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**To the question of the choice of the effective tools of graphical  
visualization  
In the design tasks**

*Abstract: In the given article, the principles of use of modelling tools of objective and aesthetic properties of the projected forms proceeding from in advance defined conditions were issued.*

*Perception of various aspects of an object's practically implemented by means of a number of special images. Each of them, revealing a certain aspect of the design plan, can also have an emotional assessment of its perception.*

*The problem of ensuring the functionality, information content, laconicism and relevance of project images, as well as emphasis of the figurative characteristics of a designed project put by the author, conducts to the solution of the question of the expediency of graphic tools.*

*From this perspective, the recommendations on the choice of modelling tools of certain objective and subjective properties of the designed forms on predetermined conditions were developed, and it is possible to increase efficiency of the graphic determination by using these recommendations.*

*Keywords: design graphics, graphical modeling, graphical element, objective properties of shapes, visual image, design object.*

**Problem statement.** Modern trends in graphic design development are characterized by widespread transition from man-made graphics to digital technology. Rapidly developing of computer and information technology is resulting in increased physical correctness images, in active use of market-ready elements, component models, in increasing the functionality of software. The developers are trying to create computer programs as convenient,

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easier to learn, and their interfaces are characterized by term “humane”.

In such circumstances there is a risk of images originality loss of projected objects, mostly through thoughtless use of ready “template” computer configurations that partly makes graphics unclear, low quality and devalues it.

Creation of qualitative graphics requires the development and implementation of scientifically grounded principles, some of which are based on classical laws and experience of traditional man-made tools of image.

The question of choice of effective visualization tools in modelling tasks is the most important issue which will be discussed in this paper.

**Analysis of the recent researches.** The existing information sources do not contain recommendations for selecting optimal means of image graphics design in sufficient volume. Among the sources related to use of graphic design in certain types of project activities there is a quite informative work of K. Zaitsev [5], which deals with the possibilities and methods of creative use of tools, techniques and materials of the graphic art to figurative tasks of architectural design. This book fully covers the use of traditional man-made graphics, but with the advent of alternative graphical tools it has lost relevance. Work of the famous American graphic artist U. Boumen [4] is devoted to consideration of questions of rationality of graphic means use in a wide range of tasks of information transfer. From the point of view of detection efficiency of the figurative contents represented in presentation tasks of architectural practice the research of A. Kulikov [6] is of interest. Significant research of aesthetic and utilitarian aspects of project graphic also contained in a doctoral dissertation of M. Yakovlev [7], where means of objective properties formalization of architecture and design works are considered in particular. The expressive properties of the elements of project graphics and the impact of their compositional organization in the plane of the perception properties of the image are considered in the author's publications [1; 2]. The priority principles of creation of

graphic models of objects of design and architecture in form-building practice are formulated in author's article [3], which became a basis for writing of this work.

**Article purposes.** The goal of this article is the development of theoretical bases and recommendations about the choice of optimum tools of graphic visualization of designed projects.

**The main part.** It is known that the main aspects in the presentation of objects of architectural and industrial design is a position in space, surface appearance, a geometrical structure, functional structure, the principle of work, and also constructive and technological structure.

Part of the images which contains information on the functional and utilitarian part of a plan conceptually differs from images of surface appearance which, instead of that, set forms as the priority purpose of modelling of aesthetic properties. However aesthetic qualities of an object and its figurative contents can be expressed also in images, concerning especially utilitarian characteristics. For example, one model of the plan can be expressed by various ways, changing character and relationship of graphic elements. Therefore, at a stage of the design objects presentation, questions of the choice of graphic style of the image takes the important place.

U. Bouman proved that in order to the model was the most effective in terms of its basic characteristics, the question of expediency of the choice of graphic elements, and also ways of their organization in a graphic form on plane space is important [4]. Functionality of model depends on a right choice of a foreshortening of perception and the choice of type and the direction of projection and ways of formalization of an object that is replacement of its real properties with conventional graphic signs – symbolical or abstract. Also efficiency of graphic model is influenced by method of the object image (complete, sorted, transparent surfaces etc.). All this is also directly connected with the choice of the representing means of design graphics which defines the technological aspect of the image constructing.

It is necessary to apply the principles formulated by U. Boumen to concrete tasks of design graphics in an art form building. Some recommendations concerning the priority in the choice of the tools for objective properties modelling of the projected forms on predefined conditions are provided in Tables 1 and 2. These recommendations are developed based on both theoretical practices and practical experience of designers.

It is necessary to make some explanation. Recommendations concerning the choice of graphic elements, elections of a foreshortening and a way of projection, a way of formalization of graphic elements, receptions of the image and graphic means for especially utilitarian reasons which depend on functional purpose of model are provided in Table 1. But Table 2 concerns the choice of means of the image, proceeding from its aesthetic characteristics (massiveness, lightness, static character, dynamic, monumentality).

Therefore, using recommendations from both tables, it is possible to develop the most effective graphic model.

Let us consider certain provisions of these recommendations on the examples.

The location of an object (Tab. 1) on the area is modelled in two-dimensional plane space, as a rule, in orthogonal projections. Thus images of objects at the same time have most simplified appearance, but with preservation of dimensions of a form. Therefore, the main form of the image of provision of an object is the map or the scheme of the area (the situational plan) designated with all objects of the nature and architecture in a symbolical form, according to overall dimensions, where the designed project, as a rule, is visual accent of this type of the image.

The geometrical structure of an object (Tab. 1) includes identification of its volume and spatial form in axonometric or central projections which give the most complete spatial idea, and also the description of its geometry by means of system of plane projections.

The geometrical description traditionally is given by means of orthogonal projections. Generally, projections that reflect the most

objective form of preserving natural values are used, as the conceptual basis for constructing orthogonal projection is to represent what we know about the subject, but not what we see.

By means of system of dimensional lines the geometrical parameters necessary for form creation are specified. If an object is geometrical primitives, then a linear grid is used for the description.

Geometrical models of a form are built by the most laconic means of graphics: by means of accurate drawing lines of different type and thickness. So the main line which indicates contours of visible elements is traditionally allocated by thickness from others.

Geometrical models of a form are built by the most laconic means of graphics: by means of accurate drawing lines of different type and thickness. So the main line which indicates contours of visible elements is traditionally allocated by thickness from others. To increase the visibility of images that shows the volume and spatial structure it is possible to use own and falling shadows, tone allocation of the horizontal planes etc. Thus the falling shadows on a horizontal projection inform on the relative height of an element or change of level of the horizontal planes. Moreover, for differentiation of the object components on the drawing in order to increase information content colour of lines and painting of plane zones – continuous or shading – are used. With development of computer graphics these means gained efficiency in use. However, spots on such drawings should have local character on the plane for not to destroy planned structure of graphic space.

The following aspect of representation of a designed project is a functional structure (Tab. 1) which discloses the principle of its main functioning. As, for example, the ergonomics of architectural space is connected with the functional solution of the last one, then in architectural objects components of the general functional structure are the various zones of functional zoning limited by surfaces of architectural elements that they are formed by (the building envelop), and also communications that connects them and creates interrelations between them.

*Table 1*

**Priority in the choice of the tools for modelling of the object  
functional properties on predefined conditions**

<b>Characteristic/ means of modeling</b>	<b>Graphic elements</b>	<b>Foreshortening, a way of designing</b>	<b>Method of characteristics showing</b>	<b>Method of object showing</b>	<b>Traditional means of image</b>	<b>Modern means of image</b>
<b>Plane form</b>	Line, local spot	Orthogonal projections, elevation view	Symbolic	Complete view	Drawing, picture, collage, modular walls	Vector drawing, raster drawing
<b>External form of space surface</b>	Line, local spot, gradation, light-and-shade, grid	Axonometric projections, perspective	Symbolic	Complete view, drawing the grid and stroke in a form	Drawing, picture	Linear 3d-model projection models or local planes
<b>Objective appearance</b>	Colour, texture, light-and-shade	Perspective (adequate to visual perception)	Objective	Complete view	Picture, drawing	Physically correct visualization
<b>Form with surfaces of various structural characteristics</b>	Colour, texture, straight line, line	Axonometric projections, perspective, orthogonal projections	Symbolic	Complete view	Picture, drawing	3d-model projection by planes of different texture /colour
<b>Spatial geometrical structure of a form</b>	Line, local spot	Axonometric projections, perspective	Symbolic	Complete view, transparent framework, transparent surfaces	Drawing	Linear 3d-model projection models or local planes
<b>Functional structure</b>	Line, local spot, texture, colour	Orthogonal projections, axonometry (objective)	Symbolic, abstract	Transparent surfaces, sorted appearance, section drawing	Drawing	Vector drawing
<b>Constructive and technological structure</b>	Line, local spot, texture, colour	Orthogonal projections, axonometry (objective)	Symbolic	Transparent surfaces, sorted appearance, section drawing	Drawing	Vector drawing
<b>Location</b>	Line, local spot	Orthogonal projections	Symbolic, stylized, abstract	Complete view, transparent surfaces, section drawing	Drawing	Vector drawing
<b>Geometrical description</b>	Line, local spot	Elevation view, orthogonal projections (objective)	Symbolic	Complete view, sorted appearance, transparent surfaces, section drawing	Drawing	Vector drawing

The detailed functional structure shows placement of the equipment, accessories and furniture – functional elements which organize the space. On the other hand, the space is formed by passageways, driveways, functional zones which are calculated according to requirements of ergonomics, standards of fire safety etc.

*Table 2*

Priority in the choice of the tools for modelling of the object aesthetic properties on predefined conditions

Characteristic/ means of modeling	Completeness of image	Foreshortening, a way of designing	Position in space of the image	Direction of a stroke	Light- and- shade	The size concerning space	Spatial organization of the plane
<b>Massiveness</b>	Complete, silhouette	Perspective, low points	Bottom	In form	Dispersed	Large	Continuous space
<b>Lightness</b>	Dismembered, a side, a rib	Angle perspective, orthogonal projections	Top	Diagonal, horizontal, tight	Distinct	Small	Plane space
<b>Statics</b>	Complete, silhouette	Frontal perspective, parallel projection	Centre	Vertical	Dispersed	Balanced	Plane space
<b>Dynamics</b>	Dismembered, a side, a rib	Angle perspective, sharp foreshortening	Shifted	On the main direction, tight	Contrast, long shadows	Balanced	Continuous, multidimensional space
<b>Monumentality</b>	Complete, silhouette	Perspective, low points	Bottom	Vertical	Dispersed	Large	Continuous

The functional structure of space is determined by the movements of the person, as a rule by a horizontal surface therefore the main way of the image is the projection of all of the elements forming space to the horizontal plane at the level of eyes of the person (plan). The objects presented on the plan represent partly conditionally in symbolical representation with observance of their overall dimensions. The detailing degree of these elements depends on the scale of the image. The line is the basic structural graphic element in construction of such types of the image. Additionally, surfaces and volumes of the building envelop are founded.

Except horizontal structure, the space can be created behind the vertical direction: in connection with change of height of rooms, zoning with change of vertical level of the planes, of the number of floors etc. The structure of the vertical solution of space is

represented, respectively, by means of a projection of all elements, inclusive with vertical communications, on the vertical plane that in a certain place crosses an object (section drawing).

The functional structure of objects of industrial design can be rather various and depends on the main (working) function of an object. The functional structure displays situation and spatial interrelations of its basic components. Therefore, the choice of the plane of projection is directed to disclosure of the main idea. For the image of this structure, except a classical section, the method of transparent surfaces, a partial section can be used.

One of the main aspects of the objects imaging in the industrial design is the ergonomic scheme which convinces in convenience use of a certain object and shows interrelation with the person.

The constructive and technological structure of objects (Tab. 1) usually is invisible under normal conditions. In architectural and industrial facilities, as a rule, bearing and the building envelop are allocated. The purpose of the image of a constructive structure is identification and the image of the bearing construction of an object, interrelation and a relative positioning of the building envelop and isolating constructions, its connection with bearing constructions, the image of compound details of the construction etc.

For example, the basic structural elements of the bearing construction of the architectural form building are the base, a skeleton, overlapping and a covering, and of some car they are a farm, a beam, a frame etc. The constructive structure shows the principle of a structure of an object, interrelation of the basic structural elements which disclose the principle of transfer of loading, its geometrical spatial structure which provides rigidity of construction in general and forms the constructive scheme.

For the image of the bearing constructive structure such types of the image as a section, a partial section, the image of the sorted object, the principle of invisible surfaces is used.

Section, a partial section, disclosure, cutting, the sorted structure (explosion scheme) are used for disclosure of a layer-by-layer structure of a certain construction.



Symbolical designations which differentiate components and at the same time associative inform on character of their material are widely used for the image of a constructive structure. Traditionally for this purpose different graphic plane structures from points, lines of its various combinations and the directions etc. are used.

It should be noted that any image in design graphics can have certain universality, so it can open not one, but several aspects of a designed project. Multifunctionality of the image is limited by its informative loading and is defined proceeding from the principles of profitability and simplicity of perception. Multifunctionality of the image is also directly connected with its physical size and conditions of perception, and respectively, with a scale.

Appearance (Tab. 1) is the main carrier of the artistic and figurative information perceived through sight. The appearance of a visible part of an object surface defines its form which includes a type of an external surface (exterior) and an internal appearance (interior). The form is result of a functional and constructive structure, and also its artistic reflection.

The form of any design object has certain composite structure which is characterized by plasticity, is defined by geometrical parameters of an object, and also by characteristics of the components surface. The surface of components is defined by their material which has colour, texture, surface finish, ability to beat off, pass or absorb light etc. Therefore, surface material, interacting with surrounding space, acquires certain visual characteristics.

In design practice there are a lot of different ways of the imaging of an object appearance. It is known that the image of appearance in an objective form aims to the image of the end result of design as it can be perceived under normal conditions. And though this way is rather effective, however it is not directed to disclosure of a design and composite thought. But there are formal image means of appearance which has an aim to disclosure of the main idea of composition of a plan.

There are fundamental differences in the choice of the modelling tools which depend on the idea which is been the basis for composition. If, for example, it is necessary to open surface composition, i.e. composite solution of a certain plane, then for the

presentation it is necessary to choose orthogonal projections that most objective (without projective curvatures) will show it.

If the main idea is an interrelation of various forms, surfaces visual properties of which differ by its characteristics, then the model has to be directed to identification and differentiation of such composite components in structure of a spatial form.

In that case when the aesthetics is defined by spatial properties of a surface of an object, the model is under construction so that as much as possible to inform about this property. For the construction of the image it is possible, for example, to ignore the natural properties of the material object instead of impose a grid on the surface to form and a stroke, use tone modelling of light-and-shade.

To identify certain emotional property shown on the plane of the sheet properties of perception of graphic composition (Tab. 2) are used.

The form can be given in different systems of projections – by means of the central and parallel projection. The volume and spatial and plastic structure of a form reveals in foreshortenings which at the same time give information on three of its dimensions. Appearance of objects can be presented:

- from points of real perception (a visual picture) which give a concept about scale;

- from points choice of which is directed to disclosure of the composite idea of the work (axonometric images, bird-eye perspective etc.). In that case at the imaging of an interior it is possible to use methods of transparent surfaces or a partial section;

- in objective plane foreshortenings that show completely certain characteristic component of an object (the plane, a surface) without projective curvatures, and its composite decision (facades, wall elevation etc.).

For example, to show monumentality (Tab. 2) low points of perception are used, dynamics of a form is emphasized with sharp angular prospect, static character amplifies by use of parallel or frontal projections.

It is known that information on a volume and plastic structure is also supplemented by shadows: falling one inform about the mutual provision of objects in space, own shadows give information

on a form of a surface and its position in space concerning other represented surfaces. In case of modelling of aesthetic properties of an object (Tab. 2) shadows on the image perform not only function of form modelling tool: lighting which includes the direction and length of the falling shadows, ratios of the lit part of a form and dark form composite dynamics of the image, influence on perception of weight, respectively, determine figurative content. Contrast and the direction of lighting influence on character of the dismemberment forms and consequently, form emotional qualities of the image. For example, long contrast shadows give the chance to emphasize certain dynamics of the work.

An interrelation of masses is one of fixed assets of expressiveness of the work. The big mass of an object concerning space of the image is capable to increase its massiveness and monumentality whereas it is expedient to use the small size of an object concerning space of composition for strengthening of lightness and dynamic. Emotional qualities of the represented object will be influenced also by its position in space. It is known that static character of the image can be increased if to construct composition of graphic model by the principle of statics; it is similarly possible to strengthen dynamic of the work (Tab. 2).

The composite structure of a form, except plasticity, is defined by the ratio and character of materials which influences on perception of weight and dynamics of the form. Material has texture which is characterized by the direction, the amount of segmentations and the drawing. Also perception of mass of the material is influenced by its transparency and glassiness which defines degree of forms dismemberment. In graphics there are several ways of detection of properties of material of an object:

- linear reflection of material texture;
- tone and colour gradation (by different shades);
- surface finish displaying (using graphic surface finish);
- mixed displaying mode (linear and tonal or linear and colour, etc.);
- naturalistic imitation of texture (by means of a photo, scanning, realistic transfer of texture graphic means).

Since the direction of the stroke is also an active means of conveying the emotional content, it has to be some explanation on how to use it in images (Tab. 2). Thus the vertical direction of a stroke will work for formation of an image of firmness and monumentality, and horizontal one can increase lightness, and the stroke in a form will emphasize the general mass of represented. At the same time the diagonal stroke will lead to more dynamic perception of the picture. Massiveness of an object can be increased if to represent its silhouette visually by complete spot, to create big weight on the image while it is dismembered visual image of an object on the plane and border seems to be lightweight.

The method of graphic space organization by depth will influence on image dynamics (Tab. 2). The plane space which “holds” a form in the graphic plane is capable to increase lightness of represented image whereas diversity leads to a certain rhythmical organization of composition. Uninterrupted organization of graphic space can entail destruction of the plane and, respectively, strengthening of dimensions and ponder ability of image.

**Conclusions.** With the aim of maximum efficiency of the image, the choice of visualization tools is subject to two conditions: compliance to its functional purpose and the main aesthetic qualities of the represented form.

As it follows from the first condition, any design image in general has to retell the content as informatively and precisely as it possible. Proceeding from this it is necessary to choose graphic means to which a way of formalization, the choice of a projection, receptions of the image and the nomenclature of graphic elements belong.

The second condition defines the style of the image which is formed by such means as plane composition, a way of showing of a form illumination, election of a foreshortening, character of graphic elements. Thus for the sake of exact understanding of figurative characteristics of a designed project it is necessary to choose means of graphic expressiveness expediently.

Some recommendations about effective choice of visualization tools are provided in tables.

**Research perspectives.** The researchers conducted in this work can be used for the purpose of creation of the systematized technique of application of means of design graphics in formative process.

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### **Transliteration**

1. *Berdyns'kykh S. O. Vyrazno-zmistovni yakosti formalizovanykh elementiv I form proektnoyi hrafiiky. Kontseptsiya suchasnoyi mystets'ko-dyzayners'koyi osvity Ukrainy v umovakh evrointehratsiyi* : Zbirnyk materialiv Mizhnarodnoyi naukovometodychnoyi konferentsiyi profesors'ko-vykladats'kohoho skladu i

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*Аннотация:*

***Бердинских С. А. К вопросу выбора эффективных средств графической визуализации в задачах проектирования.*** В статье рассматриваются принципы применения средств моделирования объективных и эстетических свойств проектируемых форм исходя из заранее определенных условий.

*Познание разнообразных аспектов дизайн-объекта практически реализуется с помощью ряда специальных изображений. Каждое из них, раскрывая определенную сторону проектного замысла, может обладать также эмоциональной оценкой его восприятия.*

*Проблема обеспечения функциональности, информативности, лаконичности и содержательности проектных изображений, а также акцентирования заложенных автором образных характеристик*

проектируемого объекта, ведет к решению вопроса о целесообразном выборе графических средств.

Исходя из этого, разработаны рекомендации по выбору средств моделирования определенных объективных и субъективных свойств проектируемых форм по заранее определенным условиям, используя которые можно повысить эффективность графического решения.

Ключевые слова: проектная графика, графическое моделирование, графический элемент, объективные свойства формы, визуальный образ, объект проектирования.

Анотація:

**Бердинських С. О.** До питання вибору ефективних засобів графічної візуалізації у завданнях проектування. У статті розглядаються принципи застосування засобів моделювання об'єктивних та естетичних властивостей проєктованих форм за наперед визначеними умовами.

Пізнання різноманітних утилітарних властивостей дизайн-об'єкта практично реалізується за допомогою низки спеціальних зображень. Кожне з них, розкриваючи певну сторону проектної задумки, може володіти ще й емоційною оцінкою. Проблема забезпечення функціональності, інформативності, лаконічності та змістовності проектних зображень, а також акцентування закладених автором образних характеристик проєктованого об'єкта, спонукає до вирішення питання доцільного вибору графічних засобів.

Виходячи з цього, розроблено рекомендації щодо вибору засобів моделювання певних об'єктивних та суб'єктивних властивостей проєктованих форм за наперед визначеними умовами, використовуючи які можна збільшити ефективність графічного вирішення.

Ключові слова: проектна графіка, графічне моделювання, графічний елемент, об'єктивні властивості форми, візуальний образ, об'єкт проектування.

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