VISUAL MEANS OF DESIGN AND PLASTIC MODELING

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Abstract. The topic of this paper is the problem of the professional design thinking formation in students which learn such discipline as design. Design thinking is a specific spatial-figurative thinking that allows designers to materialize their ideas and designs. Design thinking allows new forms and solutions of design problems to search and find. A creative search for a designer is based on empathy, which is an understanding and emotional experience concerning a practical problem being solved. Means of formation of design thinking are graphic and layout spatial modeling. They are used in conceptual, logical and physical modeling. They are implemented in the form of a two-dimensional graphic sketch and three-dimensional layout. The iteration method allows them to gradually narrow the search for the optimal form in the design, returning from a three-dimensional model to a planar one (for example, as a photo), and make adjustments to the final three-dimensional model layout based on the analysis. To create a design object, it is necessary to have professional skills in both plane-graphic and three-dimensional space modeling. The extrapolation of planar approaches to three-dimensional once and vice versa is productive. Both methods of modeling serve a consistent approximation to the solution of a problem. They can complement each other at different stages of designing, bringing the designer closer to the embodiment in the material of the created object. The layout allows them to define and refine the design and proportional ratios of the parts of the object being created, its functional and aesthetic characteristics. The graphic sketch makes it possible to capture the emotionally significant characteristics of the designed object, simultaneously fix its role in various contexts of the environment, and capture the intermediate stages of creative search.

Keywords: two-dimensional graphic modeling in design, model-plastic modeling in design, iteration in design, design thinking, designing.

1. **INTRODUCTION.** The relevance of the study of graphic tools in design-plastic modeling is determined by the overall objectives of the development of project activities. “When visually solving problems, there is no a list of absolute truths “this should be done” and “this should not be done” which must be followed. In certain eras, visual art faced different tasks, so it’s impossible to talk about exact laws. However, the expression “no rules” can be understood by some in the sense that all design works are equally valuable and good. This is not true, too. Artistic techniques and criteria were developed on the basis of outstanding works that an artist or designer should know about. Thus, there are not laws, but indications that help to create a successful design. This, however, does not mean that an artist will have to limit him or her to any one decision [1]. ”In the system of tools that ensure the process of engineering and design creativity which are widely used in the design, we can distinguish graphic and layout methods of creating an image. They play an important role at all stages of the creation of an artistic and design work from the inception and development of an idea to the realization of a design solution. Project activities should be carried out taking into account the possibilities and feasibility of using graphic plastic materials at various stages of designing, which allows the process of design creativity to intensify. The study of the correlation, possibilities, and expediency of application of the model-plastic formation at different stages of the design is necessary not only to improve professional, but also educational designing process. Education of future designers cannot be limited only to the layout or only a graphic tool. The literature on graphic design tools is very extensive and includes the historical-theoretical and art criticism works, as well as project-methodical guidelines for mastering various types of graphic and plastic means.

At the same time, it is necessary to consider the possibilities of graphic and layout forms of spatial modeling in the designer’s work, the expediency of using them at various design stages. A number of tasks were defined to study the boundaries and levels of application of model and graphic modeling in educational designing:

- to analyze the commonality and differences between the 3D model and graphic spatial modeling in design creativity;
- to identify the functions and specifics of the considered forms of spatial modeling in professional and educational designing;
- to determine the boundaries and conditions for the use of graphic and 3D model forms in educational and professional designing.

2. **METHODS**. The main methodological principle of the study was a comparative analysis of graphic and 3D model forms of spatial modeling according to their functional purpose in educational and professional designing. This made it possible to identify the specifics and capabilities of the analyzed forms of spatial modeling, to outline ways of effective and expedient use of these forms of modeling both in design practice and in the educational process.

3. **RESULTS AND DISCUSSION.** The design is based on iteration, that is, a consistent approximation to the solution of the problem: the combination of aesthetic, functional, marketing, manufacturing and other components of the design process. The stages of scientific design were formulated by Hans Gugelot [2]. At the preliminary stage, the

necessary information for the design is collected and pre-design analysis of the source data is carried out. As a rule, the following design tools are used: photofixation, sketching, copying, timing, questionnaire survey, somotographic research and other methods [3]. Then conceptual, logical and physical modeling is carried out. In conceptual modeling, brief sketch and a generalized image are developed, the principles of artistic shaping are thought out, usually in 2D graphics. A logical model created at the next level assumes working mockups, axonometric images, orthogonal projections in scale and in color [4]. Then designers return to their ideas, correlating them with the capabilities of the material and technology, as well as sanitary and hygienic standards and / or fire safety requirements and other restrictive conditions. At the level of physical modeling, a designer creates a detailed sketch of the designed object in color, scale, with basic dimensions, ergonomic scheme and 3D model, defining general compositional and layout models. Often, a design process requires a reverse translation of a model into a graphical planar image. We mean by model an artificially created object which is similar to the created design object. The model in the design reproduces the important functional and aesthetic characteristics of the object of designing [5]. Such a model can be verbal (descriptive), visual in the form of a sketch or 3D model.

Project modeling is the reproduction of essential properties and forms of an object or phenomenon in the form of a conditional model, a prototype of a future object. When designing objects, especially complex ones, a significant arsenal of various modeling tools is used: functional diagrams, flowcharts, system models, various matrices and classification tables, typological models, etc. The design uses different methods of modeling. The development of the artistic image of an object involves the use of planar graphical and spatial plastic modeling tools [6].

Next, we consider the design-graphic modeling (creating a sketch) and three-dimensional modeling (creating a 3D model layout) and compare their design capabilities:

- in professional designing, the model and graphic forms of spatial modeling do not in all cases equally reflect the content of the designed object;
- the use of one or another form of spatial modeling depends on the nature of the designed object;
- using the graphic and 3D model forms of spatial modeling, the designer proceeds from the tasks at each design stage.

A 3D model layout is a spatial object that reproduces visual or individual functional characteristics of a product / structure / complex. With the exception of demonstration models, the purpose of which is to create an idea of the appearance of both the designed and existing products; the other types of models serve primarily design goals. The 3D modeling is creation of a conditional or "natural" three-dimensional image of an object at a certain scale, which allows searching and evaluating the aesthetic, functional, structural-and-technological or consumer qualities of new products and forms, and to analyze various aspects of a particular design in a complex. 3D modeling makes it possible to re-create and study various phenomena in the laboratory conditions; it contributes to the mechanization of the design process, allows obtaining materials of testing of the designed objects close to nature and quickly.

3D models could be classified in the following manner:

- Depending on the simulated sides of the design objects (artistic, aesthetic, constructive, technological);
- Depending on the design stage (work, draft, demonstration, for laboratory tests);
- By scale (life size, reduced or enlarged in various proportions);
- By volume (three-dimensional - volumetric, semi-volumetric dioramas, cycloramas, perspective 3D models, scenery 3D models, planar models);
- By material of manufacture – made from paper, cardboard, fabric, wood (conditionally expressing the shape of future objects), up to direct reproduction of materials, texture, color being conceived.

In the design, the graphic and 3D model forms of the spatial modeling are the materialized image of the projected spatial forms of an object. They are used in design creativity in order to see something and understand the results of a creative search. In a creative search, graphic and spatial modeling obeys the iteration process for a problem. The transition from graphic modeling to prototyping is caused by the need to solve both constructive and aesthetic tasks.

It is possible to materialize and then adjust the form obtained graphically before only in a 3D model form. The 3D model itself becomes the object of study: we conduct further modeling of its three-dimensional form; we specify the style and proportions with the help of a 3D model and on the 3D model. The graphic model of a structure cannot be subjected to stress, it cannot be tested for strength, and the distribution of forces cannot be traced. In turn, in graphic form, you can abstract away from the design features and focus on the aesthetic side of the image, its sensory perception. The graphical modeling method is the primary visual fixation of a creative idea. It allows the creative process to capture in stages. The simultaneity of "visual frames" makes it possible to simulate various conditions for the existence of a projected object in space and time. For example, this method allows the designer to see how the piece of furniture will be perceived in different interiors and at different times of a day. Unlike a 3D model, graphics can provide the most economical and fast contextual approach and create a generalized visual image. Sketches capture the stages of a creative search, which is important for educational analysis of works or in the process of working with a customer [7].

Modeling in the 3D model form allows a designer to focus on the design of a specific material object. It is the 3D model that allows perceiving the spatial relationships of the details of the object holistically. Sequential reviewing of the 3D model from different positions makes it possible to holistically perceive its shape. No drawing or graphic image gives such a visible, visual impression as a 3D model. Using a model, we can simulate the illumination of the designed object, but with the help of the model we cannot fix the emotional experience of the play of light and shadow on it.

With the help of graphics, we can fix the visually perceived illumination, but graphics, as a timeless art form, do not allow for modelling the variability of this illumination. To transfer the status of the "Rhine Cathedral" at different times of a day, Claude Monet had to write eight of its images from one point. We can visualize the perceived illumination with one-time "frames" in the graphic, not in the 3D model. If it is necessary to return to the planar form, it is advisable to use the 3D model photographing. Iteration allows us to return to contextual analysis and to identify desirable and undesirable effects at a new stage of development. The combination of graphic modeling capabilities with prototyping allows a comprehensive approach to solving functional, material, structural and aesthetic tasks to represent.

4. **Summary.** The analysis above allows us to formulate the following conclusions:

1. To create an object of design, it is necessary to have professional skills in both planar graphic and spatial (3D) modeling. Extrapolation of planar approaches to three-dimensional and vice versa is productive. For example, Suprematic spatial compositions on the plane underlie the design of a new shape of dishes as in the Suprematist service (1922) of Kazimir Malevich and Ilya Chashnik [8]. Cardboard linear plasticity in the 3D model helped create a collection of chairs and coffee tables designed by designer Roberto Venturi. The plastics of linear bends of the "Well-Tempered Armchair" by Ron Arad served for creation of an ingenious and innovative construction made from four flexible steel sheets, bent in an arc and bolted to each other. In fact, a bent sheet of plastic forms the "Bookworm" shelf of the same designer [10].

2. Both modeling methods serve to iterations, that is, a sequential approximation to the final solution of a problem and they can complement each other at different stages of designing, bringing the designer closer to realization in the material of the object being created.

3. A 3D model allows us to define and refine the design and proportional ratios of the parts of the object being created, its functional and aesthetic characteristics.

4. A graphic sketch makes it possible to capture the emotionally significant characteristics of the designed object, simultaneously fix its role in various contexts of the environment, and capture intermediate stages of creative search.

5. Conclusions. Satisfying needs of customers and providing novelty in design is the content of the designer's work. Fundamentally new engineering ideas, technologies and materials come not every day, but, as a rule, the objects of mass production with a long-established set of functions require a permanent giving of novelty. Satisfying needs through design "begins with empathy i.e. with a deep understanding of the people for whom this design is intended "[10]. Design thinking is a creative process that ensures novelty of a final product and a non-standard solution of a practical problem. The specificity of design thinking allows us to solve nontrivial, non-standard practical problems with many unknowns. One of the problems in the education of future designers is lowering of motivation of students which are future designers, to master the skills of graphic modeling and 3D modeling [11]. As an alternative to man-made modeling, students prefer computer modeling, considering it to be simpler and more effective [12], [13]. This paper is more likely to raise the question of the significance of the classic designer's toolbox, rather than giving it an unambiguous solution in its favor. In many respects the scope of the design determines the choice of design tools. The authors of the paper see the ultimate goal of the education of designers in the formation of design thinking. Which design tools can achieve this goal has yet to be explored in future.

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