Study on mechanical properties of silk fabrics in the 45°bias direction

Younhee Kang*, Seoul National University, Korea
Hyo-Seon Ryu, Research Institute of Human Ecology, Korea

Keyword: Bias direction, Silk fabric, KES-FB

1. Introduction

Through the decades, many researchers have investigated mechanical properties of various fabrics for manufacturing proper fabric for end-use. Many researchers such as Kawabata (1980), Sung et al (1988), Matsudaira and Matsui (1992) and Yokura et al (2013) studied mechanical properties and hand values of fabrics by using Kawabata Evaluation System (KES-FB system). Most researches are focused on the properties of warp and weft directions, and only few attentions were paid on the bias direction. Spivak and Treloar (1968) attempted to find the relation between shear properties and bias extensions, and presented a theoretical model. Du and Yu (2008) determined the angle of the warp thread direction in bias extension which mostly reflects the shear properties and concluded that 45° direction (true bias) has the highest result. However, the previous researches in bias direction mainly studied shearing and tensile properties. Therefore, in this study we focused on the two aspects: Comparing the mechanical properties of bias with warp and weft directions and see how the result can be changed by various weave type.

2. Experiments

100% silk fabrics with different weave structures are chosen for investigation and specifications of tested materials are shows in Table 1. Four different directions of fabrics are considered in this study (Figure 1**)**. All of samples were cut into 20cm x 20cm size and named by its weave type and direction.

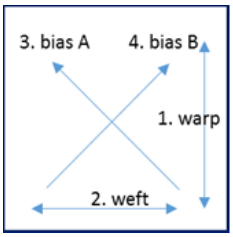


Figure 1.

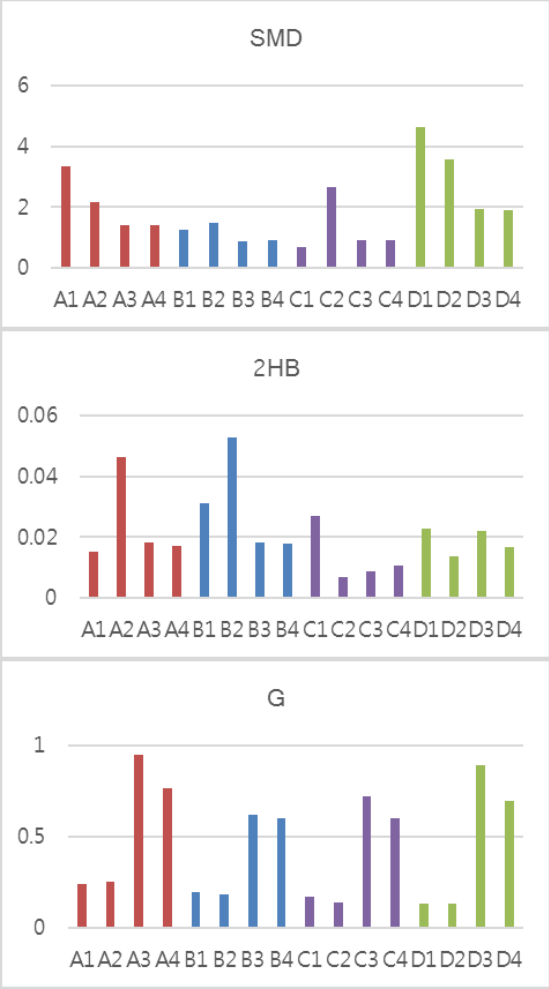
Table 1. Specifications of tested materials

Fabric type	Weave type	Density	Weight	Thickness	Yarn count (warp x weft)
Silk 100%	Plain (A)	150 x 105inch²	67.5g/m²	0.15mm	46D x 52D
	2/2 Twill (B)	166 x 117inch²	70g/m²	0.16mm	55D x 61D
	5-ends Satin (C)	336 x 131inch²	70g/m²	0.18mm	34D x 30D
	Jacquard (D)	152 x 114inch²	67.5g/m²	0.19mm	61D x 52D

The basic tensile, shearing, bending, and surface properties of silk fabrics were measured by KES-FB system under the condition of 20℃ and 65% RH.

3. Result & Discussion

The results of surface properties of all weave types show that the warp and weft directions are tend to have higher value than bias and there are little differences between bias A and bias B.



Parameters of MMD, SMD indicate that warp direction for plain (A1) and jacquard (D1), and weft direction for twill (B2) and satin (C2) are the roughest. Especially SMD values for jacquard in all directions are the highest among the weave types and this means that it has the roughest surface. As jacquard combined with various weave structures, it has more variations on the surface than the others. In case of bending properties, weft for plain (A2) and twill (B2), and warp for satin (C1) and jacquard (D1) have the highest B and 2HB value while both bias A and bias B have lower values. It shows that bias direction of the fabric is more flexible and suitable for applying curved shape silhouette. Through the G, 2HG, 2HG5 parameters, there are two noticeable results: One is that bias A has higher values of shearing properties than bias B. It's because shear angle (ϕ) is smaller than 45° so the results can be different by tested directions. The other is that both bias directions have the highest G value compare to warp and weft and there is no influences of weave types. This result shows similar tendency with Sung (1988)'s study and also means that warp and weft directions have higher shearing elasticity than bias directions.
For the tensile properties, bias A and bias B have little differences in LT, WT, and RT except in the case of satin weave. Other properties are similar to those previous researchers'.

4. Conclusion

In this study, tensile, shearing, bending, and surface properties of warp, weft and the 2 different true bias direction of silk fabric with various weave type were measured with KES-FB system. Through this experiments, following result were obtained: (1) Jacquard in all direction has roughest surface than other weave type. (2) Bias direction has higher shearing elasticity than warp and weft directions. (3) There are no significant differences between bias A and bias B except in shearing properties.

References

Kawabata, S. (1980) 'The standardization and analysis of hand evaluation', Textile Machinery Society of Japan, Osaka, Japan, 2nd edition