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Main Principles of the Composition Applied to the Industrial and Vehicle Design

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***Abstract*—In this paper, the main principles of the composition related to the industrial design are investigated. Their influence on the vehicle design is also discussed. The results from this research are useful for designers and practitioners in the vehicle industry.**

Keywords—vehicle design; industrial design; compositions

I. INTRODUCTION

Main principles of the composition are an activeresearch subject in the industrial design that has attractedmore attention in recent years. The knowledge about the composition techniques is of a great importance in the conceptual design which is an approximate description of the development of the technological, functional and aesthetic form factors of the products.

How to arrange, distribute, align and compile the design project in a way that not only looks good but is also highly functional and effective? The main instruments, qualities, principles, and objective laws relating to the harmonic retention of form in design are the subject of the composition. The composition is assembling, organizing and arranging the parts of the visual model. Composite design demand aims to give the structure and external shape of the products according to their purpose, to ensure the formation of the necessary consumer expectations.

This paper offers a brief description of some main principles and key elements of the composition related to the industrial design. The research is based mainly on [2] and [3], and will contribute to the theory and is also important for applications to the vehicle design particularly.

II. MAIN TYPES OF COMPOSITIONS

A. Techtonic

Tectonics is the visible reflection of the logic of form, the work of the structure, the organization of the materials, the visual distinction of the wearers and worn parts of the articles and products of the industry, etc. This is the trueness of the form in terms of structure and material.For example, the cast bearing structure must be expressed in such a form thatthere is no doubt about the way it is made, whether it is welded rather than welded or otherwise.

B. 3-dimensional structures

A3-dimensional structure is the interaction between all of the elements of the form and the interaction between these elements and the 3-D space. Space interacts with each form and in a particular, specific way.The volume (the material part of the space) and space are in a continuously distributed interaction based on which there are five different types of 3-dimensional structures:

- *First type*: compositions that have a total volume, but do not have an internal space (Fig. 1).

Fig. 1.*A first type structure.*

- *Second type*: Compositions with a total volume and a developed interior space that is not intended for man. For the designer, the interior space here is important for as long as it determines the general character and dimensions of the outer form (Fig. 2).

Fig. 2.*A composition structure of the second type.*

- *Third type*: Compositions with developed volume and interior space that is used by man (Fig. 3).

Fig. 3.*A composition of the third type.*

- *Fourth type*: Compositions with a fixed internal space and a changing outer volume (Fig. 4).

- *Fifth type*: Compositions without an external volume that have only an interior space, such as living quarters, production or household buildings (Fig. 5).

Fig. 4.*A fourth type composition structure.*

Fig. 5.*A composition structure of the fifth type.*

The volume-spatial (3-D) structure may be simpler or more complex, but in any case it is related to the tectonic. Tectonic disruption has a direct negativeeffect on any spatial structure, as well as, any wrong volume-space solution leads to a violation in the tectonic character.

III. PROPERRTIES OF THE COMPOSITION

The composition in the industrial has specific properties and qualities that are typical for the highly organized forms. Such a form is completed, the elements are subordinated to each other, equilibrated and have a unity in character, proportionality and scale. The significance of any property of the composition is not the same for all products, and depending on its purpose and form, one stands out in front of others. Here are the main properties and qualities used in the composition of articles and industrial products:

A. Harmonious Integrity

This property reflects on the logic and the connection of the whole construction with the composition. Especially important is the compositional, not just the technical or mechanical connection between the structural elements. Following such a principle the entire structure can be presented as a harmonious whole.

B. Subordination of the Elements

Any composition can be considered as astructural system in which the secondary elements are subordinate to the primary ones. Without an excellent subordination of the elements, parts and the main shaping elements, it is impossible to achieve a good composite integrity (Fig. 6).

Fig. 6.*Subordination of the elements in the composition structure of a motorcycle.*

C. Compositional Equilibrium

This is the state of balance between the elements of the form. This is the equilibrium of the parts of the whole structure with respect to the spatial axes. The most important is the vertical axis in terms of gravity. The compositional equilibrium depends on the distribution of the main masses of the composition relative to its center. On Fig. 7 a/ a compositional structure is represented with a higher located center of the mass, while the compositional structure on Fig. 7 b/ is with a lower location of the center of the mass.

Fig. 7. a/ Fig. 7. b/

D. Symmetry

The “symmetry” in composition is defined as "reflection”, “special uniformity” of the shape in the plane or, in general, means the matching of objects or systems by given properties. The term “symmetry” can be defined as consistency in terms of size, shape or arrangement of parts on different sides of plane, straight, point. Symmetry can also be interpreted as regularity, normalization of the form or object (geometric, algebraic, physical, biological, etc.). A well-balanced symmetrical shape is easily and almost immediately perceived (Fig. 8).

Fig. 8.*A composition structure with a central symmetry.*

E. Asymmetry

Asymmetry is defined as a counter-alternative to symmetry. It is often defined as the disproportionality of parts of a shape. Asymmetry does not always mean disharmony, and sometimes it is related to a complex intertwining of manyregularities and properties of the composition (Fig. 9).

Fig. 9.*An asymmetricalcomposition on the rear part of a car.*

F. Dynamics

Forms with an active one-sided direction, resembling movement in space, are called to be “dynamic”.

Fig. 10.*Dynamics obtained through external volume and internal lines.*

Dynamic formsare primarily related to proportions. The contrast in the proportions creates a dynamical, visual movement (Fig. 10).

G. Static

“Static” is an emphasized expression of a state of rest, stability in the shape, integrity inthe entire construction of the product, and of the geometric basis itself. Static are devices, products and vehicles that have a clear optical center and the axis of symmetry is the main organizing axis with respect to their shape. Staccity in its pure form is almost uncommon. Static shapes are more popular for the articles, but with an introduction of some asymmetric elements, dynamics is also introduced.

Fig. 11.*A dynamic form*

Fig. 12. *A static form*

On Fig. 11 and 12 a static and a dynamic forms are represented.

H. Unity of the Character

The unity of the character of the form and shape is the most important property of the composition and is inherent in the products of a high aesthetic level. The character of the form is a set of particular, individual features that distinguish shapes of each other, the products with the same purpose and the composition of products and vehicles. As humans have different faces, the shape may be different in its character (Fig. 13). Depending on the way of expression, the form may be neutral or highly distinctive.

Fig. 13. *A horyzontal character*

Fig. 14. *A highly distinctiveform*

Designers always strive to create highly distinctive shapes (Fig. 14) to express their fantasies, but they are not always relevant in terms of product exploitation.

IV. Resourses and Instruments

This section will discuss the main instruments used in the composition of products. Their application is particularly demonstrated in vehicles.

A. Proportion and Proportioning

Among the classical instruments of building the composition in the products and vehicles, first of all we have to set the proportions because of their great possibilities for organizing the shape and for its harmonization.the proportion is aco-dimensionality of the elements, a coordinated system of relations between the parts, as well as the overall volume. It gives the objects aesthetic expression and harmonious completeness. The formation of elementary proportions is easily explained using mathematical models. It is known that if we consider two similar figures, then the relation of their analogous elements forms a proportional series.In the industrial design, proportioning is primarily based on matching horizontal and vertical elements within a certain plane. A complex subject is usually embedded in a simple figure or scheme (for example a parallelogram-like marker) whose linear dimensions are more convenient to reference (Fig. 15).

Fig. 15.*Proportioning in a sports car.*

An important geometric aspect of the design is the so-called Golden Section.The used proportional ratio is always 0.618 (Fig. 16).

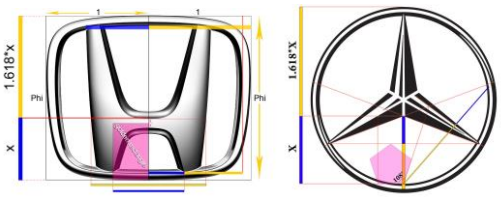

Fig. 16.*Using of the Golden Section proportion in the logos of vehicles.*

B. Scalability

A vehicle or a product of industrial design is said to be scalable, if it is relative to human size and non-scalable if there are no elements in which it can be judged about the inconspicuous presence of man.The need to link the scalable proportions and the proportioning to the size of the human body led the French architect Le Corbusier to the creation of the so-called “Modulor” [1]. The “Modulor” is an anthropometric scale of proportions, which is based on

the measures of the human body and the golden section (Fig. 17).

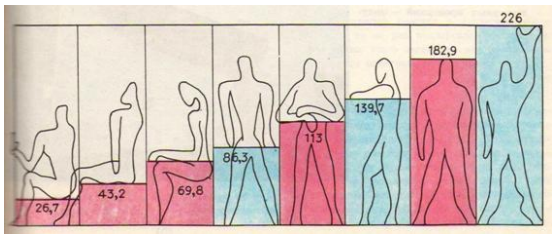

Fig. 17.*Scaling using the size of human body in different positions.*

C. Contrast

The contrast is a confrontation, a struggle between differences in composition. A contrast's composition has an active visual impact. The contrasts are used by designers toconnect and oppose simple and complex architectures, rough and fine surfaces, light and heavy constructions, low and high, horizontally and vertically, light and dark, plastic complex with simple and quiet, etc. (Fig. 18).

Fig. 18.*Contrast in size and lightness of collors.*

D. Nuance

The nuance literally means deviation. This term is used to represent minor, weak expressed variations. The use of the nuance in shapingand compositions is a very complex and important task because it is not determined by the engineering organization or by the spatial structure. This is in a sphere of purely artistic understanding of forms and materials (Fig. 19).

Fig. 19.*Model differences of a SUV segment achieved through nuance differences in the passenger compartment.*

E. Metric Periodicity

The metric repetition or periodicity is a repeated iteration with the same period of any element of the industrial product or a vehicle (Fig. 20).

Fig. 20.*Metric periodicity in a control panel.*

F. Rhythm

The rhythm is a gradual quantitative change of alternating elements, increasing or decreasing a series of volumes or areas, compressing or diluting the structural groups of a system, the tone, etc.The rhythm manifests itself in the lawful change of order. The visual reaction to the rhythm is therefore a reaction of order, not a metric but a rhythmic (Fig. 21).

Fig. 21.*A rhythmic change in the size of the elements.*

G. Color

The choice of color should be ergonomically justified, related to the volume-space structure, its proportion, its size, contrast and shade. When choosing a color, the designer needs to know what impact it takes on the shape and the entire composition.

H. Shade and Plastic

A plastic shape and composition is embossed, sculptural, with soft transitions of the main forming elements. In contrast, a reverse composition without plasticity is characteristic with a poor light-shaded structure. A composition deprived of plastics seems boring and inexpensive, so the designer often resorts to some complications, in order to make the shape of a product to be more plastic (Fig. 22).

Fig. 22.*Plastic and non-plastic shapes.*

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