

BIODESIGN IN ARCHITECTURE, LANDSCAPE ARCHITECTURE
AND FASHION

BIODESIGN NA ARQUITETURA, ARQUITETURA DA PAISAGEM E
MODA

*Biljana Jović*¹
*Dragica Obratov Petković*²
*Olga Gajanić*³

Abstract: This paper focuses on the field of biodesign through architecture, landscape architecture and fashion. Throughout all of history, nature has been an inexhaustible source of inspiration. This is why it is not surprising that today, in a time of accelerated technological development and growing alienation from nature, people have an increasing need to integrate with nature in urban areas. Biodesign can contribute to that. The very essence of the growing presence of biodesign forms is that through nature, as a model, it has a positive effect on modern human, primarily visually and psychologically.

Keywords: biodesign, fashion, landscape architecture

Resumo: Este artigo aborda o campo do biodesign por meio da arquitetura, arquitetura da paisagem e moda. Ao longo de toda a história, a natureza foi uma fonte inesgotável de inspiração. Por isso, não é surpreendente que hoje, em uma época de acelerado desenvolvimento tecnológico e crescente alienação da natureza, as pessoas tenham uma necessidade cada vez maior de integração com a natureza nas áreas urbanas. O Biodesign pode contribuir para isso. A própria essência da crescente presença de formas de biodesign é que, a natureza como modelo, pode ter um efeito positivo no ser humano moderno, principalmente visual e psicologicamente.

Palavras-chave: biodesign, moda, arquitetura da paisagem

¹ University of Belgrade, Faculty of Forestry, Department of Landscape Architecture and Horticulture, Serbia. E-mail: biljana.jovic@sfb.bg.ac.rs

² University of Belgrade, Faculty of Forestry, Department of Landscape Architecture and Horticulture, Serbia. E-mail: dragica.obratov-petkovic@sfb.bg.ac.rs

³ University of Belgrade, Faculty of Forestry, Department of Landscape Architecture and Horticulture, Serbia. E-mail: gajanicolga@gmail.com

1 Introduction

Man's connection with nature has been indivisible since time the dawn of time. Nature is man's original environment. Although one of the first associations related to nature would be the image of an earthly paradise, a tame environment of emphasized beauty, with a handful of incredible phenomena and life forms, at the beginning of human civilization, the forces of nature inspired awe and caused eternal challenges to survival on this planet. Therefore, man always had to find ways to live in it and with it, because it is part of one big whole. As a species, in order to make everyday life easier, we were forced to learn from nature over time, imitate it and, as conscious beings, see patterns with which we could control, change and adapt it to our needs. Man's interest in nature has always been present, after all, he originated from it, lives in it and returns to it. Nature is in man's focus from the first depictions of its elements on cave walls, all the way to modern disciplines such as bionics. Throughout history, man has always been drawn to and inspired by nature, whether through an attempt to transform or imitate it. Nature is the eternal source of inexhaustible inspiration that we experience with the senses, and interpret with the mind.

2 Bionic approaches

In the relatively short time of human presence on the historical scene of our blue planet, it can unfortunately not be said that our activities have contributed to its preservation, progress and prosperity. On the contrary, in a short time humans have, with their neglectful and selfish behavior, contributed to a significant degradation of nature. We are witnessing global climate change, destruction of ecosystems, growing alienation from nature and people.

The innovative field of biomimicry, the essence of which derives from the natural manifestations and processes of the Earth, instills hope in creating a more humane way of life, in cooperation with nature as our main source. The stimulating characteristics of this field, which is in full swing, instill hope that they will manifest in the right way and that their value will reach its maximum in the future by engineers, constructors, designers and artists drawing their solutions from nature and creating on its model, with maximum effect and with minimum consequences.

3 Natural forms and bionic principles in architecture, landscape architecture and design of the XX and XXI century

The biomimetic approach is present in various fields of artistic creation.

When it comes to the influence of nature on architecture, artistic trends from the end of the 19th and the beginning of the 20th century such as secession (lat. Secessio), modernism (catal. Modernisme), art nouveau (fr. Art nouveau), Art Deco style, were of great importance.

The main feature of these directions is ornamentation - reference is given to surfaces, strong colors and various decorative materials. The lines of the objects are curved, causing a feeling of movement, and the surface is emphasized with colors. In the design of ornaments, the focus is on natural forms such as leaves, flowers, human or animal figures (Figures 1 and 2).

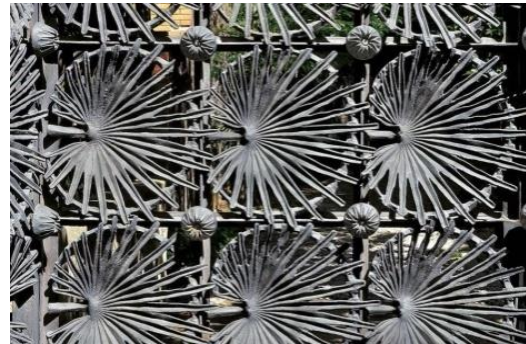


Figure 1 - Honeycomb-like ornamental spy hole (Antoni Gaudí- Casa Batlló). Image source: https://s3.amazonaws.com/cdn.switchmodern.com/images/popup/H-GAUDI-L_Calvet-peep-hole.jpg

Figure 2 - Palm leaves as the main motif of a wrought iron gate (Antoni Gaudí- Casa Vicens). Image source: <https://www.mobles114.com/wp-content/uploads/2019/07/verja-jardin-casa-vicens-gaudi-barcelona-dosde-publishing.jpg>

3.1 Architecture

The works of the Spanish architect Antoni Gaudí (1852-1926) gave impetus to the development of architecture in the bionic style. One of the most famous and often repeated phrases of Antonio Gaudi was "originality consists of returning to the origin". For Gaudí, a deeply religious man, this origin was nature. Gaudi saw the natural world as perfect, a creation from which he drew inspiration. He analyzed the functions of natural forms and applied those elements to his architecture. Frequently used elements of nature were: morphology of fauna and flora, different hardness of stones, odors, colors, tree shapes or animal bone structures.

Gaudí's most striking bionic-style creations are Casa Batlló (Figure 3) and Casa Milà (Figure 4) in Barcelona, which are said to be "nature frozen in stone". Both buildings are characterized by a few straight lines and surfaces, and many curves.



Figure 3 - Casa Batlló – Barcelona

Figure 4 - Casa Milà – Barcelona

The architecture is dominated by irregular shapes so that the winding lines of Casa Batlló (1905-1907) and the absence of straight lines make it look more closely resemble a living organism than a building, which mimics not only the effects of water and air but also more tangible elements such as bone shapes on the gallerie's pillars, eventually giving this house the name "House of Bones". Numerous ornamental elements "taken over" from the domains of mycology, zoology and botany are also present. The principles of Gaudí's biomimicry are not only applied in the field of construction, but are also reflected in the design of the furniture inside the house (Figs. 5 and 6).



Figures 5 and 6 - Biomimetic example of a ventilation model inspired by the work of fish gills, in the house of Batlló - an overview and explanation of the ideas and functions of this model is given through a virtual tour (Augmented and Virtual Reality)

The spiral, as a frequently present form in nature as well as among planetary systems, is a common motif that appears in Gaudí's works. The spiral shape of snail shells and falling maple pods / seeds served served as inspiration for Gaudi (Figure 7).



Figure 7 - Spiral stairs in the Sagrada Família. Image source: <https://www.flickr.com/photos/catire/658984385>

Gaudí's masterpiece, to which he dedicated his life and which has not yet been completed, and has been under construction since 1882, is the gothic style Catholic basilica in Barcelona, La Sagrada Família (Figures 8 and 9). Inside the cathedral, there are pillars that resemble trees, which branch at the top, and because of the light that reaches through the windows, it seems as if the sun's rays are breaking through the branches. The "branching" of the poles mimics the natural weight distribution of the tree, allowing each pole to withstand a greater load. In his works, Gaudi uses curved, organic lines, which are inherent in natural forms, instead of traditionally straight, rigid lines. Gaudí's legacy is one of the most prominent references in the world history of biomimetic architecture.



Figure 8 - Sagrada Família

Figure 9 - Interior of the Sagrada Família. Images source:

<https://steemit.com/architecture/@snaves/biomimetic-architecture-sagrada-familia>

"Many problems would be solved if people took just a little wisdom of the flora: its slow growth, rooting, use of sunlight, incredible ability to adapt and renew."

Friedensreich Hundertwasser

The Austrian artist Friedensreich Hundertwasser (1928-2000), a visionary who deeply felt that with the growing distance from nature we are essentially moving away from ourselves, and who, through his work in the field of architecture, advocated connections between man, nature and architecture.

The main features of F. Hundertwasser's work are the absence of straight lines, the application of organic, irregular architectural forms, rich polychromatic facades and the integration of vegetation with the building (Figures 10 and 11). The American architect Frank Lloyd Wright (1867-1959) considered architecture as a means of creating a perfect balance between the artificial and natural worlds, as such, in his work he advocated the design of structures that are in harmony with human nature and the environment. He called his creative philosophy organic architecture. This philosophy is best represented by the Fallingwater (1935) (Figure 12), which is considered one of the greatest works of American architecture of all time.



Figure 10 - Rogner Bad Blumau, Friedensreich Hundertwasser, Austria. Image source: https://upload.wikimedia.org/wikipedia/commons/3/32/Hotel_Therme_Rogner_Bad_Blumau_Kunsthhaus.jpg

Figure 11 - The Waldspirale (1990), Friedensreich Hundertwasser, Germany. Image source: <https://www.solaripedia.com/images/large/4837.jpg>

Figure 12 - Fallingwater (1935), Frank Lloyd Wright. Image source: https://upload.wikimedia.org/wikipedia/commons/thumb/0/08/Fallingwater_-_DSC05639.JPG/220px-Fallingwater_-_DSC05639.JPG

3.2 Landscape architecture

Landscape architecture is a type of activity, which deals with the vivid and lively elements of the landscape, their volumes, shapes, color composition, dynamic in time and space. Landscape architecture is a profession of landscaping, through planning, designing, building and managing landscape. Landscape architects improve the quality

of life by arranging the space by creating an image of the landscape, but also by solving environmental problems.

Landscape architecture as a profession is a combination of nature and art, and that is why the field of biomimicry and the process of creative creation inspired by nature is very compatible with the very essence of this profession which provides unlimited opportunities for development and cooperation. As in other areas of artistic expression, in the field of landscape architecture artists whose work is inspired by natural processes and forms stand out.

The focus of the works of Charles Jencks (1939-2019), an American cultural theorist, landscape designer and architectural historian, was primarily on observing the ultimate forms and natural laws from which everything originates. He called this domain Zero Nature, because from these elements and natural laws, all of life arises: gravity, DNA, black holes, galaxies. In his book *The Universe in The Landscape* (2011) he points out that almost every design is based on some concept of nature, ie. of the cosmos, which derives from a peculiar pattern and rhythm. The search for universal patterns of nature is the main driver in architecture and art. "Spirals, coils, and patterns of repetitive curves have been my constant source of inspiration because of their good structural shape and great representation in nature." In the *Garden of Cosmic Speculation* (Figure 13), the thematic parts of the garden are: Fractal Terrace, Six Feelings and DNA, Naked Snail Lakes, Snake Hill, etc. Another example of the work of this artist inspired by natural forms is "Lady of the North", a large earthen sculpture of anthropomorphic form (Figure 14).



Figure 13 - Garden of Cosmic Speculation. Image source:
<https://www.sciencephoto.com/media/129074/view>

Figure 14 - Earth sculpture of the anthropomorphic form "Lady of the North". Image source:
<https://cached.imagescaler.hbpl.co.uk/resize/scaleWidth/885/cached.offlinehbpl.hbpl.co.uk/news/WOH/Northumberlandia-201706280110132761-20180318063034776.jpg>

The Brazilian landscape architect Roberto Burle Marx (1909–1994) worked in a variety of artistic media, from painting and sculpture to graphic design and mosaics.

He participated in the development of the plan of Brasília (Figure 16) alongside urban planner Lucio Costa and architect Oscar Niemeyer. The city is constructed in the shape of a bird with outstretched wings, which can be clearly seen from a bird's eye view. The project of arranging the Copacabana beach promenade in Rio de Janeiro (Figure 15) was done by Roberto Burle Marx. The inspiration for this project was the meandering rivers of Brazil. For Roberto Burle Marx, painting and landscape design were inseparable, if not identical, art forms: He spoke of design as a way of painting with vegetation, but acknowledged its distinguishing dimensions, which encompassed touch, sound, fragrance and change with the passage of time.

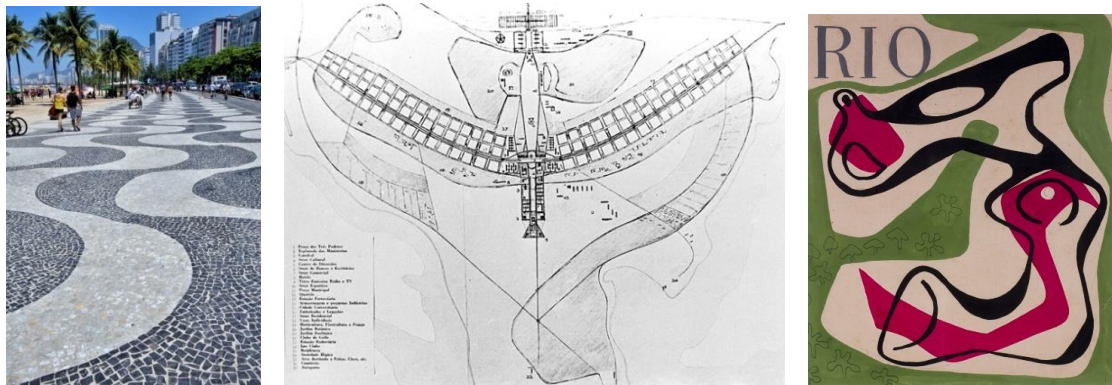


Figure 15 - Copacabana Promenade, Rio De Janeiro, Brasil. Image source: <https://3iqhm91wtiv21y4zza4dqwj2-wpengine.netdna-ssl.com/wp-content/uploads/Brazil-Rio-de-Janeiro-Copacabana-Beach-Promenade-971x1440.jpg>

Figure 16 - Bird or airplane-like form of Brasília, Brazil. Image source: <https://4.bp.blogspot.com/-sV4i9K96Tko/UQ7wmOnp80I/AAAAAAAAABHg/wcnFkiW5qIU/s640/brasilia+urban+plan+2.jpg>

Figure 17 - A cover design for a 1953 issue of Rio magazine



Figure 18 - A design by Roberto Burle Marx from 1938 for the Ministry of Education and Health roof garden in Rio de Janeiro

3.3 Interior design

Radiolaria marine unicellular protists with a mineral shell were the inspiration for the creation of the Biomimicry Chair - Radolaria (Figure 19). The structure of the chair was created through the method of 3D printing according to the model of the structure of this group of organisms. For the assembly of the chair without additional binders, Lilian Van Daal found inspiration in the structure of lattice connections within the skeleton of the species Bryozoa (sea moss) (Figure 20).



Figure 19 - Biomimicry Chair – Radolaria. Image source:

https://static.dezeen.com/uploads/2014/08/Biomimicry_3D_printed_soft_seat_by_Lilian_Van_Daal_dezeen_468_4.jpg

Figure 20 - Building material inspired by the skeleton of the Bryozoa species. Image source:

https://static.dezeen.com/uploads/2014/08/Biomimicry_3D_printed_soft_seat_by_Lilian_Van_Daal_dezeen_468_8.jpg

3.4 Fashion

Throughout the history of fashion design, it can be seen that fashion is often inspired by nature, but the degree of danger that the fashion industry imposes on the environment is not negligible, and for that and many other reasons, the field of bionics i.e. biodesign in this sphere can contribute to the development of new materials, technologies and the transition to a new, self-sustaining system of functioning.

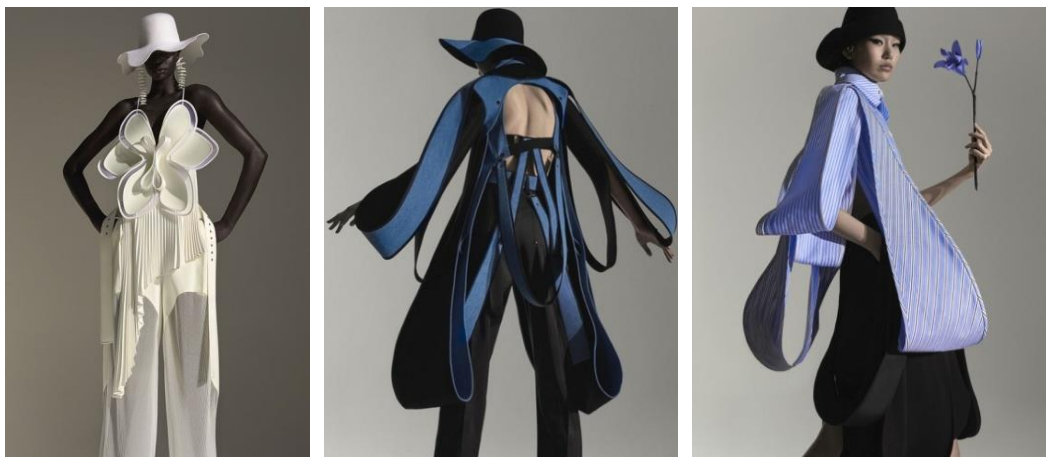
Iris van Herpen (1984) is a Dutch fashion designer known for combining technology with traditional high fashion. In her work, she combines art with science and technology, including in the concepts of her work the most modern materials that will contribute to the transformation of the fashion industry into a sustainable one. Iris van Herpen has always been fascinated by the world of nature, the complexity of ecosystems and the ways in which nature is constantly renewed.

This year's fashion collection (SS 21) is based on the use of waste plastic taken from the ocean, which has been turned into "fabric". The dresses of this collection were inspired by water, its fluidity, while their appearance itself points to its natural movement (Figures 21, 22, 23 and 24).



Figures 21, 22, 23 and 24 - Iris van Herpen, collection (inspired by nature) spring/summer 2021

London fashion designer Robert Wun often uses natural motifs as inspiration through his avant-garde, futuristic creations of sculptural elegant silhouettes. His designs draw on Hong Kong tradition, science fiction and the natural world. In Wun's work, the floral motif of the orchid is especially emphasized, which for this artist is a symbol of power - a feminine, graceful, poetic interpretation of the act its flowering. (Figure 25) In addition to the orchid, he also uses a lily flower motif with an emphasis on the structure of the petals (Figures 26 and 27).



Figures 25, 26 and 27 - Robert Wun - floral motif as inspiration

Emma Rie is a Japanese fashion designer who, through her artistic creation, primarily inspired by natural manifestations, includes the application of science and mathematics. The goal and end result is to create a beautiful and innovative design inspired by nature and to develop new methods of shaping and designing clothes. In cooperation with researchers in the field of mathematics and science, various forms of clothing were created.

Thus, in collaboration with Matsumoto, a brain researcher, a dress was created in the year 2000 that represented a printed pattern of nerve cells (Figure 30).

In collaboration with Dr. Hiroyuki Kamiguchi, a researcher of nerve cell reproduction from the Institute of Physical and Chemical Research, she created a collection inspired by the formation of living tissue from the cell (Figures 28 and 29). The dresses with their different shapes represent the phases of change of the cell's shape and the inevitable transformation of living matter.



Figure 28 - Dresses expressing the temporal changes of a living thing

Figure 29 - Dresses expressing the changes of one cell



Figure 30 - A dress based on a brain sketch

Figure 31 - A dress that makes us feel fractality

For the creation of a collection of dresses called "Touch of Infinity" (2004), the inspiration was fractal geometry that deals with natural patterns. A fractal is a geometric shape that can be decomposed into smaller parts so that each of them, at least approximately, is a reduced copy of the whole (Figure 31).

4 Form of the flower as inspiration

Flowers have always been a universal symbol of beauty, love, peace, and bliss that we primarily associate with good and positive human emotions. The shape, smell, color, and texture of flowers positively affect human perception and create a sense of harmony. This is why it is not surprising that today, in a time of accelerated technological development and growing alienation from nature, people have an increasing need to integrate with nature in urban areas. Bionics, an area of connection of nature and technology, with its principles, can contribute to that. The very essence of the growing presence of bionic forms is that through nature, as a model, it has a positive effect on modern human, primarily visually and psychologically.

Of particular interest is the harmonious shape of the flower, which is often used as inspiration in architectural design. Examples of modern architectural structures, whose basic shape is inspired by the morphology of the flower, are based on minimal geometric shapes that build complex structures. Possibilities for applying biomimetic principles in architectural design are based on geometric principles, providing an opportunity to develop various generic models based on parameters originating from nature and whose configuration is adapted to the requirements of spatial structures.

5 Fashion and floral motifs as inspiration in creating textiles

Clothing has existed for as long as man himself. The first and most basic function of clothing would be to protect the body from external influences, primarily weather conditions. It was necessary for the human consciousness to develop to a level where it does not want to only use clothes as a means of covering up or protection, but also as a form of self-expression. Dressing is undoubtedly a form of non-verbal communication.

The material, color, texture, shape, cut of the fabric from which the clothes are made have a significant psychological, visual and aesthetic effect on the wearer.

The timeless beauty of petals and the strikingness of floral pigments have been a favorite design inspiration for centuries. Vivid, floral motifs and floral prints are considered the greatest allies in the fashion industry. People have been using floral motifs to decorate their wardrobes for centuries.

The ancient Egyptians were the first, known for their long history and high development of the textile industry. Clothing pieces decorated with floral motifs could only be afforded by the nobility and were worn on special occasions.

In the east, primarily in China, and then in Japan and India, floral motifs and landscapes adorned garments from the twelfth century. This trend soon reached Europe, where flowers were primarily used as ornaments on famous Renaissance churches and castles, and later on wardrobes, especially during the 18th century, when Baroque and Rococo were the most prominent fashion inspirations. The symbolism of flowers served as a way of communication, ideal for sending the desired message. In the 19th century, florals were also found on the luxurious dresses of ladies from high society, on their wallpapers, and even on home textiles and ornaments that adorned interiors and exteriors.

While modern printing methods didn't exist yet, floral prints were created by hand printing, painting, weaving, or embroidery, making them quite expensive.

In the early 20th century floral prints became more mainstream, thanks in part to the Industrial Revolution, which introduced new manufacturing processes that made printed fabrics more accessible. The expansion of floral motifs took place in the 1960s, during the hippie movement. In the '60s, many designers were influenced by pop art, leading them to create bright, vibrant clothing with bold floral patterns.

As a paradigm of romance and tenderness, flowers have remained in the women's fashion industry until modern times. In addition to drawing inspiration from nature, designers provide ladies with the opportunity to evoke more romantic times with their clothes and awaken the essence of femininity, as well as an escape from the city crowds and bustle.

In the field of fashion design, in order to systematize the process of creating design projects intended for the creation of printed textiles, Laschuck (2017) singles out four phases: preparation, design, finalization and pre-production.

5.1 Serbian fashion designer Vesna Kracanović

Serbian fashion designer Vesna Kracanović is the founder of the fashion brand Modle. Vesna Kracanović is not burdened by current trends and her design clean and clear forms which rely on the distinctiveness of female body. In 2012 Kracanović started a new brand called Siveno dedicated to the European market.

Siveno focuses on experimenting with form and cut, repeating the small details and magnifying them into the main theme. The Simplicity of her designs and the geometric approach to the cut was mainly influenced by Japan. Although she prefers darker tones, rich and bold colors are not intimidating to her and she uses them once in a while. Her latest collection has over-sized items (skirt, collar on the coat, part of a

sleeve...) but they don't overwhelm the model. Their purpose is just to emphasize the geometry of the model and overhaul simplicity.

In the collections of this artist, in addition to the recognizable geometric expression, one can also notice the creations of an impressive floral print, vibrant colors (Figures 32 and 33).



Figures 32 and 33 - Creations with floral motifs by Serbian fashion designer Vesna Kracanović

5.2 Pattern lab in India

Arch College of Design & Business in Jaipur (India) was set up in the year 2000, under the aegis of the ARCH Educational Society to impart industrially and globally relevant, specialized education in design.

To promote entrepreneurship, ARCH has conducted several workshops for Skilled Entrepreneurship Development Courses. The Incubation cell provides budding entrepreneurs with the appropriate environment and support for taking their concept from conception to execution.

Dyeing & Printmaking Workshop

The dyeing and printing space has an arrangement for students to be able to practice and learn various forms of dyeing and printmaking. The lab has equipment to enable learning of natural dye making techniques and also traditional tie n dye methods used in India along with contemporary techniques of printing and dyeing.

Pattern Drafting Studio

Pattern drafting is the stepping stone to creating a garment, students at ARCH are taught in-depth pattern manipulation and drafting to enable them to experiment with silhouettes and patterns of garments. The drafting studio is equipped with large work surfaces, which enables efficient handling of patterns and garment testing.



Figure 34 - Pattern making lab in Arch College of Design & Business in Jaipur (India)

6 Dandelion (*Leontodon taraxacum* L.) flower as inspiration

The dandelion (*Leontodon taraxacum* L.) (Figures 35 and 36) – a very resistant plant species, of cosmopolitan distribution and exceptional vitality – is considered a symbol of hope, unity, peace, happiness, and childhood. The seemingly tender, fragile, and extremely resistant plant species, such as dandelions, are "designed" to perfection, proof that the essence of this life actually "lies" in small, simple things. Man adapts space to himself with his technical achievements. When from such a sterile environment, chained with concrete, steel and glass, through the smallest crack, this plant is able to "erupt" (finds its way with the power of life force), then it can be said to be proof of a superior, an above-average intelligent form of life.

An interesting metaphysical association is that the dandelion is the only flower that, in its stages of development, represents three celestial bodies - the Sun, the Moon, and the stars. When it blooms, the yellow flower looks like the Sun; when it matures, its white head (rosary) is associated with the Moon, and the seed scattered in the wind translates to countless stars in the sky. Only seemingly tender and vulnerable, it is a

symbol of perseverance and strength: the dandelion is a "pioneer species," one of those plants that will be the first to grow roots after major natural disasters, especially fires. Due to its regenerating ability, it is believed that it collects and emits solar (cosmic) energy throughout the year.

The flowers are bright yellow, rarely orange-red or whitish-yellow, arranged in a glabrous inflorescence. The fruit is a single-seeded syncarp nut (achenia) with white pappus. Achenia is light (gray to dark brown) or black, never brown to bright red, with many prickly nodules.



Figure 35 - Dandelion (*Leontodon taraxacum* L.) on Kosančićev venac, Belgrade, Serbia

Figure 36 - Overblown dandelion flower

In the research paper 'Biodesign inspired by the leaf and flower of dandelion (*Leontodon taraxacum* L.)' is represented an art installation that stylizes one such form of existence, seemingly simple but very powerful. The paper focuses on the analysis of the natural shape of dandelions, using a bionic pattern and parametric modeling recognized as biodesign.

Emphasis was placed on the use of Blender software, which enabled parametric modeling and proved to be suitable for generating bionic patterns and modeling bionic forms. In addition to the Blender software for displaying 3D models of dandelion flowers, the following softwares were also used in this paper: AutoCAD, SketchUp and Lumion. In this paper, the form of a geodesic dome was used as a basis for the symbolic representation of the construction of the plant form of the dandelion flower (*Leontodon taraxacum* L.).

The result of this research is a generated bionic art form that is materialized in the form of conceptual solutions for the design of spatial installations inspired by the leaves and flowers of the species *Leontodon taraxacum* L (Figure 37).



Figure 37 - Final appearance of a 3D model (installation/pavilion) inspired by a flower of the species *Leontodon taraxacum* L.

7 Dandelion motif in fashion design

A wonderful plant such as the dandelion has served as an inspiration for creating motifs, patterns on textiles (Figures 38, 39, 40 and 41).

The process of transforming the shape of the dandelion flower is fascinating, from the phase of the yellow flower to the whitish achenes with the papus that the wind blows. Many of these scattered parachutes will turn into new dandelions and the life cycle continues. The whole secret of nature and the absolute secret of life is hidden in one dandelion flower. Just as life represents a great cycle, when something 'dies' something new begins to be born. The whole harmony of nature is based on constant change.

This way of implementing the dandelion flower would pay homage to this cosmopolitan flower through the form of fashion design on fabrics. The stylization of this flower leads to a geometric circular shape that contains the symbolism of a circle. The symbolism of the circle can be safely said to be universal, sacred and divine. A circle has no beginning, no end, no corners, no pages. That is why people have always seen in it a symbol of unity, that is, unity and infinity. It seems that the circle does not have a limit, although it gives form, in it and outside it everything is in motion, it offers potential, it is the Zero from which everything starts and to which everything, in the end, returns. The circle calls for action, symbolizes time cycles, the change of seasons, the movement of the planets around the Sun - in it we really see a picture of the perfect cosmic rhythm.

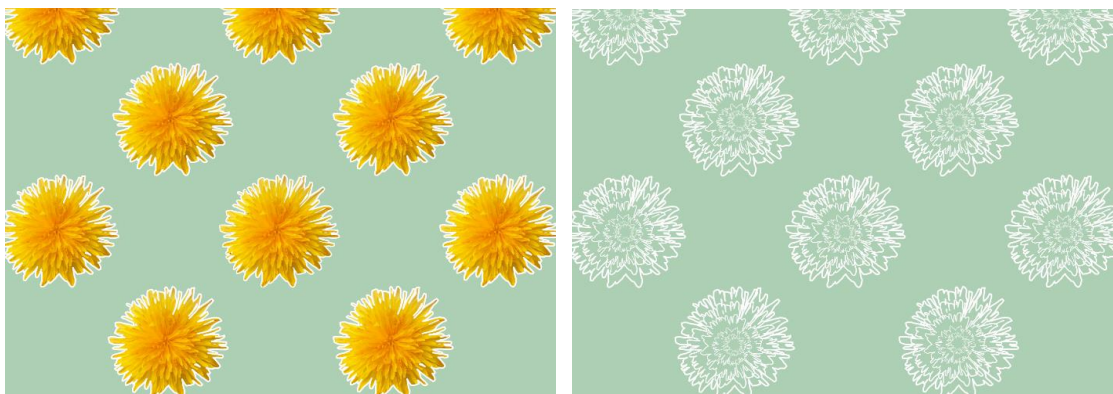


Figure 38 - Pattern 1 – dandelion flowers as inspiration for pattern fabrics

Figure 39 - Pattern 2 - dandelion flowers as inspiration for pattern fabrics

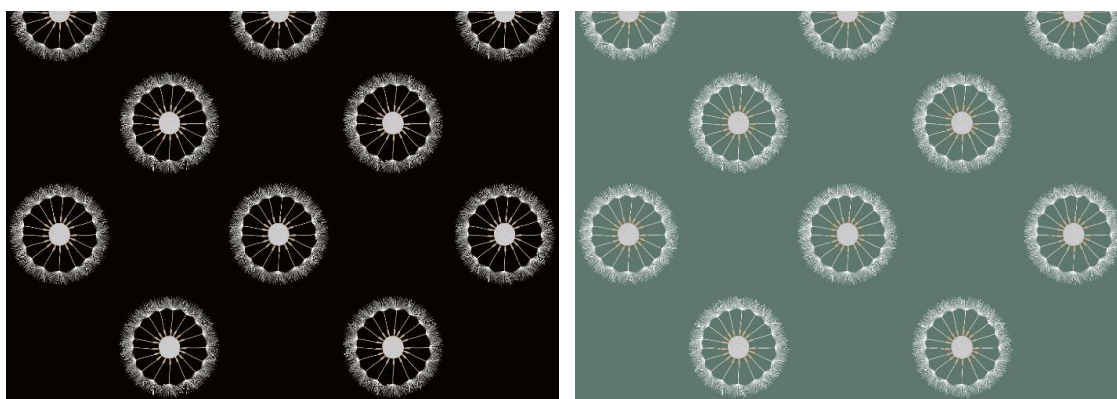


Figure 40 - Pattern 3 - dandelion flowers as inspiration for pattern fabrics

Figure 41 - Pattern 4 - dandelion flowers as inspiration for pattern fabrics



Figure 42 - A presentation of a fashion creation inspired by a dandelion flower by Olga Gajanić

8 BIO-GEOMETRY workshop

The objective of this workshop was to co-relate geometry, graphics and incorporate bio-mimicry, having flowers as inspiration to represent Indian Culture. The Bio-geometry workshop was mentored by Biljana Jović and the workshop lasted from Sept. 16 to Oct. 3, 2019 in the ARCH College of Design & Business, Jaipur – India.

The project involved basic knowledge of platonic solids and a study of flowers growing in the vicinity. Students were required to study and relate this with Indian culture and practices. The students explored several flowers and their structure in nature. This resulted in a 3D structure with its applications in real life. During field visits on the first two days of the workshop the students went to the Patrika Gate in Jaipur where they drew live sketches, and took photographs of a flower of their choosing. The students searched for further details like the scientific names and details of the flowers. Some of the flowers studied were Scarlet Jungle Flame, Bottlebrush and Red Hibiscus.

8.1 Art installation as a result of graphics education of Bio-geometry workshop



Figure 43 - Platonic installation with stages of the Hibiscus flower



Figure 44 - Mirrored installation with platonic cubes



Figure 45 - Various stages of development

9 Geometry workshop

The geometry workshop was founded in 2012 by Professor Dr. Biljana Jović, which was designed as a creative platform for students of all levels of studies at the Serbian Faculty of Forestry, Department of Landscape Architecture and Horticulture. The workshop provides to students the opportunity to develop and express their creative inclinations. Students are engaged in geometry, graphics, form, composition and visual communications. So far, students have had the opportunity to participate in group exhibitions in the faculty building and present their work. In addition, the Workshop had the opportunity to exhibit at the International Horticulture Fair (2016/2017), the International Triennial of Extended Media (2017) at the Art Pavilion "Cvijeta Zuzorić" and the International Festival Belgrade Month of Photography (2017, 2018 and 2019).



Figure 46 - Geometry workshop logo

The plan of the geometry workshop is to continue creative research and expression in the field of graphic sciences, which would also go into the domain of fashion design, all within the geometric mode of expression. As the Workshop was founded on the Department of Landscape Architecture and Horticulture, the description of its work includes the connection between geometry and nature.



Figure 47 - International Triennial of Extended Media and Multimedia Arts EXTENDED MEDIA - EXPANDED VISIONS / December 15, 2016 – January 21, 2017 / Art Pavilion "Cvijeta Zuzorić"



Figures 48, 49 and 50 - Art collection of the Faculty of Forestry: Natasa Teofilovic, Rados Antonijevic & Milica Rakic

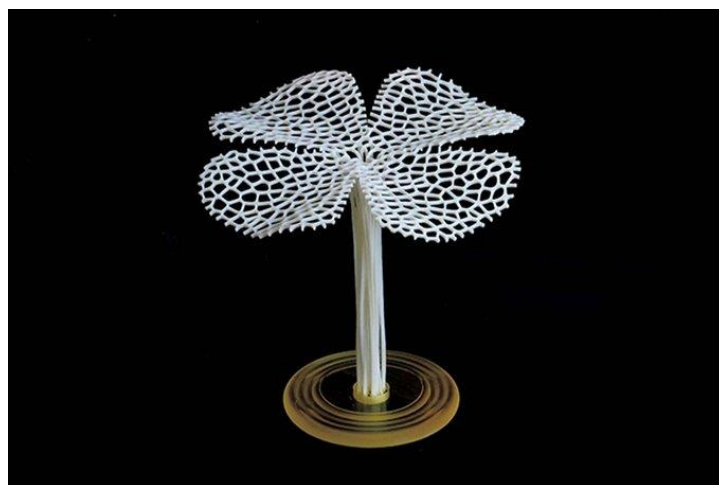


Figure 51 - 11th Asian Forum on Graphic Science (AFGS 2017), Tokyo, Japan

10 Conclusion

Today, biodesign, as a multidisciplinary field, is more and more present in all spheres of life, because in this alienation from nature, man needs to embody that primordial nature from his environment through his creations. We see this in the domain of landscape architecture, architecture, in all areas of artistic creation, such as fashion design, where creations inspired by plant motifs are especially expanding. Creative creations, of a versatile artist as was Roberto Burle Marx, are positive examples of the sublimation of various artistic spheres that he developed and created mainly in Brazil, and he also had great recognition around the world.

Acknowledgment

The authors are supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, n°.451-03-9/2021-14/ 200169, and the Ministry of Culture and Information of the Republic of Serbia.

References

CAMARGO, Cariane Weydmann; RÜTHSCHILLING, Evelise Anicet. Design de superfície e cultura local: abordagem metodológica para criação de estampas. **Revista Brasileira de Expressão Gráfica**, v. 6, n. 1, 2018.

CIRLOT, Juan Eduardo. **Gaudi: introduction to his architecture**. Triangle Postals, 2018.

ČUČAKOVIĆ, Aleksandar A. et al. Parametric modeling as geometric tool for designing urban model of biomorphic form inspired by flower of bell flower (*Campanula persicifolia* L.). In: **Proceedings of 6th International Conference on Geometry and Graphics "MoNGeometrija 2018"**. Serbian Society for Geometry and Graphics (SUGIG) Faculty of Technical Sciences, University of Novi Sad, 2018. p. 117-124.

ČUČAKOVIĆ, Aleksandar; JOVIĆ, Biljana; KOMNENOV, Mirjana. Biomimetic geometry approach to generative design. **Periodica Polytechnica Architecture**, v. 47, n. 2, p. 70-74, 2016.

Eri MATSUI: SENSING GARMENT: A FASHION DESIGNER MEETS SCIENTIST, The 11th Asian Forum on Graphic Science 2017 August 6-10, 2017, Tokyo, ISBN978-4-9900967-3-1 © 2017 Japan Society for Graphic Science.

Grić M.: **History of Garden Art**, University of Belgrade, Faculty of Forestry, Belgrade, 2015.

HUNDERTWASSER, Angelika et al. **Hundertwasser architecture: for a more human architecture in harmony with nature**, 2018.

JENCKS, Charles. **The Universe in the Landscape: Landforms**. Frances Lincoln, 2011.

Jović, Biljana S., et al. Biodesign Inspired by the Leaf and Flower of Danedlion. **Proceedings of 13th Asian Forum on Graphic Science (AFGS 2021), 6-7, DEC, 2021, HONG KONG**, Virtual Conference. <https://afgs2021.com/wp-content/uploads/2021/12/AFGS-proceeding-v5-20211204.pdf>, ID 25, pp. 1-14.

JOVIĆ, Biljana; Invited lecturer, 13th Asian Forum on Graphic Science 6-7, DEC, 2021, HONG KONG, AFGS 2021 abstract online, page 6, KEYNOTE SPEECH 1, <https://afgs2021.com/programe/>

LIZOŇOVÁ, Denisa; TONČÍKOVÁ, Zuzana. Exploring the application of nature-inspired geometric principles when designing furniture and interior equipment. **Acta Facultatis Xylogologiae Zvolen res Publica Slovaca**, v. 61, n. 1, p. 131-145, 2019. DOI:10.17423/afx.2019.61.1.13, 2019.

Maldini S.: **Lexicon of Architecture and Artistic Crafts**, Official Gazette, Belgrade, 2012.

McCarter, R. : "Frank Lloyd Wright", Clio, Belgrade, pp. 278., 2013.

Vujković Lj., Nećak M., Vujković D.: **Landscape Design Technique**, University of Belgrade, Faculty of Forestry, Belgrade, 2003. <http://www.upa.org.rs/o-profesiji>; (accessed 16.05.2021).

Complementary References

<http://www.vesna-kracanovic.com/about.html>

<https://afgs2021.com/wp-content/uploads/2021/12/AFGS2021-Conference-Book-v6.pdf>

<https://blog.whitehouseblackmarket.com/the-history-of-floral-prints-in-fashion/>

<https://ihindustan.com/shop/1909/arch-college-of-design-business>

<https://miamaya.online/life/131/floral-print-i-cvetni-motivi-omiljeni-saveznici-zenstvenosti-u-modi>; (accessed 02.12.2021)

<https://www.casabatllo.es/novedades/la-biomimetica-en-la-planta-noble-de-casa-batllo/>
(accessed 15.04.2021)

<https://www.dezeen.com/2014/08/05/biomimicry-3d-printed-soft-seat-chair-by-lilian-van-daal/>; (accessed 05.06.2021)

<https://www.fastcompany.com/90609023/iris-van-herpen-has-always-been-fascinated-with-the-natural-world-now-she-wants-to-save-it>; (accessed 02.06.2021)

<https://www.nytimes.com/2016/05/13/arts/design/review-revisiting-the-constructed-edens-of-roberto-burle-marx.html>

<https://www.smartcitiesdive.com/ex/sustainablecitiescollective/gaudis-masterpiece-nature-inspired-architecture/18727/> (accessed 15.04.2021).