OPTIMIZATION OF PROCEDURES OF ELABORATION OF BASIC CONTOURS OF TRICOTAGE SHOULDER SUPPORT PRODUCTS FOR WOMEN

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Abstract: *The work examines the assurance of maximum correspondence between the product support surface shape and the shape of human body by selecting the optimum initial data and use of adequate techniques for designing the basic templates. The experimental studies are based on the comparative analysis of 10 design methods for shoulder-supported tricot products for women. These results allowed to optimize the algorithms of elaborating the basic templates owing to the identification of optimum connections between the calculation relationships and the shape of support surface. The attempt has been made to elaborate a relatively simple algorithm of designing tricot products that would allow to reduce considerably the time spent for elaborating the basic templates in industrial conditions without affecting the positioning of products on the body. The subsequent verification of sample positioning on the mannequin has demonstrated the viability of applied algorithm. The optimized algorithm has been proposed and implemented in the experimental section of the company «Saltoianca» LLC in Chisinau municipality.*

Keywords: *design procedures, shoulder-supported tricot products.*

INTRODUCTION

The notion of design technology comprises a complex of methods and procedures used for designing templates allowing to resolve a specific design task. The most important design tasks are [1]:

- ✓ Determination of main physical dimensions of parts and construction elements, providing parametric connections between them;
- ✓ Parametric and geometric correspondence between the elements of support surface and the body shape and dimensions;
- ✓ Solution of problems of assuring the parametric and geometric correspondence between the lateral surface of product construction and the dimensions and shapes of human body.

These tasks become more complicated when designing tricot products due to the need to adapt these technologies to the physical-mechanical properties of textile materials.

THEORETICAL ASPECTS OF CALCULATION AND CONSTRUCTION OF BASIC TEMPLATES

The graphic calculation methods widely used for the elaboration of unfolded surfaces of shapes in order to obtain the basic contours of garments in the industrial production systems use different approaches to the task of determining the major dimensions of components and construction elements, as well as to the formation of parametric connections between them. Although, the best results are obtained using the methods involving the preliminary calculations of constructions. These calculations allow to determine both the physical dimensions of constructions and the connections between the constructive segments and the connected contours. So, in the absence of a preliminary calculation of parametric connections between the cut and the sleeve head there occurs the situation where the sleeve parameters depend exclusively on the sleeve cut parameters and are not correlated with the dimensions of upper extremities.
The problem of assuring parametric and geometric correspondence between the support surface elements of the construction and the dimensions and shapes of human body is directly related to the positioning of product on the body and implies [2]:

- ✓ Determination of values of anterior-posterior and lateral equilibrium;
- ✓ Determination of values of elements assuring the right shape of product on the frontal reference element (the bust cut) and at the back (shoulder cut).

The product is well-balanced on the body if the major level of equilibrium passing to the horizontal perimeter level of bust is in horizontal position. The position of this line depends on the relationship between the length of product front and back. The value of anterior-posterior equilibrium depends on the reciprocal position of

upper extremities and neck cut of the front and back template creating the superior component of anterior-posterior equilibrium. The value of this component depends on the curvilinear profile of the body at the back and at the front. In case of greater convexity at front the equilibrium is positive, in case of equality of curves of back and front it is zero and in case of convex back (curved) – negative. The inferior component of anterior-posterior equilibrium depends on the difference between the length of anterior and posterior components measured between the bust and waist lines [3].
The lateral equilibrium depends on the correspondence between the angles of shoulders. The slope of shoulder lines in the construction depend on the position of upper extremities of neck cuts and the position of shoulder points that as a rule, are determined by the intersections of circle arcs, the dimensional indicators involved in these processes determine the quality of positioning the shoulder points in the construction [4].
In order to determine the depth of basic cuts (bust and shoulders) the design methods imply numerous processes. The less justified are the procedures of defining the depth of basic wedges via constant values. Most often, the design methods determine the depth of a bust wedge using the difference between the perimeters of bust II and I. One must mention that the correction coefficient appearing in these calculated relationships indicates a smaller degree of their precision.
The basic construction elements providing for the product shape in the lateral area and in the sagittal plane are the lateral lines, the „relief" lines, the symmetry lines of back and front reference elements. The definitive character of the symmetry lines depends on the presence of seam at that level, on the degree of product adjustment and on the shape of human body. The position of lateral lines depends on the product type, on the wearer's body shape and sleeve cut [5]. So, in free-cut products the lateral lines are located at the middle of sleeve cut, in light clothing for women they are slightly displaced towards the back, while in the constructions for coat or jacket-type products – with a substantial displacement towards the back of the construction.

ASPECTS OF OPTIMIZING ALGORITHMS OF DESIGNING THE BASIC TEMPLATES

In order to determine the optimization criteria for the algorithms of designing the basic templates of tricot products we used the parametric and geometric analysis of 10 graphic calculation methods of designing the unfolds of body surfaces adapted to tricot as basic material. The study involved the formal aspects of these methods: structure of initial data, calculation relationships, determination of connections between the construction elements, as well as the practical research – elaboration of product models and analysis of their positioning on the human body. The study was focused on the jacket-type product for women.
22 dimensional indicators of transversal and longitudinal orientation have been used as initial data, they included the perimeter, length, width, distance, height and diameters. The list of dimensional indicators has been established based on the existing anthropometric standards in order to provide for the possibility of industrial design. It is proposed to extend this list by adding two more dimensional indicators in order to improve the precision of tricot constructions – the distance from waist to the basic line of axillaries and the distance between the waist line and the shoulder line. For experimental purposes the values of these dimensions have been determined by measuring 10 subjects fitting in the selected body type. The system of add-ons has been conceived based on the analysis of alternative design methods, being then adapted after checking-up the product models. As for the product data, the semi-adjusted silhouette has been used, the tricot 0,1… 0,2 cm thick has been used as basic material, of first extensibility group.
In order to determine the main physical dimensions of parts and construction elements, as well as to establish the parametric connections between then a preliminary calculation has been done starting from the sleeve volume, calculated depending on the axillary perimeter of arm, with a legerity add-on, the cut parameters and the sleeve head have been determined, in order to provide for a connection between them. The transversal physical dimensions have been determined using the calculation relationships of type I, providing for the proper precision of construction.
The basic network has been designed bearing in mind the posterior symmetry line and the cervical line. The vertical lines of the basic network include the posterior symmetry line, the basic neck cut line, the line delimiting the width of back from the product, the line delimiting the width of product front, the bust central line and the symmetry line of the product front. The position of these lines has been determined by the I. In order to complete the network, the following horizontal lines have been drawn: cervical line, axillary-bust line, the waist line and the shoulder line coinciding with the product termination line. One must mention that for the tricot products, when determining the position of horizontal lines in the basic network it is recommended to use only thickness add-ons, the legerity add-ons being reduced to 0. This approach is explained by the deformation properties of material in the longitudinal direction under its own weight.
The assurance of correspondence between the product shape and the body at the level of support surface is done at the stage of designing the superior contours of product back and front. The neck cut at back has been fitted into a rectangle, its width depends on the transversal diameter of neck, while its height depends

on the difference between the vertical arc of back and the length of back to the waist. The position of shoulder point at back has been determined at the intersection of arcs, depending on the value of oblique height of shoulder and shoulder length. Due to the properties of textile material, the scapular wedge has been substituted with a positional add-on o the shoulder line.
In order to provide for a good correspondence between the body shape and the product, the neck cut width has been increased, compared to the back cut width, by 0,5 cm. The position of upper extremity of neck cut at front, determining the anterior-posterior equilibrium of construction has been determined with the help of frontal waist line. One must mention that the experiment has been focused on a typical body of average size allowing the waist line to be designed horizontally. For bigger bodies the anterior-posterior equilibrium must be divided into superior and inferior components. The position of bust wedge top has been determined by relationships of type I, considering the height of bust and the distance between the mamelon points. The problem of adequacy of product shape in the bust zone is resolved by the parameters of bust wedge depth. It has been decided to use the traditional variant of determining these values by the difference of bust perimeters II and I. Despite of the fact that this variant of determining the wedge depth value is approximate, the ability of tricot to cover complex surfaces has compensated the insufficient precision and excluded the need to use the additional dimensional indicators. The slope of the shoulder line on the front template is equalized with the respective value of the posterior template in order to provide for the optimum value of lateral equilibrium.
The contour of sleeve cut has been traced by segments – two superior and two inferior segments by curved lines. The slope of inferior sector curves has been determined using the position of additional points. Cuts have been made at the limit of inferior sectors.
The position of lateral line has been determined by the basic line of sleeve cut with deviation towards the back reference element – this situation is characteristic for the straight-shaped jacket-type products. The configuration of lateral lines depends on the product shape at the level of waist line and is variable – from the straight line to a complex shape line repeating the body contour. The degree of product adjustment at the waist line level is determined by the specific legerity add-on, while the distribution of excess volume depends on the wanted product shape in the frontal and sagittal plane.
Before designing the reference element of the sleeve one must verify the length of its cut, the contour shall be re-designed, should any deviations be found to exceed 0,5 cm.
The length of sleeve head is determined by the cut length with positioning add-on necessary for providing the proper shape of that element, specific for the assortment. Traditionally, classic sleeves with one seam are designed for tricot products. However, for the jacket-type product the sleeve has to be designed of a stricter shape and therefore, two seams are necessary. The sleeve head contour is connected to the cut contour, the contour itself being a smooth curve.
In order to verify the optimized design algorithm, a product model has been manufactured with subsequent evaluation of its positioning on the body (figure 1).

CONCLUSIONS

The optimized algorithm of designing tricot products is based on a series of graphic calculation methods adapted to the properties of the mentioned textile material. The qualitative and quantitative analysis of these methods allowed to identify the sectors of the construction having a decisive impact over the shape of product and implicitly, over the quality of its positioning on the body. The structure of initial data has been examined in the process of optimization and solutions have been searched for designing the sectors of construction with the most numerous deficiencies. It has been established that despite of the high spatial shaping properties of tricots, when designing exact shapes a sufficiently large number of dimensional indicators is necessary, while the contours of basic templates must be designed with high precision. The results obtained in the process of optimization of the design algorithm have been demonstrated in the process of testing the product model.

Figure 1: Model of jacket-type product elaborated base don the optimized basic template design algorithm for tricot products

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