An investigation of pattern design of draped necklines

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Abstract. The paper presents an investigation of pattern design of this type of drapery with main idea easy and correct constructing. The aim of the work is development of a facilitating and accurate system of pattern design on the base of studying different constructional systems and finding a way of correct measurement with the help of approximation of the draped neckline with a parabola and a dependence, obtained by a multiple linear regression. The results of the investigation lead to easy and correct geometrical way of pattern design and easy and correct measurements of the draped necklines in ladies’ clothing. The dependence of measurements can be use not only with presented pattern design system but with every other way for constructing draped neck opening. The measures on the made prototypes show that there isn’t any additional length to the draped neckline as result of the skew direction (in the more times) and the weight of the fabric in the garments made from woven fabrics. But there is additional length of the draped neckline in the garments made from knitted fabrics, result of the stretchability in all directions. In the garments from woven fabrics stretchability in skew direction is balanced by lack of it in both basic directions, and by this reason the stretchability forms the drapery but does not add length to the draped neckline. Therefore, the obtained dependence of measurement of the draped neckline is suitable for garments from woven fabrics and a base for the future study about draped necklines in clothes from stretched materials.

1. Introduction
The draped neckline, known as Greek neckline, is one of the most popular draperies and a type of a neck opening in the contemporary lady’s fashion. It is a kind of the free drapery which does not need a seam, twisting or knot for its forming. In fashion design the draped neckline is formed in the front or the back of the bodice.

The paper presents an investigation of pattern design of this type of drapery with main idea easy and correct constructing. The aim of the work is development of a facilitating and accurate system of pattern design on the base of studying different constructional systems and finding a way of correct measurement with the help of approximation of the draped neckline with a parabola and a dependence, obtained by a multiple linear regression.

2. Pattern making model development
Figure 1 presents a geometrical model of pattern design of draped neckline. This easy constructional way is developed on the base of analysis of different pattern makings systems [1, 2, 3, 4, 5, 6, 7]. The study of geometrical ways of constructing shows that in [1, 2, 3, 4, 5, 6] the draped piece is divided on parts for designing of more folds or additional volume of the drapery.
The analysis shows that the numbers of divisions for folds can be minimized, as it is in [7]. The partings about number of folds and the subsequent arrangement of the divided parts transform shoulders in curved lines or give a more intensive curves of arm holes. Therefore, the divisions in the shoulders can be replaced with curves which transform whole or part of shoulders in curved ones, as it is presented in Figure 1 right. And as it is seen in Figure 1 left the results is a drapery with more folds. If the divisions about number of folds are made in the contours of arm holes, they can be replaced with only one parting for contour and after that the arm holes be formed with more intensive curves. Similarly, the divisions about volume of drapery can be minimised too. As it is shown, the volume for drapery in the construction in Figure 1 right is a result of manipulation of darts by moving in the middle line of the front. The difference of geometrical model, presented in Figure 1, and this one, presented in [7], is that the model in Figure 1 suggests different intensity of the curve in the shoulder contour, as smaller intensity leads to smaller number of drape folds, and bigger intensity leads to bigger number of drape folds.

Figure 1. Geometrical pattern model and a prototype made on the base of the model.
3. **Measurements of the neckline**

How to determine the length of the main fold or the neckline roll line – FL, in green in Figure 2, according to the neckline width and the neckline depth? The width and depth of the neck opening depend on the design of a garment and the body sizes and by this reason they can be limited in the next intervals: The neckline width (half width), NLW = 7,0-15,0 cm, and the neckline depth, NLD = 9,5-20,0 cm.

![Figure 2. Geometrical pattern model. FL – the length of the main fold.](image)

When the cloth is worn, the main drapery fold falls in the form of a catenary line. The catenary line can be approximated with a parabola. The parabola is drawn, shown in Figure 3, using the tangents method of this curve creation [8] with a NURBS line in CAD system ASCON KOMPAS 3D LT 12. NURBS is the most suitable because, as it is known, it is drawn on the base of tangents. Parabolas are drawn for different combination of neckline width (half width), NLW between 7,0 and 15,0 cm, and neckline depth, NLD between 9,5 and 20,0 cm.

![Figure 3. A parabola drawn using the tangent method of creation.](image)
Figure 4. Approximation of a draped neckline with a parabola. Measurement of the main drapery fold $F_L$ on the base of the neckline width $N_l W$ and depth $N_l D$.

On the base of parabolas, drawn by the tangent method, shown in Figure 3, the model for the measurement of the draped neckline is presented in Figure 4. The length of the main drapery fold $F_L$ is measured for every combination of neckline width (half width), $N_l W$ between 7.0 and 15.0 cm, and neckline depth, $N_l D$ between 9.5 and 20.0 cm. With a multiple linear regression, made with software STATISTICA 7.0 [9, 10], a dependence of the main drapery fold length (half length), $F_L$ and the neckline width (half width), $N_l W$ and neckline depth, $N_l D$ is searched, Figure 4. The regression model is presented with formula (1):

$$Y = a + b_1 . X_1 + b_2 . X_2,$$

where $Y$ is the dependent variable; $X_1$ and $X_2$ – independent variables; $a$ – constant; $b_1$ and $b_2$ – coefficient of regressions.

In presented regression the dependent variable $Y$ is $F_L$, the main drapery fold length (half length), and the independent variables are $X_1 = N_l W$, the neckline width (half width), and $X_2 = N_l D$, neckline depth, Figure 4, and formula (1) is modified in (2):

$$F_L = a + N_l W . X_1 + N_l D . X_2.$$

The results of the regression analysis are: $a = 0.116557$, $b_1 = 0.661127$, and $b_2 = 0.816302$. The correctness of the linear regression model is proved by the values of $p < 0.0000$, $R$-square $= 0.99543535$, and Std. Error of estimate $= 0.27552$. The linear interaction between dependent variable – $F_L$ and independent variables – $N_l W$ and $N_l D$ is shown in Figure 5. According to the results of the regression analysis formula (2) is transformed in dependence (3):

$$F_L = 0.12 + 0.66 . N_l W + 0.8 . N_l D.$$

The results of the regression show that the value of the constant $a = 0.116557$ is minor and the dependency (3) can be modified in (4):

$$F_L = 0.7 . N_l W + 0.8 . N_l D,$$

where $F_L$, cm is the length of the main drapery fold (the neckline roll line); $N_l W$, cm – the width of the neckline; and $N_l D$, cm – the depth of the neckline.
4. Conclusion
The results of the investigation lead to easy and correct geometrical way of pattern design and easy and correct measurements of the draped necklines in ladies’ clothing. The dependence of measurements can be use not only with presented pattern design system but with every other way for constructing draped neck opening. The measures on the made prototypes show that there isn’t any additional length to the draped neckline as result of the skew direction (in the more times) and the weight of the fabric in the garments made from woven fabrics. But there is additional length of the draped neckline in the garments made from knitted fabrics, result of the stretchability in all directions. In the garments from woven fabrics stretchability in skew direction is balanced by lack of it in both basic directions, and by this reason the stretchability forms the drapery but does not add length to the draped neckline. Therefore, the obtained dependence of measurement of the draped neckline is suitable for garments from woven fabrics and a base for the future study about draped necklines in clothes from stretched materials.

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Figure 5. The linear interaction between dependent and independent variables.