

PRODUCT AESTHETICS FOR MECHANICAL ENGINEERS

Abstract: This paper gives a scope of course called Product aesthetics at Mechanical faculty, University in Belgrade, Serbia. During this course students are learning about standards and laws in process of product design. With this knowledge students are able to create more profound ability of aesthetic evaluation and form aesthetic judgement of in creating certain mechanical product such as car, motorcycle etc. Practical part of this course includes creating a product by using a 3D CAD software which has both aesthetic value and practical usage. Students are presenting that product to other students and they give their evaluation grade.

Key words: Course, Design, Aesthetics, Industry design, 3D CAD software,

1. INTRODUCTION

Origin of a word aesthetic comes from Greek word *aisthesis* that can be roughly translated as sensation or understanding through perception [1]. It usually represents a branch of philosophy that studies creation and appreciation of beauty in art. There are many application for aesthetic such as in architecture, fashion, website design, music etc. Basically everything that surrounds us can be subjected to certain kind of aesthetical judgment and that is a reason of rising awareness of importance for aesthetic in all occupations.

For instance, while designing a product an engineer must take in consideration many aspects before dispatching product on market. These aspects include: robustness, lifetime expectancy, price, ergonomic etc. One of this aspect is appearance of product. Average buyer makes its first impression based on product appearance. If product is more appealing, rises probability that buyer will purchase that certain product.

Most representative example of importance of product is in car industry. Rise of new eastern brands that, by quality, are approaching more and more to their European, North American and Japan competitors. Brand and design are one off the crucial battleground on which a destiny of certain brand will be decided [2] [3]. One of the famous German designer Dieter Rams had a contribution in a concept of simplifying complex products forms to make them easier to use and better looking. His approach was known as "less but simpler" and made company Braun most famous for made design of home appliances. Through this approach was introduced a new way to communicate with appliances using graphic images and colours rather than written description that lasted to this day [4].

There are so much more examples of usage aesthetic in different kind of applications and it rises an urge to create a bridge between engineers and designers. After graduating many engineering students have knowledge of mathematics, different kind of stress static and dynamic calculations on constructions but there is a lack in designing a product in aspect of aesthetics. Based on studies done at Faculty of Technical Sciences, Novi Sad, Serbia by professor Ratko Obradovic [5] has shown a

needs of this kind of courses in high education in Serbia. Professor Ratko Obradovic is Head of Chair at Chair of Animation in Engineering and he included in his course many subjects which include aesthetic principles in their curriculum.

To provide future mechanical engineers with better understanding of an importance of products aesthetic appearance Faculty of Mechanical engineering, in Belgrade Serbia, has introduced in 2008. a course called Product Aesthetic. This course belongs to M.Sc. (graduate) academic studies and is mandatory for student that took module in Food industry as their M. Sc. study in Department Theory of Mechanisms and machines.

Course is divided in three parts. First part covers a field of principles of aesthetic in the process of product design. Students are introduced to the standards and laws of aesthetics by recognizing the subjective and objective factors. Students also learn about geometric harmony laws, how to combine traditional and modern means of creating aesthetic properties. In order to achieve this students use features of modern graphical signs and aesthetic properties of packaging with advertising as one of mandatory lecture students hear on this course.

Second part of course is introduction to the different schools of aesthetics through their styles. In these lectures students are learning about a styles that were used in XX century and modelled he world we live in today. Here they also hear about famous designers of that era and most iconic of certain style. To show learning outcome, student must choose one of styles and present it in front of the others.

Third part of this course is where students are use software package called Solidworks and especially his add-in called Surface. This add-in allows students to create shapes which are difficult in regular Solidworks such as free form surfaces or organic forms. By successfully managing this software student can create on object whether is that machine or home appliance to design in their own idea. Eventually students are prepared with knowledge of principals of aesthetic and styles students elaborate their idea of design in front of their colleagues and thus finishing this course. All of these three parts of course are fused in one student's projects which they presented at the end.

2. UNIVERSAL PRINCIPALS OF AESTHETIC

When it comes to grading and giving an aesthetic value to certain objects people are relying on their psychological perspective. Based on analytical psychology, created by Carl Gustav Jung (1875.-1961.), there are 4 psychological functions:

- thinking and feeling (which are rational)
- sensation and intuition (which are irrational)

This initial lecture gives students an insight how these four psychological function are essential parts in creating any judgement. This also includes that any aesthetical and design decisions are based on these four functions.

To comprehend more about principals of aesthetics there are theoretical lessons which student hear during semester. This principles can be divided in several different categories.

Mathematical and geometrical principles based on Golden ratio: Golden ratio, Kepler triangle, pentagram (five-pointed star), Fibonacci number, Golden and Fibonacci spiral, Golden angle, Dynamic balance, Generalization, aesthetic values and application.

Principals based on some geometrical transformations: symmetry, Homothetic transformation (homothetic center, scaling, proportions and congruence) and Fractals.

There are several more principals related to rational and cognitive principles such as: Pareto principle (80/20 rule), Occam's razor, Maslow's hierarchy of needs etc.

At the end of this lessons student use a practice in sketching and drawing the basic principles of descriptive geometry in different types of projections and perspective (oblique, orthogonal axonometry and central). Parallel to their drawing practice students starts to learn principles of computer modelling using the appropriate forms CAD software in this case Solidworks. By combining a handmade drawing and computer forms, students get insight in materialising their ideas in a form of pictures and computer 3D models.

Before hearing about design styles, students learn about opposites of aesthetic values through examples of poor taste: kitsch, camp and trash. Kitsch represents something that has been designed in poor taste so it can be appealing to lowbrow taste and it is made in poor quality. Camp presents a designers way to show a bad taste using it to overstate. They implement a humour, irony and allusion to point out obvious lack of certain aspects of design. Trash is also design with poor taste but unlike camp it lacks humour and creativity. It represent a brutal design which does not try to hide its bad side rather it shows it in full potential.

3. HISTORY OF AESTHETIC STYLES IN INDUSTRY DESIGN

After hearing about aesthetical principles, students are taught is about existing styles, their development through history and impact on modern world. Origin of modern industrial design can be found in "Industrial revolution" in early XIX century. Need for products that are easily manufactured in large quantities and yet affordable for wide masses has caused a designers to seek optimum solution. It was also required that all

products must satisfy consumer need for aesthetic beauty of in that matter that they are appealing on first sight. This principle remain to this day and different political and economic factors influenced on developing different types of industrial design through XX century.

By style it is implies a distinctive appearance, typically determined by the principles according to which something is designed. Student are learning about several most important styles of late XIX and XX century:

- Arts and crafts (1851.-1914.)
- Art Nouveau (1880.-1914.)
- Dutch style - De Stijl (1917.-1928.)
- Bauhaus (1920.-1930.)
- Art Deco & Streamline Modern (1925.-1950.)
- Late Modernism (1950.-1975.)
- Pop Art (1960.-1980.)
- Postmodernism (1980. - present)

As said before, industrial revolution has a greatest impact on modern industrial styles and of the first style that is studied is the Arts and Crafts. The Arts and Crafts movement was an international movement that had strong impact on all future styles in decorative and fine arts. It begin as response to industrialised production and tried to preserve old kind of product making. In core of this movement is traditional craftsmanship using simple forms. This forms are often decorated with folk, medieval and romantic motives.

Art Nouveau is an international style of art, architecture and applied art. It meaning is New Art and it was developed under the influence of Arts and Crafts. The main features of this style are natural forms and structures, particularly the curved lines of plants and flowers, long horizontal lines, and sometimes nautical elements. Biggest impact left in architecture under a name Streamline Moderne, sometimes termed Art Moderne, as a late type of the Art Deco architecture style that emerged in the 1930s.



Fig. 1 De Stijl clock and furniture

De Stijl (Dutch: "The Style"), also known as Neoplasticism, was a movement founded in 1917 in Leiden by Dutch artists under the influence of cubism. These artists and architects required a reduction to the essentials of form and colour to achieve universality and by creating an abstract forms. They simplified visual compositions to vertical and horizontal straight lines and using only black, white and primary colours. Some of the most known representative works of this style is shown in Fig 1.

The Bauhaus was a German art school that combined crafts and the fine arts. It was founded in 1919. by Walter Gropius in Weimar, Germany. The German term Bauhaus means literally "building house", and it was founded with the idea of implementing art used for items in everyday life and architecture, would be combined together. Their main goal was to create complete household, from furniture to house exterior, in such manner to be pleasant for living using minimalism as much as possible. In this school students are thought not only theory of art but also how to make items by themselves. It created a unique surroundings for them and in many ways Bauhaus left a permanent mark on all future designers. It became a synonym for products that have a balance between shape and functionality without any unnecessary details such as ornaments or adding more colours than necessary. Logo and iconic furniture of Bauhaus are shown in figure 2.



Fig. 2 Bauhaus logo and some of its famous products

Art Deco (also known as Deco) was founded in France prior to World War I, thus the name is derived from Decorative Art. It left profound milestone in development in many styles of arts, architecture and design. Art Deco is remembered as style of extravagancy and luxury. Golden years of this style are after World War I. It presented a combination of modernist styles and fine craftsmanship which included using rich materials. Aldo it stands for luxury as a social marker it represented a global optimistic faith in progress that future brings for all people.

World War II and its consequences also left a mark in design styles. One of the styles that emerged from the chaos of aftermath is known as Late modernism. Under this term is represents a products made in simpler form but with preservation of its functionality. It is based on strict form that is required to be easily massively produced following a shortage of materials after the war. This concept can be found though so many different objects that this way of design lives up to this day.

Pop art is movement that appeared in mid-1950. It represents a combination of modernism and popular culture (thus the name: Pop(ular) art). Pop artists often takes images from popular culture (movies, comics, brands etc.) and places those images on everyday items, for example home appliances.

Postmodern is derived from modernism and has certain distinction from it. As modernism has become ideologically coloured so postmodernism tries to be unique. Designers use same principles as modernism but add a dose of humour or irony to their products playing with man's vanity. Golden age of postmodernism can be found in 1980s and 1990s. Since then there is stagnation in its development.

4. WORKING WITH SURFACES

In order to get the best caption on engineers intentions to create a models that have better design students are introduced to software package Solidworks. Trough course of Engineering graphics, which is placed in first year, student are learning about basics about modelling and drawing [6], [7]. In order to fulfil the continual learning and development in area of engineering modelling in Solidworks there are several other courses included as Mechanism design [8]. During this course students are introduced to advanced knowledge on modelling and gaining simulation results. Next step is learning more about one Solidworks feature called Surface. This Solidworks add-in allows student to create different shapes easier than using regular Solidworks features.

This software package enables students to define the shape of models in such way that models are more artistic [9]. This includes organic forms, complex geometry with complete control of their parameters. Using simulation tools students can conduct a product design analyse and generate photorealistic images. Intuitive user interface allows students to learn quickly all necessary command so they can perform all given task and start creating their own items. Some of exercises

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are shown in figures 3, 4, 5 and 6. Every exercise has an exactly defined learning goal which helps students later to create their own products.

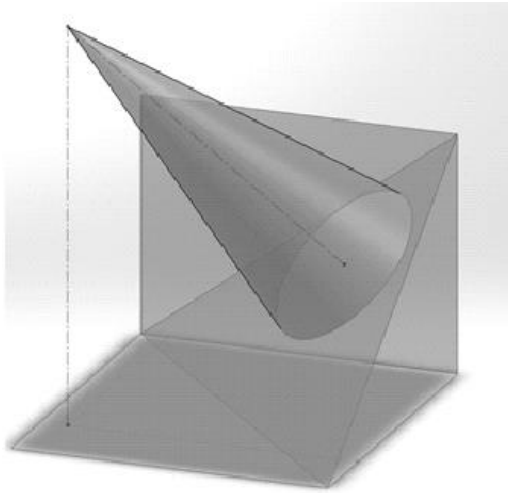


Fig. 3 Cone on plane



Fig. 4 Helmet



Fig. 5 Four-sided bottle



Fig. 6 Candlestick

5. STUDENTS PRESENTATIONS AND WORKS

For a final grade students are taking two part exam. As a first part of their exam students are given tasks to prepare presentation about industrial design styles. Students choose between describing one of style throw several their most famous objects, such as cars, furniture, home appliances etc.

Second option is taking one object (for instance a car or bike) and that show how it evolved throw styles. This part of exam bears a smaller portion of final grade than a second one.

Second part is placed for ending of semester and student must create a certain product of their own choosing and that describe it. Beside product it is required to make a logo of their company.

Product and logo are then presented to other students. Presentation should show how their vision of that product is better than existing, where they draw inspiration from, process of designing etc.

For logo, they should describe it origin, meaning (conscious and unconscious alike).

One of the finest student work is shown in figures 7 to 11. This works has been made in autumn 2018. and represents one perfect combination of a culmination of student knowledge during a semester. Student created a logo using acronym of her last name and gave it unique appearance which is distinct from any other logo making it appealing and memorable (Fig. 7).

For product design she choose to make a lamp.

This lamp is inspired by nature (Fig 8) and she demonstrate several types of lamp (figures 9-11).

More of the student's works are shown in figures 12 to 14.



Fig. 7 Logo



Fig. 8 Nature inspired detail



Fig. 9 Lamp type 1



Fig. 10 Lamp type 2



Fig. 11 Lamp type 3

6. CONCLUSION

Product aesthetic is only course that includes of many interesting aspects of aesthetic usage in engineering construction. Future engineers will have a greater knowledge in design and will be easier for them to comprehend demands given to them by designers.

After successfully completing a course students gained insight in aesthetic evaluation and ability to form aesthetic judgement. Through theoretical and practical exercises, students are trained to creatively use different means in creating aesthetic characteristics of their products. These means can be classical and modern

practical means or some abstract elements and principles of aesthetics. Providing students with this knowledge will create a new generations of engineers that will implement learned design principles into their further work.



Fig. 12 Piano



Fig. 13 Car wheel with brakes implemented

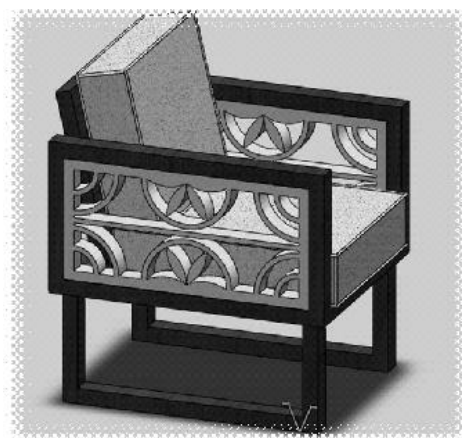


Fig. 14 Chair

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