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THE POSSIBILITY OF TRANSITION FROM THE PRACTICE OF THE APPROXIMATE DEFORMATIONS OF TEXTILES, CLOTHING THEIR ACCURATE ASSESSMENT

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К ВОЗМОЖНОСТИ ПЕРЕХОДА ОТ ПРАКТИКИ ПРИБЛИЖЕННОГО УЧЕТА ДЕФОРМАЦИЙ ТКАНЕЙ, ОДЕЖДЫ К ИХ ТОЧНОЙ ОЦЕНКЕ

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To justify the requirements for various products, clothing that meet the convenience, comfort, design, thermal properties and other characteristics, in particular, structural and technological allowances, strictly necessary information about the deformations occurring in materials, clothing. From the study and analysis of known sources, such information on deformations, their accounting is extremely limited.

In the work "on cutting clothes" [1] Russian mathematician P. L. Chebyshev proved the possibility of constructing scans of tight-fitting shells of fabric for different surfaces. At the same time, he proceeded from the fact that the threads of the base and the weft of the fabric in its original flat form intersect orthogonally and when dressing the surface of the fabric, only the angles between the threads change, and the length of the threads remains the same. Chebyshev also admitted that when changing the rectangular cells of the fabric in the parallelogram, the fabric resists stretching it only along the warp and weft threads. Accordingly, in the shell of fabric, tightly fitting the surface, the warp and weft strands are stretched by forces acting along their length and in order for the strands on the surface to be in equilibrium, they must be located along geodetic lines. This well-known condition of the equilibrium of the threads on the surface in General can be strictly performed only by one warp thread and one weft thread, since the direction of all the threads of the fabric does not coincide with the geodetic lines. Therefore, to ensure the balance of the threads of fabric on the surface, Chebyshev came to the need for the location of two intersecting threads of fabric on orthogonal geodetic lines. He took them for the original coordinate axes on the surface (x, y), considering the coordinates of the length of the warp and weft fabric (Pic.1).

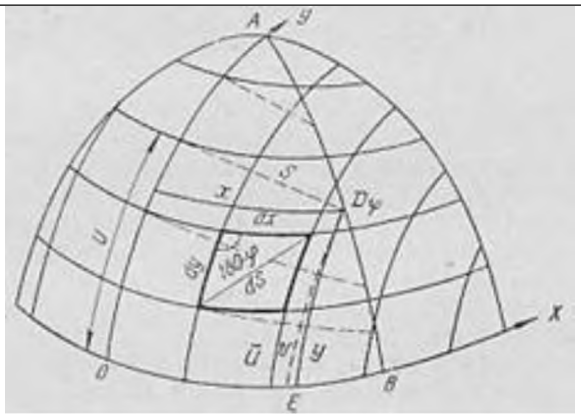
At the same time, the threads of the Chebyshev fabric are considered as coordinate lines forming a curvilinear Chebyshev network on the surface, the elements of which are infinitely small parallelograms. The length of the diagonal of the elementary parallelogram

$$ds = \sqrt{(DU2 + dx2 + 2\cos\varphi dydx)} \quad (1)$$

defines the distance between two adjacent surface points (Pic. 1).

Based on this equation, Chebyshev solved the problem of dressing the surface with a cloth in the form of the following formulae:

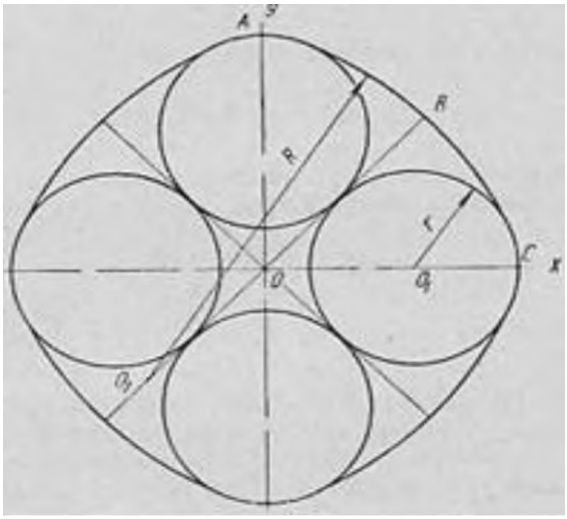
$$x = S + 1/6(k02u2 + k0k2u3 + 1/4k22u^4)S3 + 1/8\ (k0k1u2 + 1/2k1k2u3)S^4 + \ldots$$
$$y = u- (1/2k0u + 1/4k2u2)S2 + 1/6k1uS3 + \ldots, (2)$$



Picture 1. Cloth shell on the surface

Where x and y-rectangular coordinates that determine the shape of the sweep of shells of fabric on the plane; S-the shortest distance from the axis of the OU to the points of the seam line (border) of the shell on the surface (Pic. I); u is the ordinate of the point of intersection of the line of shortest distance (S) the axis Oy; k0, k2, k3 - the coefficients of the expansion in a power series of the Gaussian curvature of the surface at a given point (x, y).

To check these formulae, Chebyshev determined by them the shape of the shell sweep for a ball consisting of two parts, and found a simple way to construct it with arcs of circles of radii r and R (Pic. 2).



Pic. 2. Sweep the shell for a ball of two parts

These radii are determined by the formulae: r = 0,65 Rb; R = 2,46 Rb, at AB = sun; OA = OS = 0,5 πrb; S = 1,42 Rb, where Rb-the radius of the ball. The cutting sheath is produced by positioning the warp and weft of the fabric on the axes Oh, Oh.

Experimental verification of the shells of different fabrics (canvas, side canvas, woolen suit fabrics) indicates the possibility of manufacturing on the sweep Chebyshev tight-fitting shell of fabric for the surface of the ball, consisting of two parts.

The solution of the problem of dressing the surfaces with a cloth after Chebyshev engaged in other mathematics. However, the results of their research can not be directly used in the design of clothing due to the fact that they solved the problems of differential geometry, which does not include the study of methods for determining the shells of fabric. At the same time, their studies show that a strict solution to the problem of dressing surfaces leads to significant mathematical complications. Therefore, it is necessary to solve this problem to calculate the scans of the shells of tissues by approximate methods. The use of these methods greatly simplifies the solution of the problem of dressing the surface and provides sufficient accuracy of the calculation of the scans of clothing parts,

since their molding occurs at a small angle of skewing the threads of the fabric (15 - 18°). The coordinates included in Chebyshev's formulae are orthogonal geodesic lines; they can be determined by direct measurement of the surface using a geodesic gon. But despite this, Chebyshev's formulae were not used in the design of clothing, as they were not developed methods for calculating the sweep of different surfaces. These formulae are power series that define the coordinates of the scans (x, y). Therefore, for approximate calculations, the formulae (1,2) can be simplified.

The authors studied the possibility of determining and taking into account deformations by various methods. The main attention is paid to two main methods of experimental analysis of deformations: moire and dividing (coordinate) grids. Other methods studied by us, as a rule, have limited application, rather complex and /or have relatively low accuracy. As for the latter circumstance, in favor of the moiré method and passing it under certain conditions to dividing grids, there was the possibility of using innovative tools for determining deformations on the basis of advanced sensor, digital technologies [2,3].

As a result:

1. Questions of the existing theory and practice of calculation and purpose of allowances of garments are considered. including technical and decorative-constructive, their composition, content, features.
2. Investigated the dependence of deformation on the structure and properties of fabrics and apparel. The greatest attention is paid to the main types, especially deformations depending on the type, type of textile materials. Was considered strain as external, determined by the characteristics of the structure material, and internal, due to the peculiarities of the structure of the yarn (filaments) and fibers. Considerable attention is paid to the relationship of structural and technological allowances and mechanical properties of textile materials.
3. Mathematical models of deformations occurring in tissues and clothes are considered. Models for determining the main deformations are obtained. Practical research was carried out using sensory and digital technologies.

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