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A Study on The Application of a System for Pattern Design of Women's Dresses from Knitted Fabrics Containing Elastomeric Threads

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Abstract. The paper presents a study on the application of a system for pattern design of women's dresses from knitted fabrics containing elastomeric threads from 1% to 6%. The system uses a different approach to account the stretch of the knitted fabric when designing clothing. In this approach are used for initial information for determining the values of the reduction factors only the data on the composition of the knitted fabrics according to the current standards. The reduction factors are calculated depending on the percentage content of elastomeric threads in the knitted fabric. Three models of women's dresses were designed. Knitted fabrics containing elastomeric threads from 1% to 6% have been chosen for their sewing. The compatibility has been studied between the dresses' details when they are located in different directions during cutting, when they are with different loop structure or with different stretch. The shaping of the models by three-dimensional elements, such as by the fixed draperies, has been analysed. Approaches are proposed for resizing the dresses' details (located in different directions of the stretch of the knitted fabric), for the correct selection of compatible knitted fabrics for dress details and for the determination of the size of the knot and the width of the draped sections. The fit of the made dresses corresponds to the designed silhouettes and no creases or displaced seams are monitored. The accuracy of the mathematical models, which are determining the value of the reduction factors and the applicability of the system for pattern designing of the knitted dresses has been proven

Keywords: Knitted Fabrics Containing Elastomeric Threads, Resizing the Dresses' details, Draperies

INTRODUCTION

At the current state of the female fashion shows that there is a constant trend in presenting women's knitted wear in fashion collections. Almost 30% of the pieces presented in the collections are dresses [1]. A study of the range of knitted fabrics in recent years shows that they are most often produced with elastomeric threads from 1% to 10%. These types of fabrics have different deformation properties from those of knitted fabrics without elastomeric threads in them but they cannot be classified as highly elastic fabrics. A major point in the production of knitted garments is the determination of the exact pattern design parameters of the details of the clothing. They depend on the deformation properties of the knitted fabrics which change as a result of the type of knit and yarn. In recent years, there has been a trend of increasing the comfort of clothing by using elastomeric threads in the yarn of knitted fabrics.

Different approaches are used to construct women's dresses from knitted fabrics: by reducing the dimensional features [3]; by adjusting the used structural basis [4]; by using certain allowances for freedom, depending on the degree of extensibility [5, 6, 12].

The first and second methods use different types of correction factors to account the stretch of the knitted fabric based on laboratory tests. The third method which is significantly more convenient to apply classifies knitted fabrics into three groups: Group I - with extensibility from 0% to 40%; II group - with extensibility 40% to 100%; Group III - with extensibility over 100%. Values of the freedom allowances are determined for each of the groups, according to standard [7]. The problem with using this method is that the defined groups are too large, which requires the application of the same value allowances for fabrics with very different extensibility.

A study conducted by the authors on two groups of knitted fabrics with similar yarn composition and elastane content from 1% to 6% provided an opportunity to define mathematical models for the calculation of correction factors accounting for stretch without the need for laboratory tests [8]. A system was developed for the construction of women's dresses from these fabric groups that uses the reduction factors to account for fabric stretch [2]. The paper presents a study of the application of this system for pattern designing of knitted dresses from fabrics containing elastomeric threads from 1% to 6%.

SYSTEM FOR THE PATTERN MAKING OF DRESSES FROM KNITTED FABRICS CONTAINING ELASTOMERIC THREADS USED

The system developed by the authors for the pattern making of dresses from knitted fabrics containing elastomeric threads is based on the principles of sizing and geometric construction of the system of M. Müller & Sohn [3]. The main difference between them is that the system of M. Müller & Sohn uses constant percentage corrections equal to the stretch of the fabric in the wales and the courses for all construction's sections, and in the applied method are used reduction factors defined by the percentage of elastomeric threads in the fabric. The calculation of the stretch of the knitted fabric in the structural parameters of the garments is carried out immediately during the construction of the pattern base. Dependencies for calculation of reduction factors are derived through the percentage content of elastomeric threads in the fabric. The reduction factors are applied to the geometric dimensioning and construction of the product as it follows:

- reduction factor in the direction of the course - for horizontal body measurements;
- reduction factor in the direction of the wales - for vertical body measurements;
- reduction factor in the bias (45°) - for all measurements at an angle of 45° or when designing transverse dimensions that will be cut at an angle of 45°.

The garment construction methodology includes four main stages: determination of the required body measurements; preliminary calculations; consideration of the extensibility - determination of the values of the correction factors; geometric unfolding of the garment details.

The reduction factors are derived for the calculation of the dependences presented in table 1. They are defined for two groups of fabrics with similar yarn composition and the following loop structures - Group A - jacquard jersey and group B - Punto di Roma jersey. In the proposed system only, the transverse dimensions are corrected.

TABLE 1. Calculation of the reduction factors, depending on the percentage of elastane in the fabric

Equations for calculation the Reduction factors			
	in the courses- K_R^c	in the wales - K_R^w	in the bias (45°) - $K_R^{45^\circ}$
Group A	$K_R^c = 0,935 - 0,02 Ef\%$	$K_R^w = 1,043 + 0,02 Ef\%$	$K_R^{45^\circ} = 0,916 - 0,02 Ef\%$
Group B	$K_R^c = 0,897 - 0,02 Ef\%$	$K_R^w = 1,043 + 0,02 Ef\%$	$K_R^{45^\circ} = 0,915 - 0,02 Ef\%$

Group A - Fabrics from jacquard jersey, Group B – Fabrics from Punto di Rome jersey, Ef% - the percentage of elastane in the fabric

Basic patterns for dresses from the two groups of knitted fabrics are constructed with direct consideration of the stretch of the selected fabric. They are reduced by the reduction factor in the courses. It has been found that for the studied groups of fabrics it is not necessary to adjust the vertical dimensions with the reduction factor in the wales [8].

STUDY ON THE APPLICATION OF SYSTEM FOR PATTERN MAKING DRESSES WITH DETAILS LOCATED IN DIFFERENT DIRECTIONS DURING CUTTING

A women's dress of semi-fitted silhouette - model 1 has been designed (figure 1). The silhouette is shaped by the side and middle back seams. The length is to mid-knee. The front of the dress has a seam along the waistline that divides it into two parts. The upper front part consists of two symmetrical details overlapping each other. The back consists of two parts joined by a middle seam. At the bottom, from the hem upwards, a slit 20 cm long is made. The sleeves are short - kimono type. For the making of the model 1, a knitted fabric with a Punto di Roma jersey and composition of the yarn: 73% polyester, 22% viscose, 5% elastomeric threads were chosen.

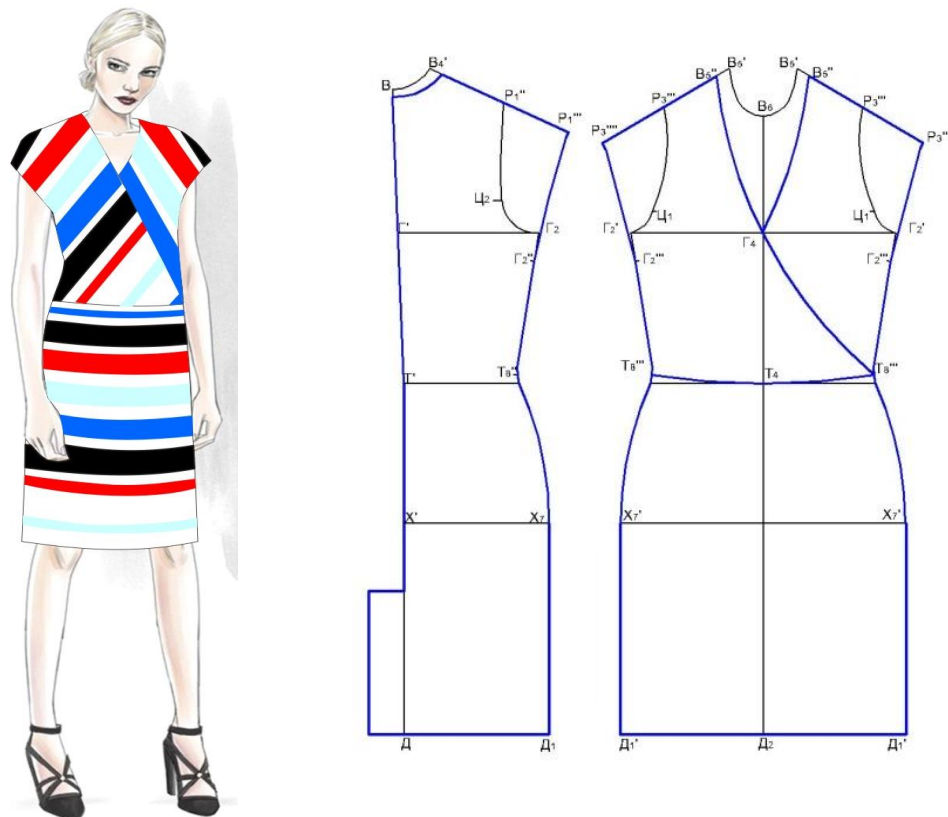


FIGURE 1. Design and pattern making of dress - model 1

During cutting of model 1, the two upper front parts are located on the fabric in the direction of an angle of 45° (figure 2). The lower part is located in the direction of the wales (figure 3).

For Punto di Roma knitting fabric, the calculation of the reduction factors has been done according to the equations indicated in Table 1. The obtained values of the required reduction factors are:

$$K_R^c = 0,897 - 0,02Ef\% = 0,897 - 0,02,5 = 0,80$$

$$K_R^{45^\circ} = 0,915 - 0,02Ef\% = 0,915 - 0,02,5 = 0,82$$

The established difference in the values of the two reduction factors is 0.02 conditional units. This would lead to a difference of 0.5 cm when adjusting the parameters of the details along the waist for a standard size 170/88/92 [9]. Based on the obtained value, we conclude that the properties of the studied knitted fabric allow to combine details cut at an angle of 45° and in the direction of the wales.

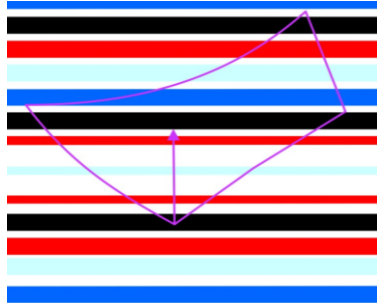


FIGURE 2. Disposition of the upper front part of the dress on the fabric during the cutting

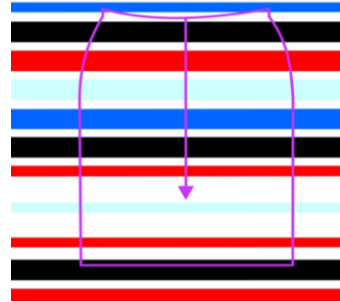


FIGURE 3. Disposition of the lower front part of the dress on the fabric during the cutting

The model is developed on a pattern basis, taking into account the stretch in the direction of the courses. In order to achieve accurate dimensions of the details located during the cutting at an angle of 45° , it is necessary to resize them. For this purpose, a coordinate system with centre point T_4 is built, which is the middle of the front part of the model. Each of the points which are to be corrected (measured against the coordinate system) changes their location, depending on the difference between the reduction factor in the courses and in the bias (45°). The transformations made and the final appearance of the part as shown in figure 4 and figure 5.

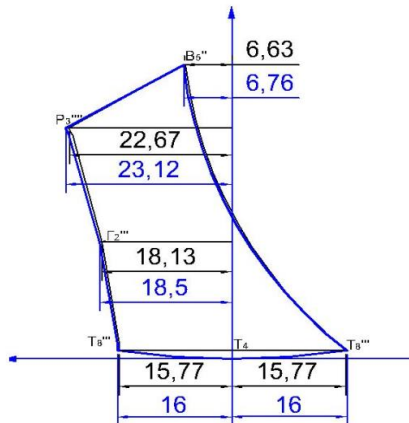


FIGURE 4. Resize the upper front detail of the dress

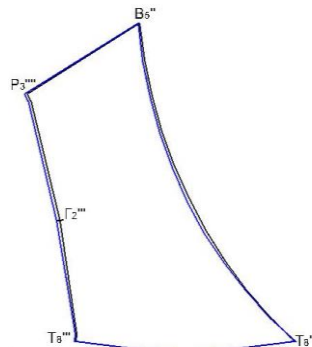


FIGURE 5. Ready upper front detail of the dress



FIGURE 6. The made dress -model 1

The designed dress – model 1 is tailored (figure 6). The analysis of the tailored model shows compliance of the constructive lines with the respective size features. There is a fit of the dress corresponding to the designed - semi-solid silhouette. The shoulder and side seams are located correctly, there is no mixing or distortion of the pattern of the knitted fabric. The developed method for determining the value of the reduction factors through the percentage of elastomeric threads in the knitted fabrics makes it possible to determine the compatibility the clothing details at the earliest stage of the garments' design.

STUDY OF THE APPLICATION OF A SYSTEM FOR PATTERN MAKING DRESSES CONTAINING DETAILS OF FABRICS WITH DIFFERENT KNIT.

A common approach to designing women's clothing is to combine different types and structures of fabrics. The widely varying stretch of knitted fabrics makes it necessary for the combined materials to have similar properties. The method developed to account for the stretch of knitted fabrics by the percentage of elastomeric fibres in their composition allows the compatibility between them to be determined at the product design stage. Designing women's clothing by combining different types and structures of knitted fabrics requires the combined materials to have similar properties. When comparing the values of the reduction factors, the compatibility of the details between two different knitting structures can be assessed. For the tailoring of a quality product, it is necessary for the combined fabrics to have similar or equal reduction factors.

A women's dress – model 2 with a length up to the middle of the knee has been designed. For this model two fabrics have been chosen with different colour, pattern and knitting structure. The fit of the silhouette is formed by the side seams and the seams on the back. The compositional centre of the model is the asymmetrically located constructive-decorative shears. The front part includes 8 decorative elements. The back part consists of two sub-parts, as one of the sub-parts is structurally divided. The neckline is asymmetrical. The sleeves are long. The main part of the dress is made of knitted fabric from group B – from Punto di Roma jersey. The decorative - constructive elements of advanced fabric from group A – from jacquard jersey. The chosen fabrics have a stable structure and allow for the dress pattern with to be made a lot of shears. Design of model 2 is presented in figure 7.



FIGURE 7. Design of dress – model 2

The presented model includes constructive shears at an angle of 45° which require a study on the stretch of the knitted structures, in both directions – the courses and the bias (45°). For this purpose, the reduction factors in the bias (45°) were calculated for the two groups of knitted fabrics according to the equations shown in table 1. Calculation of the values of the reduction factors in the bias (45°) and in the courses for two groups of knitted fabrics are presented in table 2. The analysis of the values of the reduction factors shows that there is no compliance

between the two loop structures in the two studied directions. It is necessary to take into account the compatibility of the knitted fabrics in the direction of the larger clothing details, which are located in the direction of the courses.

It was decided that the main part of the dress to be made of fabric from a Punto di Roma jersey containing 2% elastomeric threads and the decorative-constructive elements to be from jacquard jersey fabric with 4% elastomeric threads.

TABLE 2. Calculated values of reduction factors for the two groups of knitted fabrics at different content of elastomeric threads in their composition

		The values of reduction factors									
		1%EL	2%EL	3%EL	4%EL	5%EL	6%EL	7%EL	8%EL	9%EL	10%EL
Fabrics group A - Jacquard jersey	In the bias (45°)	0.88	0.86	0.84	0.82	0.80	0.78	0.76	0.74	0.72	0.70
	In the courses	0.92	0.90	0.88	0.86	0.84	0.82	0.80	0.78	0.76	0.75
Fabrics group B - Punto di Roma jersey	In the bias (45°)	0.90	0.88	0.86	0.84	0.82	0.80	0.78	0.76	0.74	0.72
	In the courses	0.88	0.86	0.84	0.82	0.80	0.78	0.76	0.74	0.72	0.70

The pattern design of the model is made on the basic pattern of a women's dress for standard size 170/88/92 [9]. The pattern design is presented in figure 8.

The designed dress – model 2 is tailored (figure 9). The fit of the garment is established in correspondence with the designed silhouette. The constructive lines of the designed and tailored dress align with the dimensional feature. No creases or seams are observed. The designed visual effect of the decorative-constructive elements is achieved. No pressure, discomfort or restriction of movement has been detected during wearing the dress.

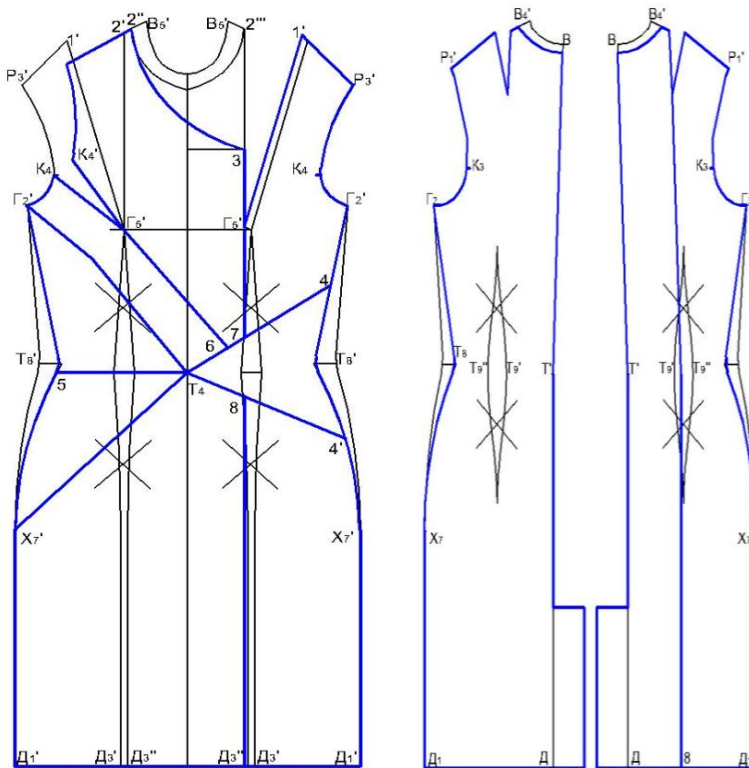


FIGURE 8. Pattern making of dress – model 2



FIGURE 9. The made dress - model 2

STUDY OF APPLICATION OF SYSTEM FOR PATTERN MAKING OF TWIST KNOT DRAPE DRESS

In recent years, draperies by twisting different types of knots are popular in the design of women's dresses. An important feature in forming drapery by twisting knots is the determination of the size of the knot and the width of the draped sections. There are many design systems devoted to this problem [13, 14, 15, 16, 17]. What they all have in common is that they present different approaches that give reasonably good results, but do not contain a mathematically sound relationship between the knot diameter and the width of the draped sections. In [11] the relationship between these two main parameters is investigated using regression analysis methods. It is found that there is a straight linear relationship between the diameter of the knot and the width of the draped sections. The research conducted was designed for the manufacture of garments from woven fabric. The methodology presented in [10,11] for pattern designing draperies is adapted for dresses made of knitted fabrics. The following straight linear relationship was found between the diameter of the knot and the width of the draped sections:

$$W = 6,5.D - 20$$

$$D = 0,14.W + 3,5$$

where: W- the width of the draped sections, D - the diameter of the knot.

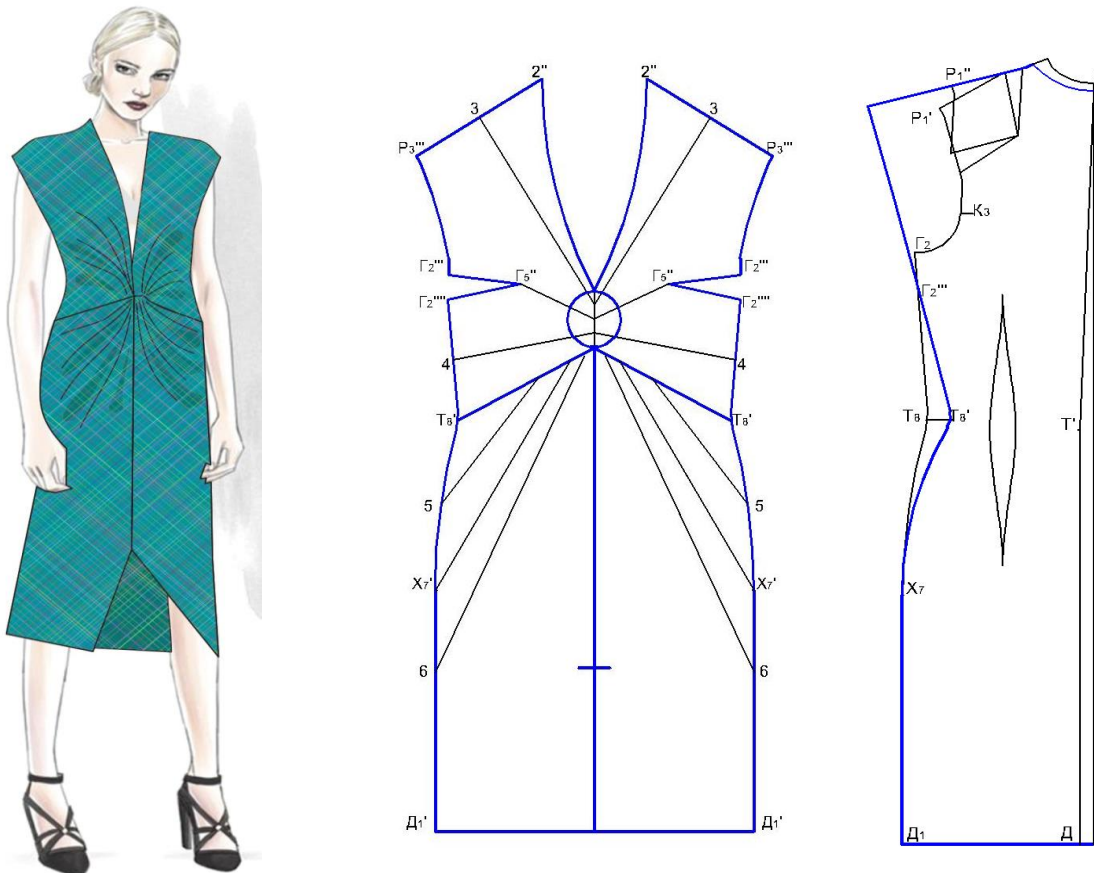


FIGURE 10. Design and pattern making of twist knot drape dress - model 3

The application of the method for account the stretch of the fabric, by reduction factors determined by the percentage of elastomeric threads allows easy and fast pattern making and designing of clothes with different knots'

diameter and draped details' width. Figure 10 shows design and pattern making of women's dress made of jacquard jersey fabric. The composition of the fabric yarn is 80% viscose, 17% polyamide and 3% elastane. The compositional centre of the model 3 is the drapery twisted by the knot along the waist line. The neckline is triangular, shaped with smooth curves. The length of the dress is below the knees. A 20 cm long slit is made on the front of the dress. The composition of the back of the dresses is symmetrical. The sleeves are short, kimono type. Figure 11 shows the draping the one of the front parts.

The designed dress – model 3 is tailored (figure 12). The fit of the dress corresponding to the designed silhouette has been established. The diameter of the knot is 7 cm and corresponds to the designed one. The construction lines are aligned with their respective dimensional features. No creases or displaced seams are monitored. The proposed method for designing the diameter of the knot and the width of the draped details gives good and reliable results.

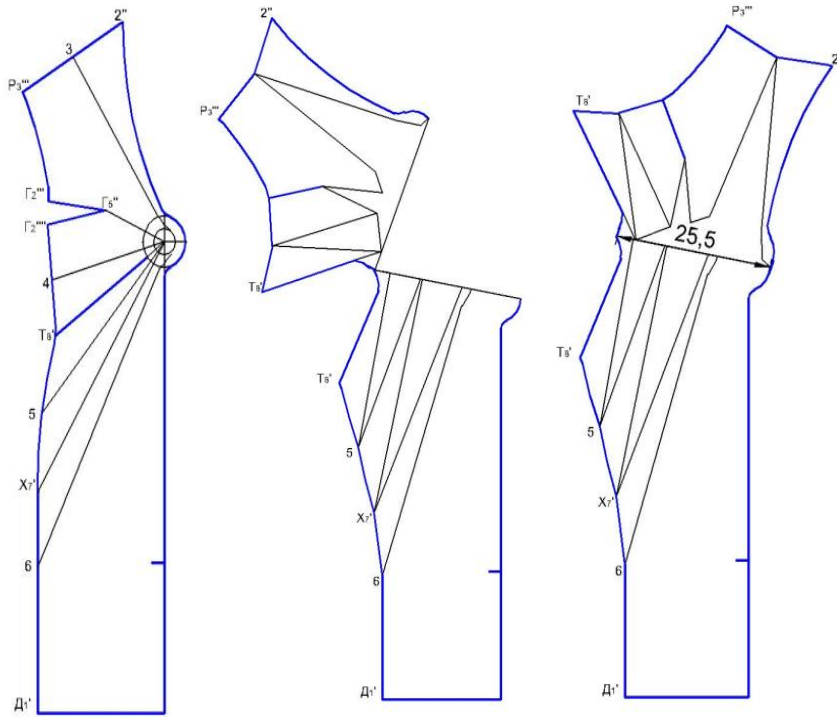


FIGURE 11. Pattern making of twist knot drape dress - model 3



FIGURE 12. The made dress – model 3

CONCLUSION

The developed pattern designing system of women's dresses from knitted fabric provides a good match of the construction lines and fit of the clothes, without the need for additional adjustments in the process of their sewing. The developed pattern bases allow for the pattern designing of women's dresses in different silhouettes. The method for determining the value of the reduction factors through the percentage of elastomeric threads in the composition of the knitted fabrics allow to assess the compatibility between details of the dress, which are tailored of knitted fabrics with different loop structures; located in different directions of the stretch of the knitted fabric when designing dresses. An approach is proposed for resizing the dresses' details, located in different directions of the stretch of the knitted fabric. The approach for resizing the details based on the knitted fabrics' properties can be applied when using ready-made pattern making bases for dress' models made of woven fabric. The shaping of the models by three-dimensional elements, such as by the fixed draperies, has been analysed. The proposed relationship between the diameter of the knot and the width of the drapery gives good and reliable results. The accuracy and applicability of the mathematical models, which are determining the value of the reduction factors by the percentage of elastomeric threads in the composition of the knitted fabrics, has been proved. The process of pattern making and pattern designing women's dresses from knitted fabric containing elastomeric threads from 1% to 10% is significantly facilitated. No preliminary laboratory tests of the fabric are needed to determine the stretch. Only the

information used is from the manufacturers about the value of elastomeric threads in the composition of the knitted fabrics.

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