



## Effect of structural design factors on modeling of raglan sleeve

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### ABSTRACT

*This paper introduced the concepts of raglan sleeve and analyzed the relationship between the design of raglan sleeve and human body from static and dynamic aspects; analyzed the design features of raglan sleeve structure and expounded the influencing factors for the design of raglan sleeve structure from aspects of composition characteristics, slanting angle of sleeve centre line, height of sleeve top and connection point between the sleeve and body piece.*

**Key words:** Raglan Sleeve; Relation with Human Body; Structural Design.

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### INTRODUCTION

Raglan sleeve is also named as link-shoulder sleeve, transforming the segmentation line of shoulder line into the slanting line from neck circumference to armhole, which connects the clothing shoulder and sleeve to form the visual effect of vigorous and slender shoulder. The position and shape of raglan sleeve can achieve the beautiful effect along with the appearance. The raglan sleeve is some kind of link sleeve after studying and integrating features of common shirt sleeve (one-piece sleeve) and suit sleeve (two-piece sleeve) [1].

### DESIGN OF RAGLAN SLEEVE AND ITS RELATIONSHIP WITH HUMAN BODY

#### 1. Static Relationship

The shape of human's upper limbs leans forward. By drawing a vertical line from the shoulder point, we can get that the horizontal distance between the vertical line and centre point of wrist is 4.9cm, the included angle between the vertical line and centre point of wrist is  $6.18^\circ$  and the included angle between the vertical line of elbow and centre point of wrist is  $12.41^\circ$  [2]. As the arm leans forward, the sleeve should also lean forward to fit the shape of upper limbs. In this way, the unfolded sleeve structure should be that the inseam is concave, and the elbow seam is convex with combined dart. Thus the design of kimono sleeve is only for the shoulder and body piece, while the structural design of sleeve under the shoulder adopts the same principles with the set-in sleeve.

#### 2. Dynamic Relationship

The movement function of garment is always to add the proper ease based upon the static position. Human's movements are produced by joints. The movement features of shoulder joints and arms are closely related to the kimono sleeve. Arms are by the side of body and movements of forward bending, afterward stretching, internal rotation and external rotation will stretch the cloth [3]. Such stretching is mainly centralized around the armhole, especially the front underarm, which can eliminate the stretching by the center of armhole. Thus the movement function of kimono sleeve has a direct relationship with the proper and comfortable wearing.

When standing up, human's arms can make the shoulder joint raise up  $180^\circ$ , afterward stretch  $60^\circ$ , externally rotate  $180^\circ$  and internally rotate  $75^\circ$  from  $0^\circ$ . The elbow joint leans forward  $150^\circ$  and stretch backward  $0^\circ$ . Thus the upper limb mainly moves forward. In this way, it should consider the forward movement of arms in the related parts of garment structure to increase the conditions of movement. To achieve better movement functions of kimono sleeve,

it should add the crotch cloth under the arm or the segmentation line on the body piece.

The intelligent methane sensor has an interface to a host computer with a serial communication or network to perform the automation and visualization of the sensor calibration. Figure 2 demonstrates the mini intelligent methane detector and its use of a digital methane detection and alarm lamp. Many factors were considered in the system's design, not only its micro size, low cost, low power consumption and good anti-interference but also the relationship between system's intelligence level and hardware and software resources.

## SOME COMMON MISTAKES

### 1. Increased Armhole Depth and Flexible Calculating Method

As raglan sleeve belongs to the loose structure, its armhole depth may vary in a large range. Its value can be calculated by equations; or it can add the certain value based upon the original one; or it can be directly cut according to the different proportion of length. If being calculated by equations, we can get 0.2 times of chest measurement plus 3-10cm; if using the original one, it can add 5-15cm based upon its armhole depth. As raglan sleeve is created relying on armhole, the change of armhole is flexible. Some short and loose types may get the armhole at the waist line.

### 2. Gentle Armhole Arc with Various Changes

The raglan armhole can adopt the straight line, curve and arc, or integrate the armhole and the segmentation of cloth pieces for the design.

### 3. Pantyhose Flexible Change of Biceps

By adjusting the degree of inclination of sleeve Centre line, we can change the biceps. As shown in the figure, line A is the biceps, while line B and line C are adjusted biceps. According to the figure, the larger degree of inclination of sleeve Centre line will lead to smaller biceps and vice versa. When the degree of inclination of sleeve centre line increases, the shoulder appearance of shaped sleeve is smooth and there are fewer drapes under the arm. But the shortening of bottom sleeve line will affect its looseness. When the degree of inclination of sleeve centre line is decreased, the movement scope of sleeve is increased, leading to the comfortable wearing and strong function, but the poor smoothness of shoulder part. In the real design, we should adopt different treatments according to specific situations. For the garment aiming at the sport, the degree of inclination of sleeve centre line will be small and the biceps will be large; for the garment aiming at the appearance and decoration, the degree of inclination of sleeve Centre line will be large and the biceps will be small. The degree of inclination of sleeve centre line for common garments is generally  $45^\circ$  [3].



Fig.1 Change in Armhole Arc of Raglan Sleeve & Width of Raglan Sleeve

## ANALYSIS ON STRUCTURAL DESIGN FACTORS OF RAGLAN SLEEVE

### 1. Composition Principle of Raglan Sleeve

According to researches of human engineering, the maximal movement scope of the arm is less than  $180^\circ$ . In daily life, the movement scope of the arm is generally within  $90^\circ$ . In the structure of raglan sleeve, it is the reason to control the included angle between the shoulder sleeve line and body piece within  $90^\circ$ . In raglan sleeve, the larger included angle between the body piece and shoulder sleeve line, the more drapes under the arm when putting down the arm. If adjusting the included angle as  $45^\circ$ , the relaxing of sleeve underarm cannot meet the requirements of arm's movement. It cuts the underarm seam, applies the crotch cloth according to the shape of gap and sews it in the underarm seam. When putting down the arm, the crotch cloth is sealed under the arm, which guarantees the smoothness of shoulder part and also makes the arm move freely.

### 2. Effect of Confirmation of Slanting Angle of Sleeve Centre Line on Raglan Sleeve

The slanting angle of sleeve centre line refers to the included angle between the sleeve centre line and horizontal line at the shoulder point (as shown in Fig.4). Generally speaking, such angle can be adjusted within  $0-60^\circ$  based upon

the design intention. The size of slanting angle of sleeve centre line has the certain impact on the movement scope of arms and the pattern of garment. According to Figure 5, the larger angle, the fewer drapes under the arm and the more proper appearance, but the movement of arms will be limited; by contrast, the smaller angle, the more drapes under the arm and the more free movement of arms. A qualitative analysis is taken within 0-60° according to appearance patterns (Table 1).

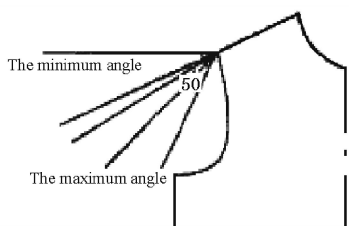


Fig.2 Slanting Angle of Sleeve Centre Line

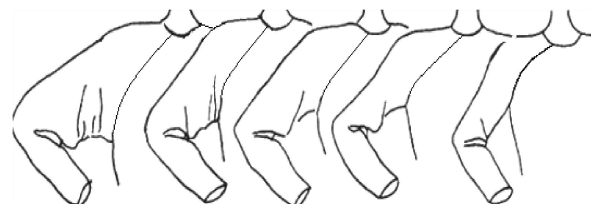


Fig.3 Relationship between Slanting Angle of Sleeve Centre Line and Sleeve Shape

Table 1. Experimental data comparison

Included Angle	0°-20°	20°-30°	30°-45°	45°-60°
Sleeve Style	Loose sleeve Suitable for nightclothes, sportswear and children's garments	Relatively loose sleeve Suitable for casual wear, sportswear and overcoats	Body-matching sleeve Suitable for uniforms, suits and overcoats	Body-fitted sleeve Seldom used in daily life

### 3. Effect of Confirmation of Height of Sleeve Top on Raglan Sleeve

The relationship between the height of sleeve top and biceps can be explained in Figure 6. A is the basic biceps, while B and C are biceps with the same armhole and different height of sleeve top. The higher the height of sleeve top is, the smaller the biceps will be. The size of biceps can affect the beauty of sleeve shape and the movement function of the sleeve. For sleeve B, the height of sleeve top is low, the biceps is large, thus its movement function is good, but its shape is not beautiful enough; for sleeve C, the height of sleeve top is high, the biceps is small, thus its shape is beautiful, but its movement function is poor. Therefore, when designing the height of sleeve top, it should comprehensively consider the shape and movement function. For the sleeve aiming at the beautiful shape, it can design the high height of sleeve top; while for the sleeve aiming at the movement function, it's better to design the low height of sleeve top[4].

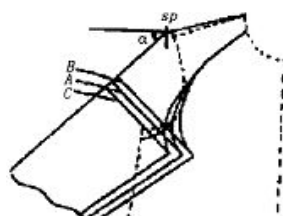


Fig.4 Relationship between Height of Sleeve Top and Biceps

### 4. Effect of Depth Change of Armhole on Raglan Sleeve

During the structural design of raglan sleeve, the depth change of armhole of raglan sleeve will lead to the change in the height of sleeve top and size of biceps. With the equal slanting angle, constant bust ease and unchanged proportion of connection point in armhole, the shallower armhole, the smaller sleeve top, as well as the biceps. By contrast, the deeper armhole will lead to larger sleeve top and larger biceps[5].

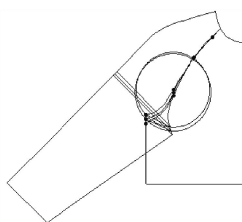


Fig.5 Relationship between Armhole Depth and Sleeve Top and Biceps

## CONCLUSION

As a result of human's individualized pursuit, the pattern and structure of kimono sleeve become more complicated and the segmentation line becomes richer. The initial kimono sleeve did not consider the sleeve crotch and segmentation line, just the plainly-designed kimono sleeve. After the emergence of solid design, the solid is transformed into the plain. To achieve the better solid effect, there are sleeve crotch and segmentation line on the plain pattern, which is closely related to the social and economic situation and social culture.

The height of sleeve top decides the looseness of kimono sleeve. When the sleeve top is high, the included angle between the sleeve Centre line and body piece is small and the sleeve is fitted; when the sleeve top is low, the included angle between the sleeve Centre line and body piece is large and the sleeve appears to be loose. Anyway, the design of sleeve top should be in accordance with the movement function of human body, but not blindly pursue the body-fitted and neglect the availability of height of sleeve top.

The underarm overlap is the key to the design of kimono sleeve and its movement function. Adding the sleeve crotch under the arm, it can make the underarm part become loose and thus guarantee the flexible movement of arms. To improve the appearance structure of kimono sleeve, it can set the segmentation line on the body piece and sleeve, prolong the length of inside-sleeve seam to form the variable sleeve crotch, which can guarantee the kimono sleeve possess the smooth appearance and certain movement function.

Many related factors should be considered in the pattern and structural design of kimono sleeve. These factors all have great effect on the sleeve shape and even the pattern of the whole apparel. For instance, the cloth material, sleeve crotch and segmentation will decide the cloth whether it is loose or fitted. In addition, we should consider the critical factor of human body when designing the shape of kimono sleeve. Different human body should adopt the different shape of kimono sleeve. For example, people with the wide shoulder can adopt the in-shoulder kimono sleeve; while people with the narrow shoulder can adopt the dropped-shoulder kimono sleeve.

The pattern and technique are two key points to produce the kimono sleeve. It's evitable for kimono sleeve to have some defects. Thus we have to grasp the pattern and structure principle of kimono sleeve and are able to make the proper corrections when defects appear.

## REFERENCES

- [1] Li Y. *Advanced Materials Research*, **2013**, 627: 520-523.
- [2] Dillon Jr J. Raglan sleeve surgical gown: U.S. Patent 5,062,160[P]. **1991**-11-5.
- [3] Fang F, Chen Y, Lu H. *Advanced Materials Research*, **2013**, 796: 462-467.
- [4] Breen, David E., Donald H. House, and Michael J. Wozny. "Predicting the drape of woven cloth using interacting particles." Proceedings of the 21st annual conference on Computer graphics and interactive techniques. ACM, **1994**.
- [5] Lubets A, Raymond N. Asymmetric athletic apparel and methods of use therefor: U.S. Patent Application 13/773,104[P]. **2013**-2-21.
- [6] TOTAL T P. 1 *Statistics*, 3(1): 4.
- [7] Rainard, L. W. *Textile Research Journal* 16.10 (**1946**): 473-480.
- [8] Clayton, Frederick Hubert. *Journal of the Textile Institute Transactions* 26.6 (**1935**): T171-T186.
- [9] Nazarboland, M. A., et al. "Computer simulation of filtration process through woven fabrics." Computational Engineering in Systems Applications, IMACS Multiconference on. Vol. 1. IEEE, **2006**.
- [10] Ting, K. C., R. J. Wakeman, and V. Nassehi. *Filt. Soc. Meeting*. **2005**.
- [11] Lu, Wei-Ming, Kuo-Lun Tung, and Kuo-Jen Hwang. *Textile research journal* 66.5 (**1996**): 311-323.
- [12] Frontczak-Wasiak, Izabela, and Marek Snyckerski. *Fibres and Textiles in Eastern Europe* 14.2 (**2006**): 29.