to 24
F1	5.75	7.08	7.52	10.62	5.75	1.33	0.44	3.10
F2	4.96	8.75	6.41	9.04	4.96	3.79	2.33	2.62
F3	10.05	13.57	13.07	13.57	10.05	3.52	0.50	0.50

Table 6. *Differences between samples with diameter d_1 and d_2 regarding the weight of the draped parts of the samples, and their drape coefficient.*

Fabric	Fabrics weight of hang part, g		Differences in weight, %	Differences in DC, %
	m_1	m_2		
F1	28.26	41.93	67,41	50.45
F2	47.29	70.16		54.27
F3	71.44	105.98		39.33

Table 7. *The required number of observations for drape coefficient and fold numbers ($1 - \alpha = 0.95$; $Z_{\alpha/2} = 1.96$).*

Fabric	DC							Fold numbers						
	$\bar{x}$	s	V, %	p_{r1}	n_1	p_{r2}	n_2	$\bar{x}$	s	V, %	p_{r1}	n_1	p_{r2}	n_2
F2 (d_2)	0.33	0.02	5.31	2 %	35	5 %	6	6.13	0.34	5.56	2 %	30	5 %	5
F3 (d_2)	0.21	0.03	12.45		196		32	7.10	0.47	6.66		42		8

The influence of bending rigidity, measured in warp (B1) and weft (B2) directions on drape coefficient is presented in Figure 9.

Connections between bending rigidity and change of drape coefficient over time (after t_1= 6 hours and t_2= 24 hours), are presented in Figure 10.

The calculation of the required number of observations of drape coefficient and fold numbers is given in Table 7 for two fabrics, F2 and F3.

Discussion

This research focused on certain points of view that explain and warn about the complexability of the phenomena of fabric drape. Understanding drape phenomena is important for evaluating the appearance of the final clothing product in real life, as well as improving computer simulation of fabric drape. Therefore the drape parameters were investigated in regard to the following aspects: influence of time, the samples' diameters, bending rigidity and measurement repeatability of fabric drape.

The values of the drape coefficient for the analysed fabric samples with standard size of diameter (d_1) are very different: the values are from 0.408 (F4) to 0.632 (F2), Table 2.

The number of folds in these groups was from 5 to 8. The fabrics F3, F5, F6 and F8 have the same number of folds, seven, by different drape coefficients and different construction parameters. Only fabrics F6 and F8 of these four fabrics have similar yarn density, fabric weight and weave type, which shows that weave type influences fabric the drape, Table 2.

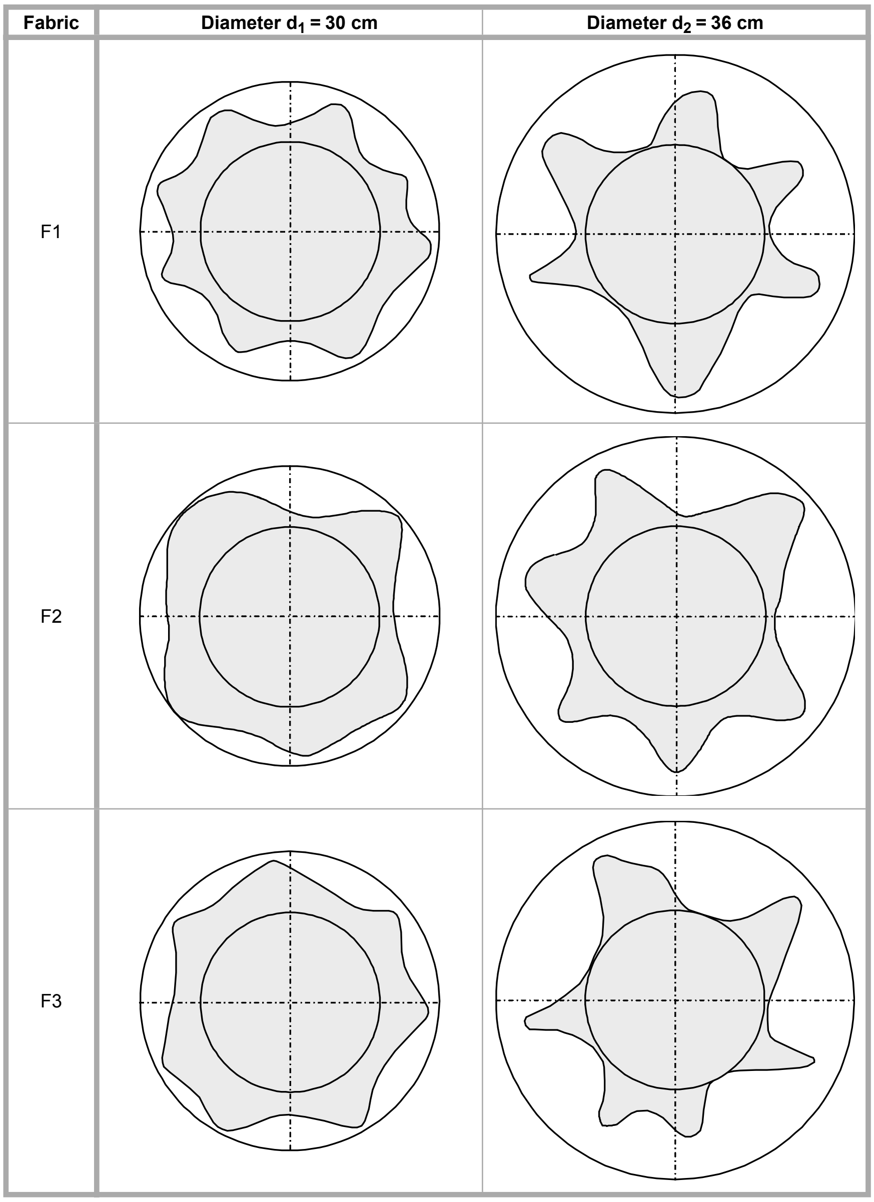


Figure 8. Shape of draped specimens with different diameters (d_1, d_2) for fabrics F1, F2 and F3.

The differences in drape coefficient are expected because very different fabrics were included in our investigation regarding fibre composition, weave type, yarn density and linear density. Just because of their heterogeneity, it was impossible to find a direct connection between the above-mentioned parameters and the drape coefficient. Certainly, the drape coefficient is also influenced by finishing; however, finishing parameters were unknown because commercial fabrics were used. From this it could be concluded, that for understanding connections in drape behaviour and drape parameters all data about fabrics are needed.

The values for drape parameters became changeable over time, regardless of the sample's size. From the results it can be seen, that the drape coefficient in all cases decreases over time (Table 4). In most cases (fabrics coded F2, F4, F7 and F8) the greatest change in the drape coefficient was seen in the first interval after the first two hours, just in one case in the measurement after four hours (F5) and three times in the measurements after six hours. The smallest change in drape coefficient was seen for the fabric coded F5, and the highest for the fabrics coded F7 and F3 (after 24 hours). The fabrics coded F5 and F7 have different fabric weights, yarn density and weave. On the other hand the fabrics coded F3 and F7, having the highest drape coefficients, have different fabric weights and similar linear density. The yarn densities in the weft direction are equal, but in the warp direction are different (Table 1).

Decrease in the drape coefficient, measured after 2 hours, expressed as a percentage was very different from sample to sample within the range of 1.94 % (F5) to 14.99 % (F7) (Table 4). During the second time interval no higher changes in the drape coefficient values were obtained. During the third interval (between the 4th and 6th hours), the highest change of the drape coefficient was for the fabric coded F3, 18.18 %, but during that interval the fabric coded F2 didn't have any changes in the drape coefficient. During the last interval, be-

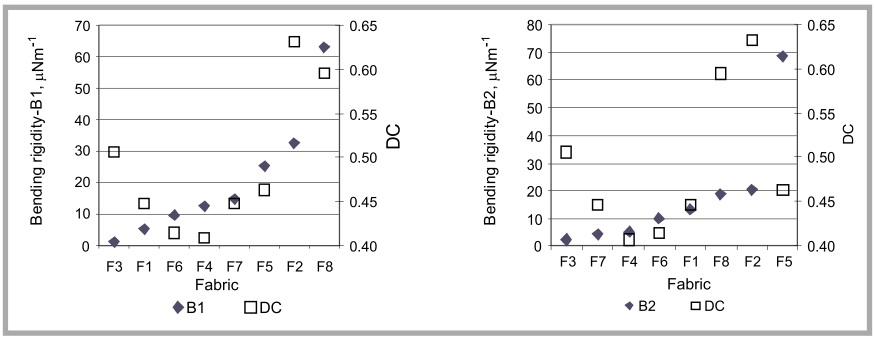


Figure 9. *The connection between bending rigidity and the drape coefficient; a. - bending rigidity in warp direction (B1), b. - bending rigidity in weft direction (B2).*

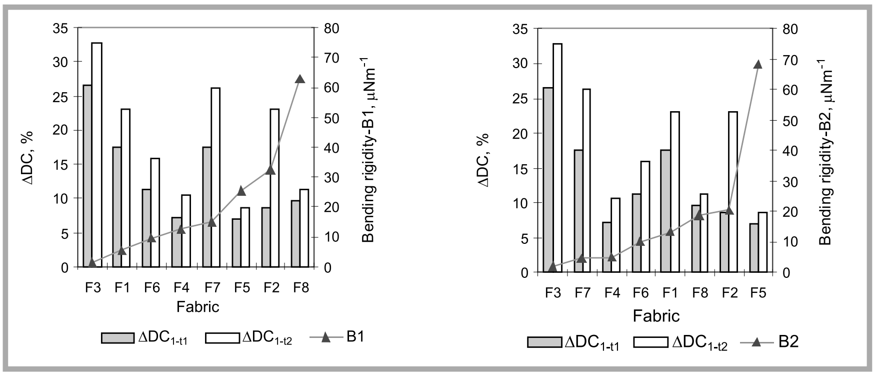


Figure 10. *Change of drape coefficient over time regarding bending rigidity; a. - bending rigidity in warp direction (B1), b. - bending rigidity in weft direction (B2).*

tween the 6th and 24th hours, the changes in drape parameters were analogous, as in the first hours of measuring. The greatest change in drape coefficient, 32.81%, according to the first measurement was for the fabric coded F3 in plain weave with the lowest fabric weight and lowest bending rigidity. In opposition to this the fabric coded F5 in weft rib, and with the highest fabric weight, had the smallest change in drape coefficient, 8.64%, over 24 hours (Table 4). In principle, the change in drape coefficient over the first six hours was greater (max. 26.68 % for F3) than over the next 18 hours, this is in the interval between the 6th and 24th hours (max. 8.72% for F7).

The curves, which describe the time-dependence of the drape coefficient, were very well represented by the function $y = A \cdot x^B$, which confirms correlation coefficients R^2 which were between 0.79 and 0.95 (Figure 5).

With decreasing in the drape coefficient, the minimum and maximum amplitudes also decrease, but the number of folds is the same. Furthermore, data about fold amplitudes does not explain the changes in drape coefficient. The decrease in drape coefficient indicates a reduction in the projection area of the draped samples. The projection area of the draped samples changes because the fold's form, length and width are changing. Mostly both amplitudes decrease over time but the changes are very small – only a few millimetres (Tables 2 and 3). Because the results for minimum and maximum fold amplitudes and their changes only represent the dimensions of two folds, and for other folds the data are unknown as no rules for drape change can be deduced from them.

The influence of sample size diameter was investigated for three fabrics. All analyses done for standard diameters were also done for samples with greater diameter.

The values of the drape coefficient for the fabric samples investigated in the group with greater diameter were from 0.199 to 0.343 (Table 3), which is much smaller than in the group with standard sample diameters (Table 2).

For fabrics with a greater diameter decrease in the drape coefficient, expressed as a percentage, is also the greatest, in comparison to smaller samples, during the first two hours and was within the range of 4.96% (F2) to 10.05% (F3). The greatest changes in the drape coefficient were obtained after 24 hours for the fabric coded F3, namely 13.57% and the smallest changes were obtained for the fabric coded F2, 9.04%, Table 6 and Figure 6. It is interesting that the larger samples (d_2) have smaller changes in the drape parameter over time (after 24 hours), like the samples with the standard sample diameter (d_1).

It can be seen, that the drape coefficient decreases over time but those samples with smaller diameters have higher changes in drape coefficient compared to larger samples, Tables 4 and 5. The changes in the drape coefficient of the smaller samples become higher after two hours, and then reduce over a longer time, Tables 4 and 5, Figures 5 and 6.

We can see that the differences in values of the drape parameters between these two different groups, according to sample sizes, are quite large. The time-dependent behaviour of the draped samples shows that the larger samples had fallen down more immediately after putting them on the Drape Meter, which can be seen from the smaller values for drape coefficient. But their drape coefficient, which decreased over time, was smaller. On the other hand, the samples with smaller diameters had higher values for drape coefficient, but their values decreased more in regard to the time periods. We assumed, that the main cause of the above-mentioned differences in the values of drape parameters is the sample size - weight of the fabric draped over the edge of the inner pedestal. The fabric weights of the larger samples' draped parts are namely, about 67.41 % greater than those of the smaller samples (Table 6). From the behaviour observed results that the fabric weight of the hung parts do not have a direct impact on any change in the drape coefficient over time, because it changes differently from fabric to fabric (Table 6). The cause of the phenomenon could be the fact that drape parameters should be investigated complexly.

The number of folds' namely 6, was the same in the group with the greaterdiameter for all three fabrics 6 (Table 3). It is interesting that these three fabrics have different numbers of folds (5, 7 and 8) in the group of measurements with standard diameter of the sample. From the given results it can be concluded that the number of folds for samples with a gerater diameter depends more on the fabric weight than on other constructional parameters.

The correlation coefficients R^2 for trend lines in the diagram drape coefficient vs. time were between 0.87 and 0.95 for samples with d_2, which is similar than the results for samples with standard diameter (Figures 5 and 6).

The values of bending rigidity for the fabrics analysed measured on the FAST measuring system,are very different. The lowest value in the warp direction is 1.4 μNm^{-1} (F3) and the highest 63.1 μNm^{-1} (F8). The lowest value for bending rigidity in the weft direction was also for the fabric coded F3, 2.2 μNm^{-1}, but the highest value was for the fabric coded F5, 68.5 μNm^{-1}.

As stated in the theoretical part, mechanical properties influence drape parameters, but on the other hand, our investigation confirmed that it is difficult to provide the same connection rules between properties and drape coefficient for all fabrics. Analyses of the connection between the bending rigidity and drape coefficient of a fabric show a decrease in the fabric's drape coefficient with increasing bending rigidity, with smaller values of bending rigidity and a repeated increase in the drape coefficient with higher values of bending rigidity (Figure 9).

Similar results are given using time-dependent analysis of the drape coefficient; for smaller values of bending rigidity the change of drape coefficient decreases, but for higher values of bending rigidity the values for the change of drape coefficient didn't show any rule referring to the bending rigidity change (Figure 10). In both cases it is difficult to conclude that this is a rule, because the range of different fabrics is rather small.

The investigation into measurement repeatability shows that the number of observations depends on the kinds of fabric. The fabric coded F2 with higher bending rigidity demands a smaller number of observations compared to fabric coded F3, which has lower bending rigidity. It is obvious that more observation is needed for fabrics where the results for the drape coefficient or fold numbers deviate more strongly (Table 7). From the results it can be concluded that the determination of confidence level and the level of relative error p_r influences the number of observations. Their level certainly depends on the purpose of an investigation.

Conclusion

In order to clarify the understanding of fabric drape phenomena we have to take into consideration the properties of the fabric, including their constructions' parameters, mechanical properties, as well as the procedure of fabric drape evaluation, all of which must to be evaluated in detail. Producers of fabrics and designers of clothing fabrics, especially have to take into account as much as possible those factors influencing drapability. Moreover, knowledge of drape parameters as a dynamic, time-dependent problem is very important for realistic visual computer presentation of textile products.

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