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ENVIRONMENTALLY SUSTAINABLE INTERIOR DESIGN - THE CHALLENGES AND TRENDS

Abstract: *In recent years, sustainable development has become a focal point for various fields of engineering design. A relatively novel concept of green architecture and eco-friendly interior design presents a new approach which is in accordance with the environmental safety concerns. This concept offers a starting point in search for adequate sollutions for a number of sustainability issues that contemporary communities are facing today.*

Key words: *sustainable architecture, sustainable interior design, eco-design, eco-friendly architecture, environmental safety.*

INTRODUCTION

Global ecological crisis was created due to the excessive, negative impact of the anthropogenic activities on the nature. The very existence of human societies is jeopardized by disturbances in the environment and by constant pressure that industry puts on the biosphere's capacities. The environmental problems are rooted in unsustainable production and consumption and unacceptable social behavioral models. It is very likely that only an appropirate design strategy can provide adequate response to ever increasing ecological crisis.

Ecodesign (green design, ecological design, sustainable design, environmental design) includes various activities that cover all the stages of product life cycle, while life cycle analysis is often used to summarize effects that a product has or may have on the environment. The life cycle stages of a product are: raw material extraction, manufacturing, distribution, usage, and waste management.

The final target is to achieve a cleaner production that can reduce operating costs, improve safety and minimize the environmental impact of the process.
Briefly, sustainable design represents equilibrium between human activities and the environment and elimination of the negative impacts of human activities on the environment through design. [1]

Basic characteristics of products based on ecodesign principles are:

- Usage of materials from the nearby environment
- Usage of materials with lower negative impact on the environment (for healthier living and working environment)
- Reduced quantities of used materials (lower production and the material costs)
- Recyclability (increased recycling potential)
- Increased usage of recycled materials
- Reduced waste (resulting in lower waste disposal costs)
- Increased energy efficiency
- Higher product durability (improved product quality)
- The ability of measuring product carbon footprint
- Implementation of the principles of sustainable development (for better protection of the environment)

This vision of green development has appeared in the late seventies of the last century, after the oil crisis and due to the need for the energy efficiency. At the same time, one of the first recycling actions were noticed in the industry of Civil Engineering.
After early analyzes of the toxicity of the materials applied and the harmfullness of the emissions of the toxic compounds, the concern about public health and the impact of the working environment on worker's productivity started to gain importance. There was a growing awareness of the need to reduce waste.
The essence of ecodesign lies in harmonisation of social, economic and ecological factors of sustainability. Our future mostly relies on sustainable design and design skills that do not exclude our responsibility for the future generations. The society should be aware of the responsibility and the importance of the ecologically oriented building process and interior design, according to the principles of sustainability and ecodesign. [2]
Architects, designers and planners have direct impacts on the quality of the environment and can contribute to the process of creating the better life conditions for present and future generations.

The principles of sustainability in the field of architecture and interior design set focus on some environmental aspects - planning with the efficient usage of space, the selection of the materials with less or just minimal environmental impact, reducing the non-renewable energy consumption, reducing pollution and waste.
A significant level of responsibility is on interior designers. They have to find sollutions that will harmonize aesthetics and functionality and reduce the negative impact on the environment at the same time. It is often said that the apartment is the basic functional unit in the field of architectural design. Whether it's about the furniture, or materials applied, the usage of eco-products and materials, as well as environmental design principles

can greatly improve the quality of life and reduce the negative impact on the environment.

MINIMALISTIC DESIGN

Minimalism was an art movement that emerged in the early 1950s and it is based on creativity with a purely aesthetic character. However, minimalism in architecture, as XX century architecture paradigm, stands for planning and design that is within manageable minimum with a stylistic balance between simplicity and eccentricity. Projects are primarily functional, while interior designs lack the furniture. The moto "Less is more" (*Ludwig Mies van der Rohe)* that directly reflects the essence of his creativity and the minimalistic approach that is reflected in the purity of lines and the extreme simplicity of space. By reducing details and using simple forms, he wanted to achieve interaction between interior and exterior through the balance between architecture and nature. The spectrum of materials applied is reduced to a minimum - glass, concrete, steel and natural stone, due to the lack of decorative elements in the space. This movement was an inspiration to a great number of interior designers. Minimalism in the interior design usually means decreased usage of building materials, decor, and lightning. As a result, space is maximally relaxed, functional and elegant. (*Figure 1.*) Due to the proper choice of materials applied, simple forms and the reduced quantity of used furniture, minimalistic approach is considered a good practice when it comes to sustainable and eco design.

FLEXIBLE PLANNING

Flexible design sollutions are crucial for solving the dynamic demands and problems in planning.

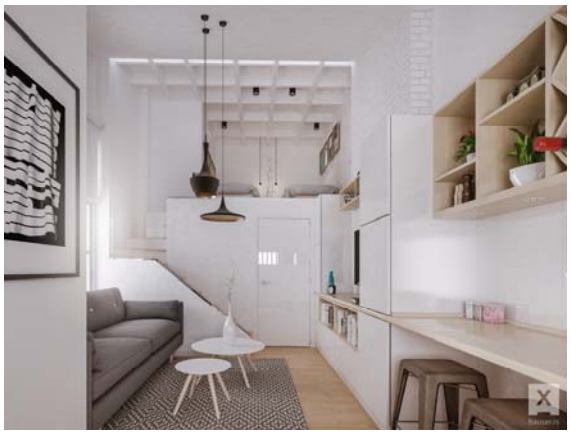

Figure 1. *Eco-friendly interior design*

Although the functionality of the planning is a priority, it is always necessary to consider which functionalities of an apartment can evolve, and which parts of the apartment may require some modifications during the exploatation in the future.

Fast technology development often requires some changes in home equipment and appliences. It is natural that families grow and change their basic needs over the time. So, we are searching for an apartment design that will keep up with the needs of the family. The key feature is space flexibility. [3]

Flexibility is now a measure of sustainability – if the space is adaptable to the changing needs of the family, some interior elements can be easily replaced, without demolition or the whole apartment renovation.

Innovation in the area of design and planning brings new possibilities of flexible design in a form of a space that can easily be modified when children grow up and show their needs. The solution can be found in adjustable, foldable or movable furniture design or in the possibility of simple replacement of certain parts of the interior.

The goal of sustainable design is the creation of "timeless space", in order to avoid the need of changing the complete interior every year, according to current trends.

Designers should aviod short-term interior designs and plannings, usage of the final finishes with questionable quality that are currently in trend. The interior space should be creative in order to be upgraded without major changes in function or used materials.

The best way to achieve flexibility lies in the choice of the quality instead of the quantity, in classics instead of the temporary elements (that are currently in trend) and in simplicity and functionality instead of pure decoration.

ECO - FRIENDLINESS

The concept of sustainable development and sustainable design is based on implementation of adequate procedures, all the way from design to the realization of ecologically acceptable products. Products thus formed are reliable, flexible, upgradable, adaptable, suitable for multiple usages and ultimately long-lasting. [4]

In previous decades, the application of ecological principles in planning was a rather expensive process. Decisions on design were guided exclusively by economy and technology based criteria. The environmental consequences of this approach opposed the justification of design principles applied. With a new concept of product creation, the goal is to preserve the non-renewable resources and to reduce large quantities of waste (*Figure 2.*)

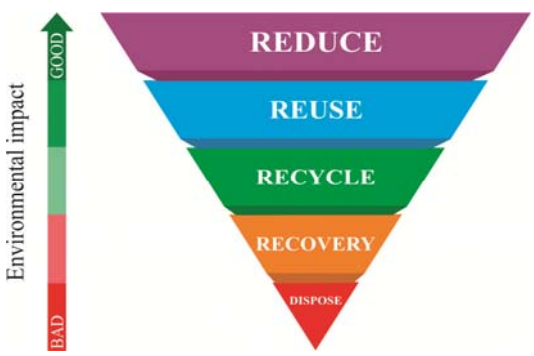

Figure 2. *Waste management*

Reducing the amount of waste by longer exploitation period, reusing the product (for the same or another purpose), and recycling a part or the whole product, altogether make the product environmentally friendly and ecologically acceptable. The focus of production is on creating zero-waste approaches that would optimize the production process while maximizing environmental impacts. [5]

The search for materials and products with the least environmental impact is becoming an imperative rather than a matter of choice, or luxury.

As one of the most demanding industrial sectors when it comes to environmental impact, construction sector should reorient toward environmentally-friendly materials and their massive application. Ecologically acceptable materials are those that are recycled, organic or manufactured in accordance with the principles of sustainability. Every modern society is aware of the importance of environmental problems, and the global survival. The emphasis is on extending the life cycle of the product through the secondary material usage and reduction of the quantity of raw materials used. This is achieved by the appropriate selection of recycled, recyclable or biodegradable materials. Diverting waste from landfills and consequential reduction of non-renewable natural resources can be supported by applying secondary materials obtained by recycling waste. Trough such an approach, waste becomes the input material for new products, and the waste generated is minimized, if not completely removed

Table 1. *Common barriers in selecting eco-materials*

Financial	Political	Management/ leadership	Technical	Socio-cultural	Knowledge/ awareness
Fear of higher investment costs	Lack of government policies/support	Lack of leadership	Lack of environmentally sustainable products	Lack of demand for sustainable products	Lack of awareness of professionals
Fear of king Pay-back period	Lack of building codes on sustainability	Lack of market segmentation	Lack of sustainability measurement tools	Cultural change resistance	Lack of professional knowledge
Client worries in profitability	Lack of government commitment	Lack of motivation and aspiration	Lack of demonstration project		Lack of awareness of clients
Ignorance of life cycle cost	Lack of legislation	Delay on decision-making	Lack of easily accessible guidance		Lack of awareness of benefits
Lack of financial resources			Lack of technical ability		Ignorance or misunderstanding about sustainability
			Lack of chronic skills and labour shortages		Lack of education and knowledge of sustainable design

The design process should take the same direction - a final product should be convenient for redesign, recyclable in one way or another, and reusable for the same or completely new purpose.

Research has shown that indoor space can be up to 5 times higher if inadequate materials are used for interior arrangements. Organic materials (wood, stone, wool, cork, bamboo) are a good choice, but they must be used and treated responsibly. Material selection should be guided by the principle of proximity - selected materials should be available in immediate surrounding (as local or regional source), and thus used in an environmentally responsible way.

The impact of materials and products on the environment must be observed throughout the life cycle - from the extraction of raw materials, transport, processing and production. In the end, their remains are treated after use (disposal, reuse, recycling). In order to prolong the exploitation period of products, the elements that are susceptible to wear (e.g. floors) should be particularly taken in consideration.

Wide availability of new technologies, the diversity and accessibility of organic products on the market and the emergence of alternative materials make the ecological design feasible and applicable. It should become a required approach and a fundamental principle in planning and design. [6]

If it is possible, chosen materials have to be environmentally friendly and sustainable, as well as benign for the environment and public health.

For materials that are unreliable and unsafe for use, a substitute should be provided. Providing a healthy environment is one of the priorities in interior design. Only materials with minimal environmental impact should be considered: non-toxic, recyclable, and energy non-intensive.

The suitability and sustainability of a particular material is highly dependent on project-specific factors. The end goal must be to promote the most appropriate option for each particular project. A promotion of a wide variety of material options is essential. Therefore, it is crucial to identify and overcome potential barriers [7] in order to successfully implement eco-friendly materials and improve interior sustainability for the benefit of society at large. (*Table 1*)

The quality and the comfort of a dwelling space are defined by the air quality, adequate heating, ventilation, lighting and acoustics. If the furniture or household equipment was treated with harmful chemicals that release toxins into the air, indoor air pollution can be a dangerous threat to human health. In order to improve the quality of indoor air, it is important that the air circulates regularly and remains fresh. Plants are natural air filters. Carpets also improve air quality by keeping dust particles from the air. By regular cleaning and maintenance, the room remains healthy and free of allergens contained in dust particles. The carpets are also good sound insulators. They can help in reducing noise levels by absorbing sound vibrations. Physical and psychological human health is of great importance to exposure to natural light. This aspect is very important for the work environment, because natural light reduces stress and affects productivity. So called Biofilter design includes an element from nature in every interior space and thus helps to establish a connection between people and nature.

THE ENERGY EFFICIENCY

Household energy consumption has its share in climate changes. It is directly responsible for the portion of greenhouse gas emissions. The concept of energy efficiency in this case refers to devices used in households. Energy efficient devices provide numerous benefits for the environmennt as well as for a home budget. Also, the concept of energy efficiency is related to measures applied (technical and non-technical) and changes in approach made in order to reduce energy consumption. [8]
Measures taken to reduce energy losses and increase energy efficiency refer to:

- Replacement of the non-renewable energy sources with renewable ones.
- Replacement of energy inefficient appliances with efficient ones.
- Instalation of good insulation for the volumes that are heated or cooled, in order to reduce energy losses
- Replacement of used-out joinery in rooms that are heated or cooled in order to reduce energy loses
- Installation of automated devices in order to control heating and cooling systems
- Implementation of tariff systems by distributors to encourage energy savings.

In order to reduce the amount of energy used to heat or cool a room, it is required that all the joinery should be with high quality marks, good characteristics and insulation performance. Carpets are also considered exellent thermal insulators, and according to research they retain 10% of the heat in the room. Reductions in the amount of energy needed for lighting can be achieved by using energy efficient bulbs. By choosing the right colors to paint room walls, energy used for lighting can be preserved. Bright colors reflect more of the light, making the area brighter, while the dark colors demand more lightning which means intensive usage of artificial lightning.

The amount of energy needed for the operation of home appliances can be reduced by selecting the appliances with appropriate energy efficiency labels. These devices save energy, and the negative impact on the environment is reduced. The Regulations on energy labels aimed to distinguish efficient devices comprise washing and drying machines, dishwashers, air conditioners, electric stoves, refrigerators, freezers and bulbs. The classes of energy savings ranges from G (lowest) to A (highest). There are also A+, A++ labels, for the appliances which have energy efficiency greater than prescribed, and each label "+" refers to 10% less power consumption. B class consumes 30% and C class 65% more energy than A class. Analyzes show that electrical appliances consume about 20% of household electricity.

The application of smart technologies in apartments is another step towards achieving energy efficiency. By installing home automation and "green devices", remote control of heating, cooling and lighting systems are enabled. Intelligent thermostats with remote sensors that are handled through mobile applications are used to automatically adjust the temperature based on a pre-programmed schedule. Such systems help tenants use energy more efficiently and more economically.

Reducing the consumption of electricity is directly related to the reduction of pollution which appear as a consequence of the use of fossil fuels for its generation. Reducing the use of non-renewable energy sources is one of the basic requirements for sustainable development. [9]

ECOLOGICAL LABELS AND STANDARDS

Environmental pollution is largely influenced by industrial and production companies. In order to limit the effects of air, soil and water pollution, a large number of industrial countries have created their national and local strategies and have started implementing environmental policies. The tendency is to reduce the negative impact on the environment without reducing the quality of the final product.

The eco-labels and green marks are important way to promote environmentally friendly products. They carry information directed toward consumers, to disclose

environmental quality of a product. The products are allowed to be marked with an eco-label if its composition, production process and further use are not environmentally harmful.

By making the difference between products that are produced in accordance with an appropriate environmental policy and those that directly threaten it, consumers are given the opportunity to directly influence the market change.

The International Organization for Standardization (*ISO*) constitutes a network of national institutes covering 162 countries. It is the world's largest standard-setting institution. The application of ISO standards increases the competitiveness between the companies through safer design and better product quality. It provides the basis for creating a legal, health, safety and environmental framework at national levels. On the other hand, various directives also tackle the environmentally friendly interior design.

The European Union has established the Eco-Design Directive (2009), which sets the framework for the use of energy in accordance with environmental requirements. The Directive refers to the products that are responsible for about 40% of greenhouse gas emissions in the EU (bulbs, televisions, refrigerators, windows, insulation materials, etc.), on energy consumption of the appliances in a standby mode (electrical and electronic devices such as laundry, TV, personal computers, etc.). Requirements are set under condition that, when applied, they do not affect the functionality, product safety or consumer health.

Statistics show that people in cities are spending about 80% of the time indoors. Hence, it is very important how their working and living environment reflects their needs.

Green buildings are considered to be healthy facilities with the high level of environmental protection. They are predicted to be energy efficient, of high comfort level, with a dominant usage of renewable energy sources. Their environmental impact is therefore much smaller compared to standard buildings [10]. For future generations of engineers, managers and designers, it is very important to adopt the concept of sustainable planning and design at an early stage - a good practice applicable in various fields of engineering and decision making. It will bring significant savings, greater energy and material efficiency and a healthier environment for general population.

CONCLUSION

Sustainable and eco design should reflect the responsibility that we have for the future generations. The society should be aware of potential environmental and health risks and understand the importance of ecologically fiendly construction and interior ecodesign.

In the Agenda 21, it was concluded that people are consuming the resources increasingly and that the pressure on nature should be reduced in order to preserve the quality of the environment (*the Rio Summit, 1992*). The final report emphasized the importance of groups and individuals whose simultaneous efforts would be globally effective. Designers and planners, as the main bearers of change, have to give a new dimension to design by facing challenges related to the quality of life, the efficient use of natural resources, and waste management. They are responsible for the future promotion of sustainable development on individual and family level.

Thus, planners and architects think that minimalism gives maximum power to an architectural space, because it represents the true essence of architecture. Minimalism stands for simplified, adaptible structures that are suitable for many different purposes. Sustainable architecture, expressed through the minimalist and flexible design is of crucial importance for an environmentally friendly future. Today, we are faced with a social fenomenon of consumption. Only by living in a more economic manner, relying on our resources, reducing waste and our needs and desire for various equipment and gear, can we protect the climate and become environmentally responsible and more resource efficient society.

Eco design must provide a product or a design solution that brings about significant innovations in human consciousness and behavior, and also provide prosperity through innovation and reduce the pressure on the environment.

The world of design should focus on a sustainable way of thinking and support a growing interest for sustainable trends in modern living. Instead of rejection of old-fashioned but functional pieces of furniture, we need to find a creative approach by extending the lifecycle of the existing products. The goal is, also, to educate and activate citizens in the field of nature preservation, improvement of quality of living through advocacy, promotion and implementation of the ecologically acceptable and energy efficient materials and technologies.

Architects and interior designers can do a lot to improve a building's energy efficiency, by reducing the amount of energy needed for heating, lighting, running appliances and by providing renewable, non-carbon-based energy sources for a building. We also need to manage the quality of the environment by following ISO standards and by using the ecologically acceptable materials and products with the appropriate eco labels.

In a process of planning and designing a sustainable interior, the tendency is to come up with integrated, innovative and interdisciplinary solutions. By engaging professionals who will manage the application of best available technologies through the selection of environmentally friendly materials and equipment, efficient use of water and energy can be achieved. Thinking about the long-term availability of resources,

and the effects that a project solution can have on the environment, makes the design sustainable and responsible.

Today's environmental challenges have brought sustainability and sustainable design to the forefront of our design practices. Many architectural firms noticed the importance of the climate responsible architecture. They are very enthusiastic about creating the eco-friendly structures. Learning from the past and having a critical approach toward present trends can help future architects and designers to determine which methods work best in creating durable and sustainable buildings, and thus ultimately help to lessen the effects of climate change.

By investing in architecture, we are creating high quality environments, provide energy savings, preserving value over the lifecycle of the building, and ultimately we are leaving a legacy for our children.

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BIOGRAPHY of the first author

Milena Petričević was born in Niš, Serbia, in 1980.
She graduated from University of Nis, Faculty of Civil Engineering and Architecture. Ms Petričević also holds M.Sc. degree in environmental protection from the University of Nis, Faculty of Occupational Safety.Her main areas of research include architecture planning, interior design, sustainable planning, sustainable design etc.
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EKOLOŠKI ODRŽIV DIZAJN ENTERIJERA - IZAZOVI I TRENDOVI

Milena Pertičević, Nebojša Milkić

Rezime: *U poslednjih nekoliko godina, održivi razvoj predstavlja fokus različitih polja inženjerskog dizajna. Relativno nov koncept zelene arhitekture i ekološki prihvatljivog dizajna enterijera predstavlja novi pristup koji je u skladu sa u skladu sa ekološkim problemima. Ovaj koncept nudi polaznu tačku u potrazi za adekvatnim rešenjima za brojna pitanja održivosti sa kojima se savremene zajednice suočavaju.*

Ključne reči: održiva arhitektura, održivi dizajn enterijera, eko-dizajn, ekološka arhitektura, ekološka bezbednost.