

# Virtual Design of Han Dynasty Curve-Front Robe Shenyi Dress based on CLO3D

Junying Wang, Junfeng Wang  
747086535@qq.com, 2653424064@qq.com

Dalian Polytechnic University Dalian, China

**Abstract**—The Shenyi dress is a kind of clothing that is connected after the upper and lower garments are cut, and it mainly has two forms: straight garment (Zhiju) and curve garment (Quju). In Tomb No.1 of the Han Dynasty at Mawangdui, 15 pieces of relatively complete clothes were excavated, of which 11 were Shenyi dresses with curve-front robe, overlapping collar, and right lapel, providing important substantial evidence for the research of curve-front robe Shenyi dress. The main object of the research is the "Xinqi Embroider" Brown Luoqi Silk Brocade Robe with the orientation number 329-10, and the research and practice focus on the structural characteristics, cutting method, and virtual fitting of the Shenyi dress with a curve-front robe. At the same time, the research restores the Shenyi dress with CLO3D software.

**Keywords**-Han Dynasty clothing; curve-front robe Shenyi dress; CLO3D; virtual fitting; clothing structure

## 1 INTRODUCTION

The curve-front robe Shenyi dress is a special kind of clothing in the history of the development of Chinese clothing. There are two reasons for its appearance: one is the need for the ceremony system, and the other is that the pants in the Central Plains at that time did not have a crotch, and the curve-front robe Shenyi dress wrapped the body by extending the lapel to cover the body, and the higher the status of the person, the longer the lapel and the more circles it wrapped around the body. [1] During the Qin and Han dynasties, people from the emperor down to the ordinary people wore the curve-front robe Shenyi dress. In the Eastern Han Dynasty, after the emergence of crotched pants, people no longer needed to wrap their cloth to cover their bodies. Since then, the straight-front robe Shenyi dress that saved fabrics and convenient to wear became popular, and the curve-front robe Shenyi dress gradually faded out of daily life. And the form "curve-front robe" had also disappeared in the long history of clothing development.



**Figure 1.** "Xinqi Embroidery" Brown Luoqi Silk Brocade Robe

The clothes unearthed from Tomb No.1 in Mawangdui are among the few Shenyi dresses that people can see today. At the same time, the lacquerware, wooden figurines, silk paintings, bronze statues and other cultural relics excavated from the Han tomb at Mawangdui show the dress form of the Shenyi, which has important reference significance for the research and restoration of the curve-front robe Shenyi. The "Xinqi Embroidery" Brown Luoqi Silk Brocade Robe (as figure.1A shown) excavated from Mawangdui No.1 Tomb is a well-preserved garment. This paper will take the "Xinqi Embroidery" Brown Luoqi Silk Brocade Robe (329-10) as the main research object, and study and simulate the structural characteristics, cutting methods, and virtual fittings of the curve-front robe Shenyi dress.

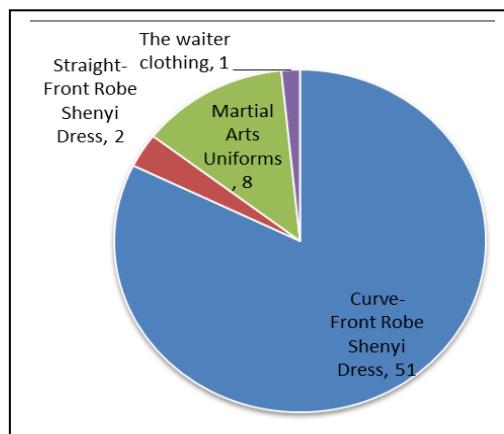
According to the excavation report of the "No.1 Han Tomb in Changsha Mawangdui", the owner of the tomb is the wife of Li Cang, the prime minister of Changsha. She was a high-ranking noblewoman, and she was 50-55 years old, with a height of 154 cm. [2] The "Xinqi Embroidery" Brown Luoqi Silk Brocade Robe is 150cm long and its sleeves are 250 cm wide. Compared with the size of the human body, the curve-front robe Shenyi dress is very wide, but its unique way of wearing is to wrap the body tightly, and the overall shape of the human body after dress shows coexisting relaxation and restraint.

The CLO3D software can edit the height and body proportion of the virtual model, adjust the model's display action, and flexibly use the model to try on clothes. 2D plates are combined with 3D simulation to more authentically show clothing styles and fitting effects, and restore the dress effect of the "Xinqi Embroidery" Brown Luoqi Silk Brocade Robe to its original owner.

## **2 STRUCTURAL ANALYSIS OF THE CURVE-FRONT ROBE SHENYI DRESS**

This paper comprehensively studies the cultural relics of the Western Han Dynasty, including two parts: graphic images and three-dimensional costumes. In terms of graphic images, 7 drawings including silk paintings, lacquerware, and bricks are collected, and a total of 60 figure images are studied and analyzed, of which 51 sets of curve-front robe Shenyi dress, 2 sets of straight-front robe Shenyi dress, and 9 sets of martial arts uniforms with upper garment and lower garment were collected. In addition, in such graphic images, it can be found that the sleeves of the Shenyi dress are mostly wide. There are 36 standing figures among which 25

figures wear top sleeves. In terms of three-dimensional clothing, 18 figurines from the Western Han Dynasty are collected, and there are 15 sets of curve-front robe Shenyi dress, and the other 3 are paired-lapel long Ru skirts. Among the curve-front robe Shenyi dressed, only one piece is shorter in length and does not reach the ground. There is also a female figurine wearing upper and lower garments with different fabrics, for the upper garment has scattered stripes, and the lower garment has horizontal stripes. Other figurines wear upper and lower garments with same fabrics. However, there are more top sleeves in flat paintings, but the presentation in the figurines is mainly under sleeves.



**Figure 2.** Statistical graph

The specific curve-front structure should be viewed according to the "Xinqi Embroidery" Brown Luoqi Silk Brocade Robe's structure details (such as Figure 1B) in the excavation report of "No. 1 Han Tomb in Changsha Mawangdui". In this report, the Shenyi dress has a simple "T" outer contour structure, its shoulder line is straight, the lower hem slightly open, and it is well shaped. The internal structure's dividing line divides the Shenyi dress into two major parts: upper garment and lower garment, and four edges: collar edge, lapel edge, sleeve edge, hem edge four kinds of edge edges, and there are 5cm wide silk strips outside the edge. The upper garment is symmetrical to the left and right of body midline and divided into six parts by vertical parallel lines, the front collar is different, and the back collar has a tab under the armpit in an arc. The lower skirt is divided into four parts by three diagonal parallel lines. The stitching lines of the collar edge, lapel edge, and sleeve edge swing edge are also diagonally oriented. The collar and lapel edge are combined with the waist to form a triangle, and the corner of the collar edge is the tip of the hem, which is wrapped around the back when worn. It is called the curve-front lower hem garment. The under garment is enlarged, and the collar edge is lengthened, so that the composition of the triangle grows, which can be circled several times around the body, it is called the curve-front cross-lapel dress. When using CLO3D software for virtual fitting, the wider the under garment and the more winding turns it will take, and the more difficult the operation will be.

### 3 THE CUTTING OF THE CURVE-FRONT ROPE SHENYI DRESS

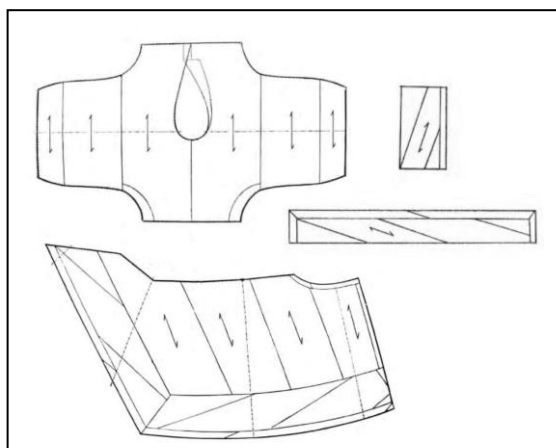


Figure 3. Statistical graph

The excavation report specifically describes the cutting method of the clothing pieces of the "Xinqi Embroider" Brown Luoqi Silk Brocade Robe (as picture 3 shown), and the part of the upper garment of the Shenyi dress is composed of six pieces of clothing, all of which are straightly cut and stitched. The two pieces in the center are the main parts of this dress, the back is sewn in the middle, the left and right pieces are cut in pieces, and the front and back pieces are cut continuously, and there is no shoulder line. The sleeves are divided into upper and lower parts. The four pieces in the center are all made of one piece, and the two pieces near the left and right cuffs are half a piece. [3] The length of a pair of fabrics is 38.8 cm (including seams).

The under garment is straight cut and oblique stitched, which can be understood as sewing the four pieces of clothing along the edge of the under garment, and cutting the required under garment according to a certain oblique direction. The collar edge, lapel edge, sleeve edge, and hem edge are also cut with the "straight cut and oblique stitched" method. The "oblique stitched" of the under garment is compared with the "straight stitched" of the upper garment, in which the silk threads form an angle with the middle line of the person when the garment is worn. In the Han Dynasty, the aristocratic class generally sat on their knees, and there were "T" shaped kneeling instruments, and the force-bearing part when kneeling in Shenyi dress was the oblique organzine with the greatest elasticity. All curve-front robe Shenyi dress not only limit people's posture when standing and moving, but are also precisely designed. The under garment of curve-front robe Shenyi dress simply changes the direction of the entire fabric tailor to achieve the purpose of "suitable for wearing": first, to stabilize the structure of the garment when kneeling; second, save fabrics and processes, do not have to cut the width; third, it is easy to sew. [3]

## 4 VIRTUAL FITTING

According to the size of each part of the "Xinqi Embroider" Brown Luoqi Silk Brocade Robe (Tabgure), the CLO3D software performs virtual fitting, through picture stickers and final rendering to complete the restoration of the Shenyi dress. There are several difficulties in the restoration process: first, there are many pieces of clothing, according to statistics, "Xinqi Embroider" Brown Luoqi Silk Brocade Robe has 27 pieces, and the amount of calculation in the production process is extremely large which will cause the computer to stutter, and the real-time feedback will be delayed; second, compared with modern clothing, after simulating the end of sewing and wearing, a relatively closed state of enveloping the body will be completed. The special way of wearing the curve-front robe Shenyi dress will make the sewing complete but wearing not complete, the clothing is still in an open state.

Table 1 size of each part

Size						
<i>Breadth</i>	<i>Llength</i>	<i>Neck width</i>	<i>Hem edge width</i>	<i>Sleeve width</i>	<i>Cuff width</i>	<i>Sleeve edge width</i>
250	150	230	28	37	28	33

a. Unit:cm

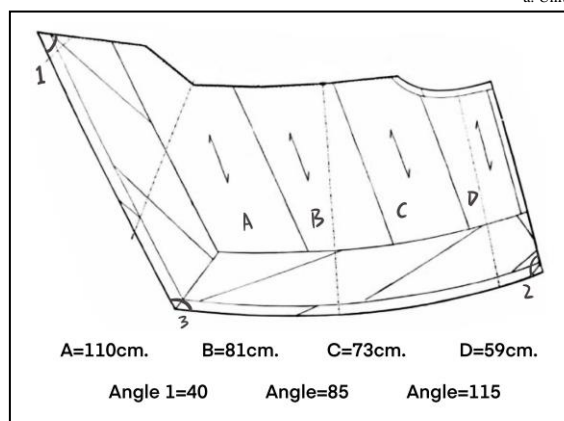


Figure 4. Data Map

### 4.1 Pattern Drafting

CLO3D software has 2D pattern design function, you can directly draw clothing plate patterns, or save the universal DXF file after other pattern design software draw clothing plates, and then import CLO3D software for clothing sewing and simulation.

Regarding the restoration of the "Xinqi Embroider" Brown Luoqi Silk Brocade Robe, in the stage of the clothing pattern design, combined with the data given in the excavate report and the pattern design, use the ET software to draw the collar type, and then draw the 4/1 sleeve type symmetrically twice, and finally modify the details. But the "straight cut and oblique

stitched” of under garment is difficult during pattern designing. There are two ways to draw: first, draw a rectangle of 93cm high and 175.2cm wide, and draw the clothes pieces from right to left; the second method is to draw from the beginning of the 115-degree angle in the lower-left corner, then extend to the hem edge and the label edge, and finally draw the four pieces of the under garment in turn. The specific data is shown in Figure 4.

When drawing a plate of curved-front robe Shenyi dress with cross lapel and top sleeve, its under garment is two more fabrics than the "Xinqi Embroider" Brown Luoqi Silk Brocade Robe, and the longer the length is increased, the longer the collar edge will be.

## **4.2 Sewing and virtual fitting**

First of all, we should establish a virtual model of the No. 1 Han Tomb in Mawangdui. From the excavation report, we can only know the height of model is 154cm, and waistline should refer to the Mashan No. 1 Chu Tomb owner, whose height is 160cm and the waistline is only 65.6cm, and hipline does not exceed 105cm. So we set the model's waistline at 62cm and the chest circumference at 80cm. And considering that the belt should fix the triangle hem, the hip circumference is set to 77cm, creating enough waist and hip difference to fix the belt.

After the model is edited, the plates in the 3D interface are arranged, and the clothes are arranged from left to right. We use the arrangement point tool to move the plate to the corresponding position, and adjust the model to an open arms posture when the upper garment is arranged, which is convenient for operation.

Virtual fitting is the most difficult part of the whole process, due to the particularity of the curve-front Shenyi dress, while wearing, we should follow the natural form of the fabric, but it is very easy to break the model, so it is necessary to use a comprehensive method of freezing, hardening, fixing needles, tape and other tools to control the position of the lapel. It is necessary to arrange the sewing order of clothing pieces to improve work efficiency. The right side of the hem is 63 cm, which is enough to wrap around the waist and can be fixed to the body with tape, while the outermost belt usually needs to adjust the warp and weft strength and thickness of the fabric, so that the belt has enough strength to press the layered fabric on the body.

In the process of sewing and fitting operation, a large number of fixed needles are used to temporarily fix the garment, and another thinner belt is used before sewing with a large belt of corset to adjust its elasticity and bind the waist fabric, which can effectively control the molding phenomenon between the belt and the fabric.

## **4.3 Patterns and fabrics**

The fabric can be divided into three types of silk fabrics. The whole dress is mainly light brown, and the upper garment is "Xinqi embroidery", which is not a combination of one or several graphics to repeat the square continuous pattern, in the pattern elements are repeated at the same time accompanied by rotation, mirroring, etc., seemingly simple patterns in the production are of extremely complex. The edges are dark brown hairy brocade, and the edges are 5cm narrow silk strips. The color scheme is dignified and stable, graceful and luxurious.

The curve-front robe Shenyi dress with cross lapel and top sleeves refers to the painting of No. 1 Tomb in Mawangdui, using the red color that represents the identity in the Han Dynasty, and the pattern is "longevity embroidery". The edges are black. And it has a strong characteristic of the times.[5]

#### 4.4 Conclusion

After the virtual fitting is almost completed, the stress test can be performed in the 3D view, and the fabric force test can be carried out. The stress point of "Xinqi Embroider" Brown Luoqi Silk Brocade Robe is mainly distributed at shoulder and back neck, and the fabric variation (100% is normal) is also concentrated here (variation rate 119%~124%), the difference is that the waist fabric has a little variation (106~119), but there is no stress point. Because of its wide sleeves, the stress point of the curve-front robe Shenyi dress with cross lapel and top sleeves is concentrated on the shoulders and arms. However, due to the relatively large range of changes in the fabric, the value is also relatively high (112% to 131%), and the wrapping of the buttocks also makes the fabric change by 103% to 110%, the forearm part has a change rate of 105% to 116% due to the weight of the sleeve itself, and the underarm fabric also has a change rate of 118% to 135%.



Figure 5. Data Map

The above data can prove that, based on covering the human body, the curve-front robe Shenyi dress can also restrict human behavior, and long sleeves make the arms and hands put in front of the body, the skirt mopping the ground initially limits the size of the step. On this basis, the multi-layered cross lapel binds the hips and thighs, making the wearer more constrained. As can be seen from the final dress picture, the final effect of the virtual fitting also basically restores the Han Dynasty figurines, and the unique clothing form and wearing method such as the curve-front robe Shenyi dress are gradually eliminated by the times, but the dignified and elegant appearance in the clothing is always retained in the traditional costume.



**Figure 6.** Final Effect

## 5 CONCLUSION

Based on CLO3D technology, this paper restored the "Xinqi Embroider" Brown Luoqi Silk Brocade Robe excavated from the Mawangdui Han Tomb. And on this basis, it tried to design and restore a curve-front robe Shenyi dress with cross lapel and top sleeves. In the form of virtual reality, it shows the flat effect of the curve-front robe Shenyi dress, and the characteristics of tight and narrow restraints after dressing.

The use of modern technology to restore ancient clothing is an extremely important part of the construction of digital museums. The use of CLO3D software to restore ancient clothing, not only retains the style, structure, color of clothing, but also preserves the cutting and craftsmanship of clothing. With the development of virtual reality technology, historical clothing is virtually presented and restored. It is also a way to protect clothing culture.

**Acknowledgment.** This study was supported in part by Social Science Planning Fund of Liaoning Province, China(L21AMZ2002).

## REFERENCES

- [1] Ren Yi. History of Chinese Clothing [M]. Peking University Press, 2015.7
- [2] Hunan Provincial Museum, Institute of Archaeology, Chinese Academy of Social Sciences. Changsha Mawangdui No. 1 Han Tomb [M]. Beijing: Cultural Relics Publishing House, 1973
- [3] Structural Characteristics and Cutting Techniques of Han Dynasty Curve-front Robes: A Case Study of Women's Costumes Excavated from Mawangdui No. 1 Han Tomb[J]. Zhang Ling. Costume Guide. 2016(02)
- [4] Examination of Jingchu Costumes from the Pre-Qin to the Han Dynasty[D]. Xia Tian. Jiangnan University 2020
- [5] Yuan Z. History of Chinese Clothing [M]. Beijing: China Textile Publishing House, 2005.