3D KNITWEAR MODELLING USING TUBULAR FABRICS

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Abstract

The paper presents valorisation possibilities for tubular fabrics with different structures produced on flat knitting machines. Starting with the approximation that the human body has a cylindrical shape, the paper presents a general design procedure for clothing that include tubular fabrics. The constructive-aesthetic development of this type of garments is made by combining the tubular knitting with the fully-fashion technique.

1. Introduction

Starting from the idea that clothing represents a more or less accurate covering of the human body, the basic problem to solve in pattern design is the conversion of the 2D surfaces specific to textile fabrics into the complex 3D geometry of clothing.

The specific characteristics of the fabrics used to produce garments (wovens, nonwovens, knitted fabrics, etc) require different ways of obtaining the spatial shapes, while keeping in mind that the raw material determines the specific **shape modelling.**

In the case of knitted fabrics, there are three groups of methods for garment spatial shaping, in which the fabric is subjected to different processing:

- Methods based on mechanical processing of the raw material (shape macrostructure)
- Methods based on physical and mechanical processing of the fabric structure
- Methods based on physical and chemical processing at the micro structural level of the fabrics

In the first type of methods, considered constructive methods, the garment shape is obtained by means that do not modify the fabric's initial structure. The shape is generated through sewing. Also belonging to this group, there is the method of integral knitting that eliminates completely or almost completely the cutting and sewing operations. ***The integral knitting is intended directly to the production of the garment (shape macrostructure), the raw material to be processed being the yarn***.

Even if the integral knitting is considered to be a constructive method, the final shape is obtained using other methods (see Figure 1). The knitted fabrics are characterised by a certain degree of deformation, due to the easy displacement of the yarn within the loop. This mobility gives the knitted fabric extensibility, which is significant for fit clothing. On the other hand, the product shape depends on the elasticity characteristics of the fabric that involve its microstructure.

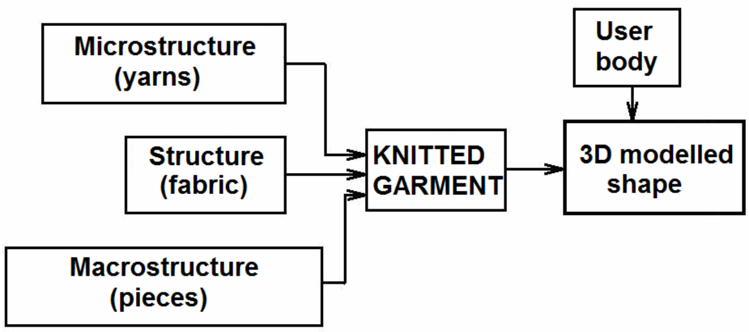


Figure 1. The concept of spatial shape for knitted garments

In the case of clothing with support on shoulders, made of straight or fully fashioned panels, the design of the basic shapes considers the straight silhouette. There are two motivations for this choice:

- The shape of the human body upper part can be approximated to a cylinder, for which the basic transversal dimension is the chest perimeter.
- The final 3D shape is obtained when the garment is dressed, the degree to which it reproduces the shape of the user's body depending on the fabric structure and its allowances.

Taking into consideration the above mentioned aspects, as well as the fact that the tubular fabrics made on flat knitting machines can have different structures [2], the paper presents a number of examples of garments that are produced through integral knitting. These shapes can be easily modified so that they reflect the most diverse stylistic characteristics.

2. Initial data for garments shape modelling made of tubular knitted fabrics

The most simple tubular garment is the so-called "tube top" presented in Figure 2. The product's support surface is the same with the dressed one. In this case, the garment position on the body is ensured by the use of more elastic structures, the garment dimensions (relaxed state) being lower than the ones of the body.

The model presented in Figure 2 takes from the basic pattern (Figure 3) the part between the bust line (31. – 34.) and the hem line – line (91. – 94.). The pattern dimensions are determined by using a narrowing coefficient $\varepsilon_x<1$, respective:

31. – 34. = (Pb/4) ε_x ,

Where: Pb = bust perimeter (cm).

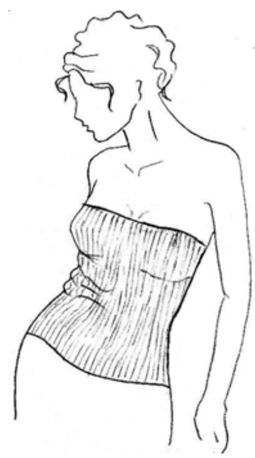


Figure 2. ”Tube top” garment

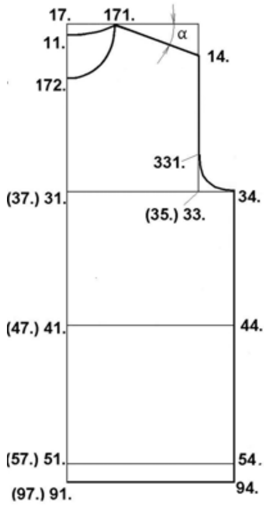


Figure 3. Basic pattern for tubular knitted garments

In order to create a larger range of garment shapes, a support zone placed between the shoulder line and the bust line will also be taken into consideration [2]. The basic pattern is finalised by tracing its superior contour and by placing the horizontal lines of the basic pattern:

31. – 33. = (Pb/5) ε_x

11 – 31. = (Pb/7 + 3 cm) ε_y; 33. – 331. = 33. – 34.

11. – 41. = Lt;   41. – 51. = 20 cm; 11. – 91. = Lpr

11. – 17. = 2.5 cm

11. – 171. = (Pb/20 + 2cm) ε_x; $\alpha = 20^0$

17. – 172. = (Pb/20 + 4cm) ε_y,

Where: Lt = back length to the waste, Lpr = garment length

The $\varepsilon_y \geq 1$ coefficient is intended to compensate the decrease of some lengthwise constructive segments that appears when the fabric is elongated along the row direction.

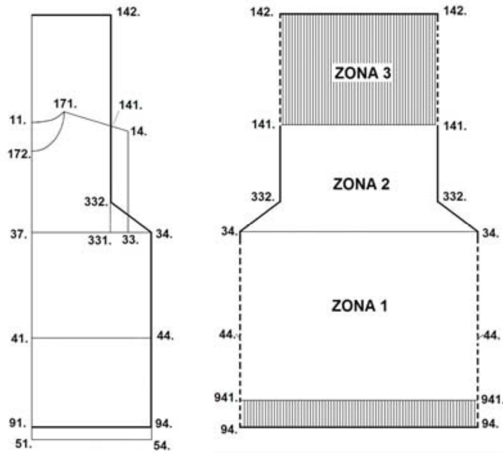
3. Diversification of garment shapes

The design of garments with tubular zones was based on the possibility of generating garment shapes through geometric pieces. The assembly of rectangular pieces represents the initial solution in dressing the human body, variants of this principle appearing throughout the entire costume history.

Figure 4 illustrates a pullover model with high collar, simple or doubled, without sleeves and with enhanced arms hole. The welt and the collar have a 1x1 rib structure, while the rest of the garment is jersey.

The basic pattern was obtained based on the initial required data, considered in relation to size and to the extensibility and elasticity characteristics of the fabric. The pattern was modified according to the garment model (Figure 5.a). Figure 5.b shows the knitting area, the dotted lines representing tubular knitting for the corresponding zone. The garment is made of two tubular zones and one zone with independent knitting on the beds. At this stage, the armholes are also fully fashioned.

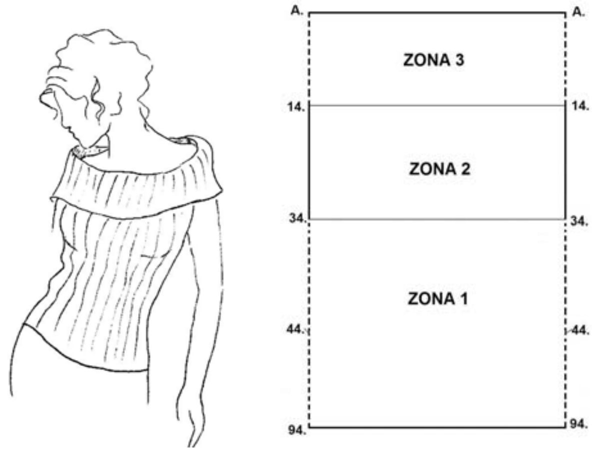
Figure 4. Model 1



a) b)

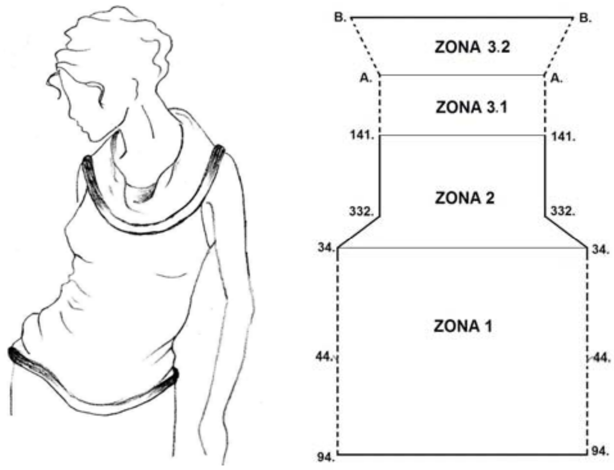
Figure 5. Patterns for model 1

The division of the garment into three zones makes it possible to create new models, varying the dimensions, the fabric structure and the fully-fashioning. As an example, Figure 6.a presents a knitted garment that has a 2x2 rib structure. Zone 2 lacks the fully-fashioning of the armholes, while zone 3 is knitted after it and has the same width (Figure 6.b). The aspect of the new garment is different from the previous model, with a less fitted silhouette due to the dimensions of the tubular areas, controlled through the knitting parameters.



a) b)

Figure 6. Model 2



a) b)

Figure 7. Model 3

Figure 7 illustrates the possibility of obtaining a different model variant with draped collar, emphasised by the dimensions of zones 2 and 3 and by the way the two zones are knitted (independently on the beds for zone 2 and tubular for zone 3). The garment has a jersey structure and its knitting programme is so designed that the silhouette is loose fitted and the border is curled.

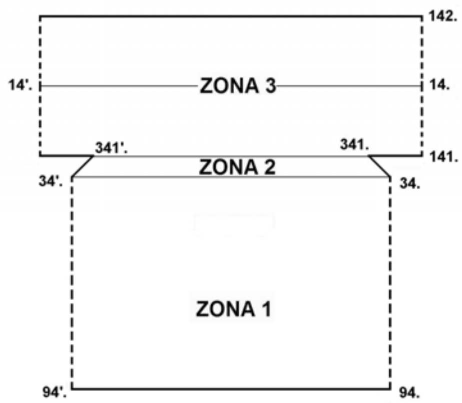
The upper part of the model at collar level is knitted with two different sequences – the tubular (cylindrical) zone 3.1 and zone 3.2 in the shape of a truncated cone, as illustrated in Figure 7.b. This way, the upper part of the 3D shape will be large enough so that the collar will present a cowl effect.

The truncated zone 3.2 can be produced by using successive enlargements or by modifying the stitch density (a lower stitch density will give wider fabrics without altering the number of working needles), considering that the enlargement of zone 3.2 in relation to zone 3.1 is relatively reduced (3 to 4 cm both sides).

The constructive solution presented in Figure 8.b generates a garment (model 8) with a particular fitting, with significant differences to the previous models. The ample neckline and the kimono sleeve are created depending on the way zones 2 and 3 are shaped. The knitting width of the tubular zone at the end of the garment is increased by introducing a number of needles corresponding to the dimension of 341. – 141. segment. This dimension depends on the arm's half perimeter and the fabric extensibility (8 cm for a medium size garment made of a highly extensible fabric).

The height of zone 3 can determine the type of garment – with a simple neckline or with a rolled collar effect. Figure 8.a illustrates the last possibility.

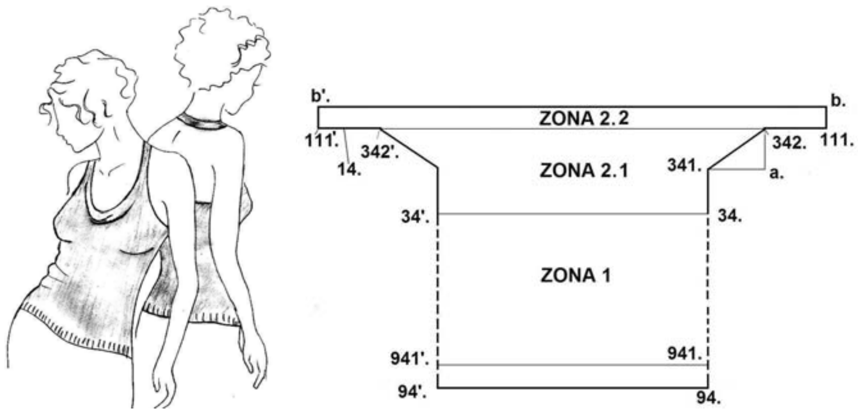
a)



b)

Figure 8. Model 4

A different category of garment shapes (models) with interesting aesthetic characteristics will be produced when knitting zone 2 separately on the two beds. This possibility is exemplified in Figure 9. The intended garment shape has different patterns for the front and the back. The front ends with a slightly draped neckline that continues with two stripes of fabric that are tied at the back. The garment shape is obtained by eliminating zone 3 and knitting zone 2 in two stages. The first stage creates the drape of the neckline while the second stage ends the garment.



a) b)

Figure 9. Model 5

The shape (pattern) dimensions are calculated based on the basic pattern dimensions and specifics of the model:

34. – 341. = (ARS – 6 cm)/2 + 0.5 cm

341. – a. = 10 cm (excess for the cowl drape along the neckline line)

a. – 342. = (34. – 341.) – 0.5 cm

342’. – 14’. = 6 cm (compensation of ARS decrease along the length of zone 2)

14’. – 111’. = $l_{rgs}/2$

111. – b. = 3.5 cm (stripe width along the back symmetry line),

Where:

ARS = depth of the armhole (from the basic pattern);

l_{rgs} = neck hole width at the back (from the basic patterns).

Conclusions

Following the possibilities of producing different tubular fabrics on flat knitting machines, a particular range of knitted garments can be thus made. The 3D shapes of these garments are obtained by correlating the design factors and the dimensions and body shape of the user.

The models presented in the paper are made exclusively through integral knitting, offering the opportunity of using expensive fancy yarns with high aesthetic impact. The variants illustrated do not limit the diversification possibilities, especially when considering the sequential knitting that combines tubular and plan zones and the use of fully-fashioning.

References

[1] Comandar C., Creţu M., Filipescu F., *Tubular knitted fabrics with various structures manufactured with flat knitting machines,* volume of the 44th IFKT Congress „ Knitting round the clock", St-Petersburg, September 2008.

[2] Creţu M., *Proiectarea şi tehnologia confecţiilor din tricoturi,* Editura "Gh. Asachi", Iaşi, 2000

[3] * * * http://www.kladez-knit.ru/

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