

On Some Principles of Vehicle Design and Styling: Character of the Forms

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Abstract— In this paper some main principles of vehicle design and styling are discussed. Using numerous examples, an overview of the developments in vehicle's styling is provided. The character of the forms and shaping are considered in the context of styling. Different styling concepts used in the transportation design are also investigated, including human-product interactions. This research may serve as a brief survey on styling for industrial designers, as well as, it may be used in the education of new designers.

Index Terms—Industrial Design, Vehicle Design, Styling.

I. INTRODUCTION

Developing of styling strategies is an important topic in the vehicle industry, as well as in training and education of future automotive designers. Design and styling have the major impact of the total appearance of a vehicle. First of all, the style of a vehicle is a power communication tool. The vehicle's body is the first that captured the interest of a potential customer. Shapes, proportions, surfaces are elements that are of a critical importance to the perception of the design idea. Therefore, styling is directly related to the human-product interaction and the so called emotional design.

On the other side, styling is also connected to the engineering principles, technologies and values. Although designers are today the key members of the development teams [1], the technical features of a vehicle related to ergonomics, performance, and other technical properties cannot be ignored.

In addition, styling depends on the particular country, brand, manufacturer's point of view, materials, the vehicle's type, the recent trends in design, and so many others.

Since different styling approaches are applicable to the real design practice, as well as to the education of new designers, there exist numerous literature sources, where the main principles in styling are discussed (see, for example, [1]-[7] and some of the references therein). In spite of the technological advances, many of the designers and authors seem to be unaware of the bulk of the work that has been done in this area recently. That is exactly what is planned in the present paper. The main aim of this research is to serve as a brief survey on the developments, methods, approaches and applications of an important area in design. It should be of particularly importance to vehicle's designers and other practitioners interested in the styling principles.

II. PRELIMINARIES

A. Overview

A brief overview on the development in styling strategies shows that vehicles always follow the style of their time. Starting at the mid-nineteenth century when the style of a vehicle had more a regional appearance, nowadays, an automotive designer is trying to give a vehicle a certain look or feel for various strategic reasons [1]. Many factors have driven changes in automotive design over time [5]. Parallel to the development in styling, there is a tremendous research activity on the topic. As it is mentioned in [4] "It is now impossible for one person to write knowledgeably about all aspects of vehicle design". In this paper, we will discuss some of the main principles and achievements in styling of vehicles.

B. Styling

Styling is a union of various concepts, principles, laws and values.

The main principles in styling and design have been always devoted to the aesthetic appearance of a vehicle. Successful cars and other industrial vehicles are usually those with designs that generate and communicate a high level of emotion and excitement. The emotional perception is related to the exterior styling. Typical features that determine a vehicle's exterior styling are: overall dimensions, wheel base, wheel size, track, front and rear overhang, hood line, windscreen line, windows, pillars, belt line, doors, wheel house size, color etc. [7]. Recently, the investigations of the emotional influence of the vehicle design have attracted a great interest. Using of new shapes, new graphics and making new compositions are some of the used approaches. These new shapes are inspired directly from human emotions or from the shapes of living organisms. Instead of sticking to just one style, very often the vehicle designers used more than one.

In addition, the interior styling is also of a great importance to achieve the total effect of the design idea.

Aside from the exterior and interior, the engine and baggage compartments are also styled [7]. The optimization of technical parameters, branding, software solutions, ergonomics, etc. complement the laws that have to be followed in styling.

The knowledge of different styling approaches has been always a valuable factor in the automotive design practice and in the engineering in general. In this paper, some main principles in styling of vehicles related to the character of the forms are discussed.

III. CHARACTER OF THE FORMS

This section will give a background of manufacturers' views and will present an overview of the development in techniques used to achieve a particular character of the

shapes. The presentation is based mainly on the book [4].

Many of the early cars were adaptations of horse carriages aided by engines. The form, structure and even the names have been taken from the carriages such as "Phaeton" and "Cabriolet". In these years only the lack of facilities for tying horses distinguished driven a motor coach from a horse carriage. In his first car Daimler stationed the engine at the rear of the coach, but it was not very convenient in terms of its suitability for repairing. A better solution has been proposed in 1890-1891 by the Panhard-Levassor company that produced a vehicle with a front-mounted engine.

By placing the engine at the front of the vehicle the hood appeared. Because a large hood (bonnet, lid) implies a large and powerful engine beneath, it is considered one of the hallmarks of the development towards the design of vehicles. In Fig. 1, where Bugatti 41 Royale 1931 is shown [4].

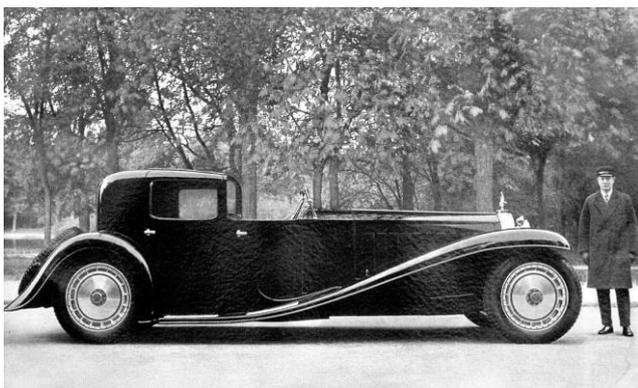


Fig. 1: Bugatti 41 Royale 1931 with an imposing bonnet

Initially luggage has been in a bag outside the vehicle in the rear, which is seen in newer cars in Europe by 1930. Later on a baggage compartments has been emerged and thus the vehicles' form gained the type of sedan with three boxes: a front box for the engine, a mid-box for passengers, and a rear box for the luggage. At first, the rear box was small, but later in the 50s 60s and 70s it increased like hood for the engine.

The development and increasing of the size of motor engines caused the need of the use of windscreens, which are not used in carriages because there the driver hold the rope with which manages the horses. Before the invention of the wiper in 1920s the only way to deal with the rain were hinged with which the screen has been opening up so that the driver could see. Carriages pulled by horses had a roof of cloth that was placed in a bad weather. The same technique was used in motor vehicles until 1930s in which the roof itself became a part of the body design and form the so-called sedans. The soft ceiling remained for use even today in some sports cars, where this technique is applied to reduce the weight of the car.

At a very early stage of development of the vehicle styling it was noticed that the influence of the aerodynamics on the tractive power is very important. A classic example of such an aerodynamics form can be noticed in the designed by the Austrian Hans Ledwinka Czech Tatra in 1937 (Fig. 2). His style is a precursor to the later modeled Volkswagen Beetle. Today, perhaps Volkswagen does not seem so aerodynamic, but at that time it was with a much better design and style than other cub-like cars. At about 1930s Germany opens a vast network of motorways, which presume a faster movement of motor vehicles, and the subject of aerodynamics advocates an even larger scale.



Fig. 2: Tatra T87 1937

Another vivid example for an aerodynamic car on that time is that of Chrysler Airflow of 1934. Its design and styling was influenced greatly by this topic. The overall shape was like casted as even the glass was directed forward headlights and grille were gathered in the oval body.

For certain amount of time, the aerodynamic style was perceived as an obstacle to the commercial production of cars because it was difficult and expensive to make the curved shapes. The above attitude to this style changed since the raise of the oil prices at 1970s. This was the turning point at which aerodynamic design associated with the low fuel came to the fore. Chaparral from 60s is the first car, with a set rear wing in order to use the power of the aerodynamic forces for better traction with the pavement, instead of going through the increasing of the mass of the car (Fig. 3). Although the main principles of aerodynamics were known enough after the World War II, it takes about 20 years for engineers and designers to apply their knowledge in practice.



Fig. 3: Chaparral 1967

Another turning point in the aerodynamic design of the cars was the presenting of Ford Sierra at 1982. The specific form was not accepted well at the beginning, but it gave the start of the total and active use of aerodynamic shapes as a key technique in the vehicle design and styling today.

Aerodynamics is an extremely complex subject and requires a vast knowledge in this direction. However, from the styling viewpoint, there are some basic principles that can be used to support the functionality. The topic of aerodynamics is broadly covered in environmentally friendly cars where it is necessary to easily slip in the air force to reduce fuel consumption. More details on road vehicle aerodynamic design may be found in [4] and some of the references therein.

IV. ON SOME MAIN APPROACHES IN THE VEHICLE STYLING

In order to achieve the nature of the formulation it is necessary to follow certain principles. The present section will introduce the most important of them.

A. Interpretation of Human Emotions

One of the most challenging ideas substantiated by physiological perspective is that when a person copies some emotional expressions, he actually experienced those emotions. For example, if you forced yourself to smile when you are in a jovial mood, then you start to feel happier. This idea is used as one of the main principles in styling. The interpretation of human emotions by means of the vehicle forms attracts more attention of designers during the last years. On the Fig. 4 a Nissan Townpod model is represented that perfectly demonstrates this approach in vehicle styling [8]. His design at the front of the body resembles a smiling face.



Fig. 4: Nissan Townpod

B. Imitation of Living Organisms

The analysis of the shapes-related ideas gives clear indications for existing of trends where the form of vehicles imitate the form of living organisms from the surrounding biological world. A number of established engineers and vehicle designers get an inspiration for their innovative ideas and models from the rich world of animals and plants.



Fig. 4: Mercedes-Benz model „Boxfish”

The term "Bionics" (this term includes parts of the word "biology" and "technology") demonstrates the eternity of the idea of the interdisciplinary continuity. Bionics investigates precisely animals and plants, trying to understand the genius inventions of Nature. Scientists seek to use and improve the prototypes from nature to find solutions to specific technical

problems. Engineers looked for specific examples in nature whose shape and structure approximated to their ideas for an aerodynamic, safe, spacious and environmentally compatible car [9].

An impressive example of a vehicle style influenced by the shape of living organisms is the Mercedes-Benz model whose design resembling the shape of the tropical boxfish (Fig. 5). The boxfish had similar aerodynamic qualities to the teardrop – a shape which streamlining specialists consider as the ideal aerodynamic form. When exposed to an open flow, this streamlined shape has a Cd value of 0.04. Using computer calculations and wind tunnel tests with an accurate model of the boxfish, the Mercedes engineers achieved a value which came very close to this ideal, namely 0.06 – an outstanding result. It explains why the boxfish is such a good swimmer with minimal effort [9]. After building the full-size car the designers were surprised at the results: the Cd value for the car was 0.095. In aerodynamic terms it was just as good as the shape – as measured on the ground - considered ideal by aerodynamics specialists (Cd 0.09).

Recently, many vehicle designers have turned to the diversity of ideas offered by nature and living organisms for their concepts. Among the numerous examples of using the principles of Bionic in the vehicles' styling we will mention the style of the Volkswagen Beetle, with contours of a lady-bird (Fig. 6a) and some helicopters' models resembling common blue damselflies (Fig. 6b).

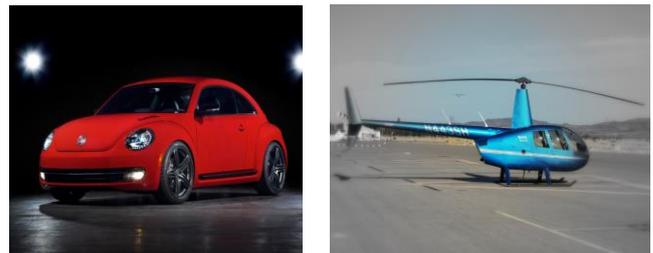


Fig. 6: Imitation of Living Organisms in Styling: a: Volkswagen Beetle; b: Helicopter

The structure framework concept of the Mercedes-Benz's Aesthetics No. 2, is another excited example with an innovative sculpture inspired by the living forms. The shape of the frame is inspired by the shape of the fin whale (Fig. 7).



Fig. 7: The framework of "Aesthetics No. 2", imitating the fin whale

Gorden Wagener, Head of Design, explains: "At Mercedes-Benz, automobile design is artistic creation. With the interior sculpture Aesthetics No. 2 we have allowed creative fantasy to develop freely without constraints. We have followed nature's diversity and perfection. However, we are not simply mimicking nature, but are instead learning from the intricate, all-encompassing interplay of her elements. This is also a characteristic of art." [10]

C. Branding and Stylistic Unity

Through the design of modern vehicles people can better recognize the identity of the production company. The specific components used in styling can redound to a raise or decreasing of the productivity of the company. Indeed, the design provides a unique opportunity first impression of the vehicle is positive and well recognizable.

A good example is the style of the side air intakes at the Lamborghini (Fig. 8).



Fig. 8: Shaping of the side air intakes in different models of Lamborghini

Owners of the automobile companies have always high requirements to the total style and design of a vehicle, and particularly to the exterior design. If the style of the exterior is attractive, the vehicle has a pretty good chance to be sold.

Any company that has a good reputation, good quality of the products has its own style, its own point of view and way of thinking about all styling factors and attributes. For example, the style of expression of the Mercedes-Benz can be seen in different styling elements used in vehicles of different types, such as elements in the shape of the headlamps, grille and front bumper with cars and trucks.



Fig. 9: Stylistic unity in the forms of Mercedes-Benz vehicles

The task of the design is to "translate" in an illustrative form the style and vision of the company. Thus clear and precise business messages become trademark and give identity to the company. Also, if the message is wrong or unclear, the expected results or desired outcome will not be positive. It should not be expected that the user will simply "guess" or "take" the message made by the design. The message must be recognizable.

The styling and design have their specific purposes. These purposes are not necessary to match with the intended use of the vehicle. For example, if the vehicle is a sanitary car, it is not necessarily the exterior design of the car to include sanitary fittings. The objective of the exterior design pursued by any company is to convince the customer for a better understanding of the vehicle, to see interior design, to learn more about its functionality. The external design should be

seen as an appropriate introduction to the essence of the vehicle, causing interest. The presentation of the brand and the appeal of identity must be carefully underlined.

V. CONCLUSIONS

The design of modern vehicles is very delicate and treacherous field of action. The task of the designer to achieve an appropriate design is a step that is full of opportunities for success and losses. The designer should overcome the limitations imposed by the social environment, physical space, customer specifics, relevant social context and purpose of the vehicle. This paper presents some main principles in styling and design related to the character of the form.

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