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Shape Factor of Flared Skirts Compared with That of Circular Fabrics

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Abstract

Shape factors of a tight skirt and 3 kinds of flared skirts were investigated precisely. Shape factors of circular fabrics were calculated from mechanical parameters obtained by KES system, however, those of skirts were obtained experimentally. Those results were compared with drape parameters of circular fabrics such as node number (n), static (D_s) and dynamic drape coefficients as revolving drape increase coefficient (D_r), saturated drape coefficient (D_{200}) and turning-around drape coefficient (D_d). They were also compared with node number and static drape coefficient of skits at hem line. Following conclusions were obtained. In the case of tight skirt, flare-1 skirt and flare-2 skirt, the shape factor showed high correlation with drape parameters of the skirts and circular fabrics. The shape factor of skirts has high positive correlation with node number and negative correlation with static drape coefficient of circular fabrics. In the case of flare-3 skirt, there is no correlation between the shape factor and the drape parameters of circular fabrics and skirts, hence shape factor becomes an important parameter which can evaluate the appearance of flared skirt objectively.

Key Words : Drape coefficient, Shape factor, Flared skirt, Objective evaluation of appearance

1. Introduction

It is commonly said that shape factor is highly correlated with conventional static drape coefficient of fabrics[1], and there is no new information in the shape factor. However, there is no report concerning real clothes such as skirts or one-piece dresses. There was no method to obtain the shape factor of flared skirts experimentally. Here, shape factor is measured for flared skirts made from representative 6 fabrics such as cotton, polyester and wool. Quantity of flare is changed as 0 cm for tight skirt, 27.5 cm for flare-1 (same as the dart of tight skirt), 46.2 cm for flare-2 (2 times of the dart of tight skirt for hem line length) and 69.1 cm (2.5 times of the dart of tight skirt for hem line length) for flare-3 skirt. Shape factors of these flared skirts are compared with those of circular fabrics and drape parameters of fabrics.

2. Experimental

Definition of shape factor (SF) is shown in Fig.1[2,3]. If the amplitude is larger and the wave length is smaller, the shape factor becomes larger basically.

Samples used were representative 6 fabrics used for women's flared skirts such as cotton broad (A), wool tropical (B), polyester tropical (C), cotton Toile (D), polyester single yarn twill (E) and polyester Faille (F). Major mechanical parameters related to fabric drapability [4-6] measured by KES system [7] are shown in Table 1. These samples were selected so that the absolute values of these parameters distributed widely. The shape factor and various drape parameters such as node number (n), static drape coefficient (D_s), revolving drape increase coefficient (D_r), saturated drape coefficient (D_{200}) and turning-around drape coefficient (D_d) of circular samples

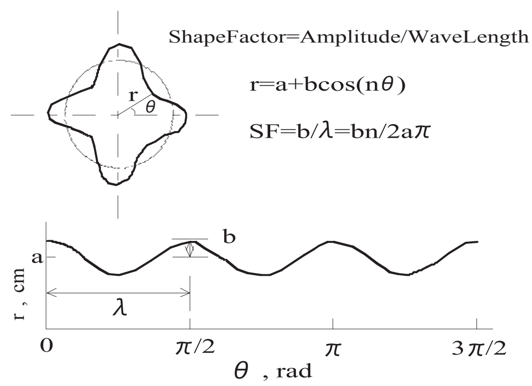

Fig. 1 Definition of shape factor.

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Table 1 Mechanical parameters related to fabric drapability measured by KES-system.

Sample	B (gf･cm^2/cm)	2HB (gf･cm/cm)	G (gf/cm/degree)	2HG (gf/cm)	W (mg/cm^2)	T (mm)
A Cotton Broad	0.118	0.124	3.72	4.51	12.38	0.497
B Wool Tropical	0.067	0.033	1.36	1.37	16.29	0.407
C Polyester Tropical	0.077	0.029	0.62	1.67	11.65	0.340
D Toile, Cotton	0.127	0.172	2.81	6.59	13.20	0.605
E Single Twill, Polyester	0.110	0.033	0.52	0.59	15.23	0.394
F Faille, Polyester	0.019	0.007	0.34	0.64	10.43	0.226

Table 2 Various drape coefficients for the samples examined.

	n	D_s (%)	D_r (%/rpm)	D_{200} (%)	D_d (%)	SF
A	2	82.9	0.155	87.5	23.8	0.051
B	5	49.8	0.344	95.5	52.8	0.144
C	5	50.7	0.402	89.4	47.7	0.145
D	4	74.6	0.274	94.9	29.4	0.082
E	5	48.2	0.361	90.5	54.7	0.156
F	7	28.3	0.479	86.0	60.5	0.200

are calculated from these mechanical parameters [8-10]. These results are shown in Table 2. It is clear that drapability is the highest in the case of the sample F (Faille) and low in the case of the samples A (Broad) and D (Toile).

Size of skirts was selected on the basis of Japanese averaged model of 20s (stature: 158.7cm, bust girth: 83cm, waist girth: 62cm, hip girth: 89cm, made by Nanasai Co. Ltd.). Tight skirt and 3 kinds of flared skirts were made according to the original pattern making system developed by Masuda [11,12] to make patters of skirts automatically as similar manner to tailor-made skirts. The length of skirts was 56.8cm for all the skirts. The basic patterns of flared skirts are shown in Fig.2 with the quantity of flares. Flares were made based on tight skirt as shown in Fig.2. A skirt was made from 2 parts of fabrics (front and back) without waistband. In order to avoid the effect of waistband on the shape of skirts, the waist part was made by the same fabrics and fixed to the waist.

3-dimensional shapes of flared skirt on the mannequin stand are measured by “3-D Body Scanner – C9036” by Hamamatsu Photonics Co. The size of skirt is measured by 4 CCD sensors using the principle of triangulation method within the error of 0.5%. The shape of skirt is measured vertically, 9 points from waist line to hem line. Node number and static drape coefficient of skirts were calculated for the projected shape of hem line.

Shape factor of flared skirts was calculated from the relationship between angle (θ) and distance (r) of vertically projected shape of flared skirts. An example of the relationship between angle (degree)

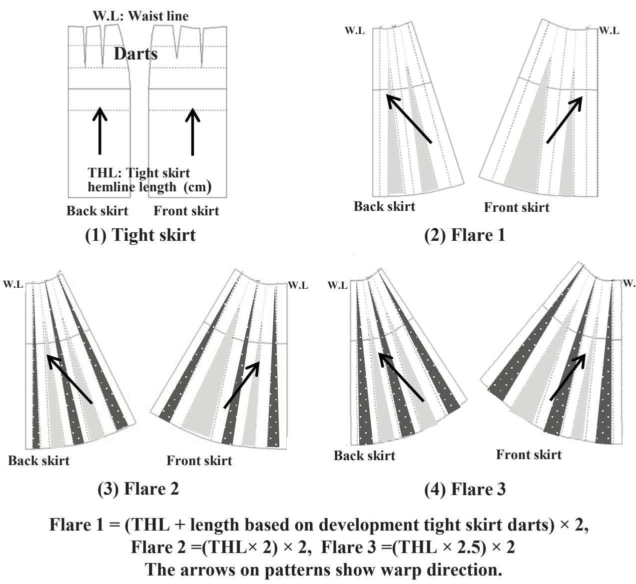


Fig. 2 Basic pattern of skirts with the quantity of flares.

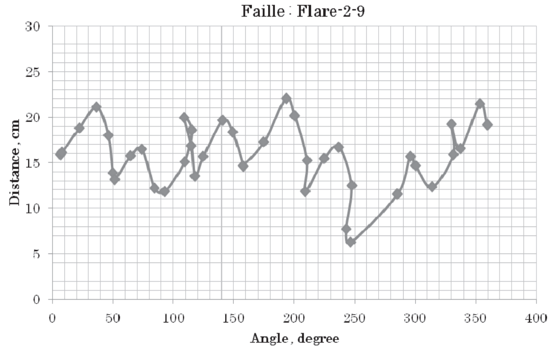


Fig. 3 An example of the relationship between angle (degree) and distance (cm) for the sample F (Faille) in the case of flare-2, 9th point (hem line).

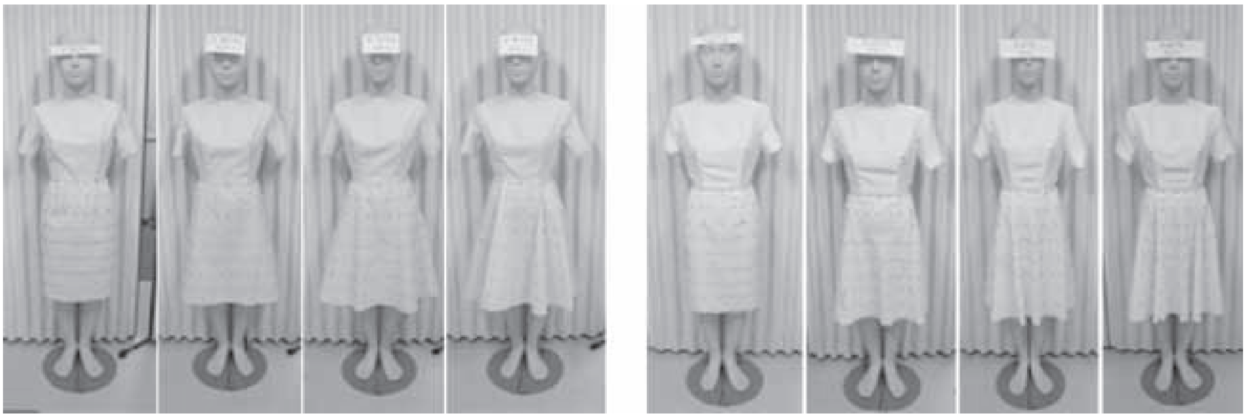


Fig. 4 Appearance of flared skirts on model stand for the sample D (left; Toile) and F (right; Faille). 4 kinds of skirts; tight skirt, flare-1 skirt, flare-2 skirt and flare-3 skirt from left to right.

and distance (cm) is shown for the sample flare-2 of F (Faille) at the point of hem lime; 9th point from the waist line (1st point), in Fig.3.

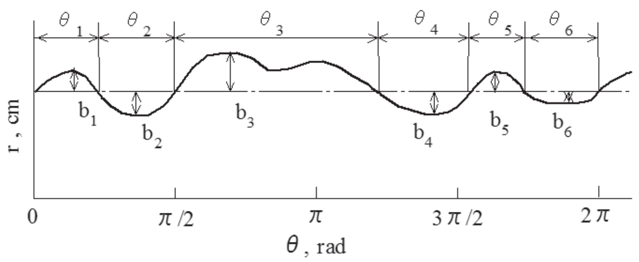
3. Results and Discussions

Appearance of flared skirts on mannequin stand is shown in Fig.4 for two examples; sample D (Toile) and F (Faille). These samples were selected by the bending rigidity of fabric; B, as shown in Table 1, having maximum and minimum value. It is shown by appearance that spreading of flare of the sample D is larger than the sample F in the order of flare-3 skirt > flare-2 skirt > flare-1 skirt > tight skirt. Number of node of sample F is larger than sample D in the order of flare-3 skirt > flare-2 skirt > flare-1 skirt > tight skirt. Curvature of the node showed the similar tendency as the node number.

Shape factor of skirts is calculated from the relationship between angle (degree) and distance (cm) by the manner as shown in Fig.5.

Shape factors of flared skirts obtained for two examples such as sample D (Toile) and sample F (Faille) are shown in Fig.6 and 7, respectively versus the height from waist line to hem line. It is clear that shape factor increases a lot after hip line for both samples. It is also clear that shape factor increases in the order of tight skirt, flare-1 skirt, flare-2 skirt and flare-3 skirt. This tendency was quite similar to those of the other 4 fabrics. This means shape factor becomes important for larger quantity of flare in the flared skirt.

As it was shown that shape factor became the largest at hem line,



Average amplitude: $b = (b_1+b_2+..+b_6)/6$

Average wave length: $\lambda = 2r(\theta_1+\theta_2+..+\theta_6)/6$

Shape Factor $= b/\lambda = (b_1+b_2+..+b_6)/4\pi r$

Fig. 5 A method of calculating shape factor of flared skirts.

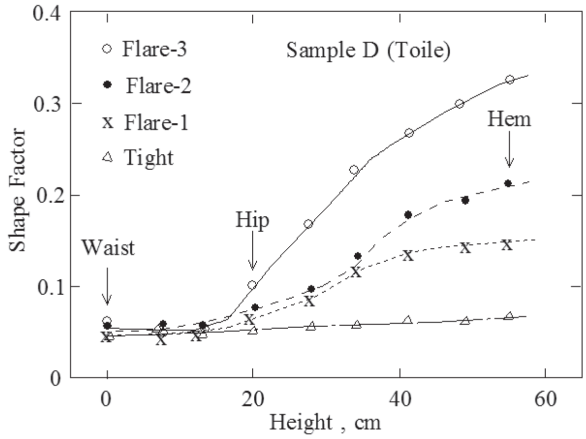


Fig. 6 Shape factor change of flared skirts of sample D (Toile) as the height from waist line to hem line.

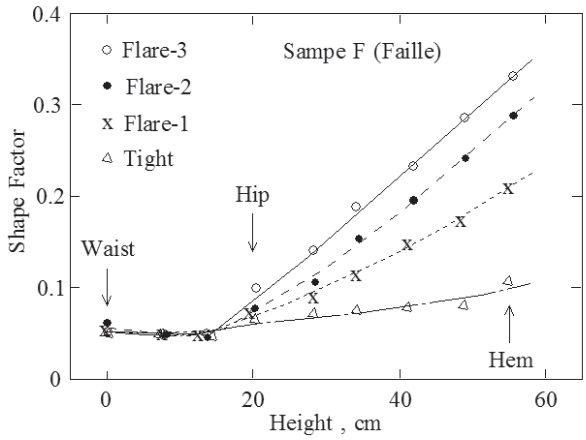


Fig. 7 Shape factor change of flared skirts of sample F (Faille) as the height from waist line to hem line.

Table 3　Relationship between the shape factor and drape parameters for tight skirt.

	n-Fabric	D_s-Fabric	SF-Fabric	n-T-Skirt	D_s-T-Skirt	SF-T-Skirt
n-Fabric	1.000	-0.959***	0.964***	0.868*	-0.793	0.867*
D_s-Fabric		1.000	-0.997***	-0.800	0.780	-0.916*
SF-Fabric			1.000	0.810	-0.758	0.893*
n-T-Skirt				1.000	-0.617	0.726
D_s-T-Skirt					1.000	-0.938**
SF-T-Skirt						1.000

***; 0.1 % significance level, **; 1 %, *; 5 %

Table 4　Relationship between the shape factor and drape parameters for flare-1 skirt.

	n-Fabric	D_s-Fabric	SF-Fabric	n-F1-Skirt	D_s-F1-Skirt	SF-F1-Skirt
n-Fabric	1.000	-0.959**	0.964**	0.514	-0.711	0.725
D_s-Fabric		1.000	-0.997***	-0.417	0.868*	-0.856*
SF-Fabric			1.000	0.432	-0.836*	0.865*
n-F1-Skirt				1.000	-0.109	0.097
D_s-F1-Skirt					1.000	-0.824
SF-F1-Skirt						1.000

***; 0.1 % significance level, **; 1 %, *; 5 %

Table 5　Relationship between the shape factor and drape parameters for flare-2 skirt.

	n-Fabric	D_s-Fabric	SF-Fabric	n-F2-Skirt	D_s-F2-Skirt	SF-F2-Skirt
n-Fabric	1.000	-0.959**	0.964**	0.329	-0.633	0.694
D_s-Fabric		1.000	-0.997***	-0.539	0.820	-0.851*
SF-Fabric			1.000	0.499	-0.808	0.842*
n-F2-Skirt				1.000	-0.807	0.796
D_s-F2-Skirt					1.000	-0.985***
SF-F2-Skirt						1.000

***; 0.1 % significance level, **; 1 %, *; 5 %

Table 6　Relationship between the shape factor and drape parameters for flare-3 skirt.

	n-Fabric	D_s-Fabric	SF-Fabric	n-F3-Skirt	D_s-F3-Skirt	SF-F3-Skirt
n-Fabric	1.000	-0.959**	0.964**	0.0.450	-0.523	0.127
D_s-Fabric		1.000	-0.997***	-0.398	0.633	-0.032
SF-Fabric			1.000	0.369	-0.579	0.051
n-F3-Skirt				1.000	-0.679	0.244
D_s-F3-Skirt					1.000	-0.079
SF-F3-Skirt						1.000

***; 0.1 % significance level, **; 1 %, *; 5 %

results of hem line were investigated in relation to drape parameters such as node number (n) and static drape coefficient (D_s) of flared skirts and circular fabrics. Node number and static drape coefficient of skirts at hem line were calculated from the result of horizontal cross-section shapes obtained from “3-D Body Scanner – C9036” by Hamamatsu Photonics Co. Relationship between the shape factor (SF) and static drape coefficient (D_s) of skirts for all the samples examined here are shown in Tables 3-6 for tight skirt, flare-1 skirt, flare-2 skirt and flare-3 skirt, respectively. Results of node number, static drape coefficient and shape factor of circular fabrics are also shown in these tables. It is clear that shape factor of circular fabrics shows strong positive correlation with node number of the fabrics and strong negative correlation with static drape coefficient of the fabrics. It is also clearly shown that correlation of the shape factor between skirts and circular fabrics is high for tight skirt, flare-1 skirt and flare-2 skirt, however, it becomes quite low for flare-3 skirt. This is because that the fabric bends more freely and shapes more complicated forms when the quantity of dart becomes larger. This means that the shape factor becomes very important to evaluate the silhouette of flare skirts when there is a lot of flare.

On the other hand, correlation coefficients of various drape coefficients of circular fabrics and the shape factor of fabrics are shown in Table 7 for all the samples examined here. It is clear that the shape factor correlated positively with node number (n), revolving drape increase coefficient (D_r) and turning-around drape coefficient (D_d), however, negatively with static drape coefficient (D_s). In the case of circular fabrics, it is concluded that shape factor has no new critical information of drapability. However, it is difficult to estimate the silhouette of skirt from the data of circular fabrics if the skirt has a large amount of flare.

Table 7 Correlation coefficients between various drape coefficients and shape factor.

	n	D_s (%)	D_r (%/rpm)	D_{200} (%)	D_d (%)	Shape Factor
n	1.000	-0.959**	0.979***	-0.131	0.909*	0.964***
D_s (%)		1.000	-0.957**	0.263	-0.974***	-0.997***
D_r (%/rpm)			1.000	-0.187	0.909*	0.966***
D_{200} (%)				1.000	-0.135	-0.226
D_d (%)					1.000	0.980***
Shape Factor						1.000

***; 0.1 % significance level, **; 1 %, *; 5 %

More detailed investigation would be necessary applying a lot of skirts in the near future. We are going to study about fabric 3-dimensional characteristics which are applicable to a real skirt with a lot of flares.

4. Concluding remarks

Shape factors of a tight skirt and 3 kinds of flared skirts were investigated precisely. Shape factors of circular fabrics were calculated from mechanical parameters obtained by KES system, however, those of skirts were obtained experimentally. Those results were compared with drape parameters of circular fabrics such as node number (n), static (D_s) and dynamic drape coefficients as revolving drape increase coefficient (D_r), saturated drape coefficient (D_{200}) and turning-around drape coefficient (D_d). They were also compared with node number and static drape coefficient of skits at hem line. Following conclusions were obtained.

1) In the case of tight skirt, flare-1 skirt and flare-2 skirt, the shape factor showed high correlation with drape parameters of the skirts and circular fabrics.
2) The shape factor of skirts has high positive correlation with node number and negative correlation with static drape coefficient of circular fabrics.
3) In the case of flare-3 skirt, there is no correlation between the shape factor and the drape parameters of circular fabrics and skirts, hence shape factor becomes an important parameter which can evaluate the appearance of flared skirt objectively when the quantity of flare is large.

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