

MODERNIZATION OF BASIC SHOE MANUFACTURING TECHNOLOGICAL PROCESS

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According to the latest statistics [1], 20 million people only in Russia need medical orthopedic shoes. Despite the fact that those numbers are based exclusively on clinical research, the figures fully confirm the trend for shoe manufacturing industry to develop individual and preventive footwear.

The urgency of speeding up the development of a manufacturing process requires the reduction of study-operation cycle along with the improvement of design technology itself. Precisely on the very first stages of a technological process, basic ways of product development and its technical and economical indicators alongside with future quality are being set. And nowadays one of the most popular and innovative direction in this particular area is 3D-modeling and printing.

It is noteworthy that the increase in the quality of design through the introduction of programs supporting 3D-format is included in the list of priority directions of development of science, technology and engineering in the Russian Federation (according to Decree of President of the Russian Federation from 07.07.2011 № 899, paragraph 3 - «Information and telecommunication systems»). Thus, the purpose of this paper is to analyze the process of creating footwear, built around the use of modern means of three-dimensional modeling and printing.

Footwear industry is very diverse. According to Russian State standard #23251-83, there are 18 major classes of shoes following the division of its purpose, materials used, and more than 20 on methods of mounting the component parts. Since the establishment of basic criteria for the study could be based only on one prototype, women's sports shoes with standard completeness were chosen as a design object. The reasoning behind this selection is the complexity associated with sports shoes: they are more susceptible to wear and tear, besides they still must meet consumer demand and current fashion trends alongside with increased comfort significance.

The first stage in designing of any product, and footwear in particular is the development of its artistic image, which leads straight to product's further competitiveness. The term «Concept» stands for the original purpose of an item and represented by the set of sketches. Fig. 1 shows the author's work sketch series. The work sketch depicts proportions of the parts and the whole product itself. The algorithm implementation of the work sketch was developed at the Ars Sutoria School (Milan, Italy) [3] and was used by the author.

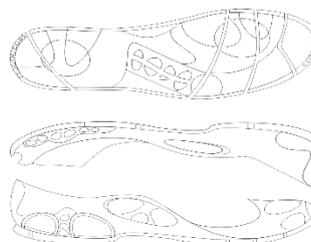


Figure 1. First stage work sketch

The presentation of this form is determined by the Bio-tech conception and focuses on the unconscious tend to select smooth and streamlined shapes, dictated by the natural environment, which are the most harmonious at its core. The side holes are provided to meet the need for natural ventilation of the foot (as the material selected is rubberized elastic polymer), and its location is based on the analysis of patterns of lepidopteras (butterfly) wings. The decision is due only to the author's choice and basically contains a feature of shoe itself - its relative symmetry. In addition, the image of the butterfly has valid popularity, especially among female target audience.

Above all, a «form» takes the main place in the process of designing. Color and texture tend to bore audience with time, and, consequently, are changing faster than the form [2]. For this reason, in Fig. 2 two basic color schemes are being shown, in particular - cold and hot. Thus, the design of the product is aimed to maximize the satisfaction factor of consumer demand and to increase the individualization of whole product line.



Figure 2. Main color schemes

The next stage of the design process is a 3D modeling and visualization. A special feature provided would be the complete absence of production of pads, which reduces the cost and accelerates the whole process. Pads are supposed to be produced by 3D scanning of a customer's foot. In this case the information goes to the CAD environment in the form of a cloud of connected points, according to which strain-shaped design is

being formed.

In the footwear industry, many large companies are using special and unique software, which greatly accelerates the process of modeling. But the access to those is strictly limited, that's why in this particular paper the process of creating a model would be described on the Autodesk 3Ds Max 2015 environment due to its high performance rates and accessibility.

3D-visualization is performed on the basis of previously established working sketches by transferring curves in DXF format. It is important that when a working sketch is created, all the parameters of the anatomical structure of the female foot and dimensional parameters of pads are performed according to the Russian State standard #3927 from 1988 (these include parameters of the following block, the parameters of the silhouette of its lateral surface, width parameters and the height of elevation of the heel pad).



Figure 3. Three-Dimension model



Figure 4. Plastic prototype model

After 3D-model is complete, the file is being prepared to print. The proportionality of 3D-model scale is being verified. Then an optimized model is stored into the STL format. The printing process is expected to be provided with the use of innovative FDM technology (Fusing Deposition Modeling), thanks to which the shoe model is created by layering elastic polymer.

Thus, Autodesk 3Ds Max is sufficiently suitable for visualization, but has a number of disadvantages, including a tolerance error. This drawback is easily eliminated by the introduction of an intermediate stage of prototyping, when design flaws are being revealed (especially with the possibility of fitting) and set for final touches. That is why, for the successful production in a competitive market, it is still recommended for developers to use specialized and adapted software.

Hereby, the possible prospects of development of 3D-printing technology is fully capable of solving the problem of individualization of the shoe manufacturing industry, as well as it leads to the optimization of the entire process.

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