

Artículo de investigación

## Development of sustainable design: directions and problems

Desarrollo de diseño sostenible: direcciones y problemas  
Desenvolvimento de design sustentável: direções e problemas

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### Abstract

This paper discusses various methods for creating a sustainable product design and discusses successfully implemented projects. Design sustainability is based on three major components: social, economic and environmental. Over the past few years, the concept of "sustainable design" has become very relevant and has been recognized by the largest cities and industrial enterprises in order to minimize environmental pollution. Attention is drawn to some alternative energy sources and their applications in environmental design and green design. The most effective systems that meet the requirements of environmental design are proposed. The new concept of sustainable design is a multifaceted concept that includes such levels as "harmonious design", "saving natural resources" (wood, water, and energy), "taking care of health" and "people's safety". In other words, it is an optimization of all components of the arrangement of a home, office, and any other object. The authors conclude that focusing on the goal of environmental design, where success is measured by improving the health and well-being of people, other living beings and ecosystems, can contribute to a more sustainable environment that could better adapt to mining, climate change and economic change.

**Keywords:** Ecological design, green design, sustainability, sustainable development, environment, urban environment.

### Resumen

Este documento discute varios métodos para crear un diseño de producto sostenible y analiza proyectos implementados con éxito. La sostenibilidad del diseño se basa en tres componentes principales: social, económico y ambiental. En los últimos años, el concepto de "diseño sostenible" se ha vuelto muy relevante y ha sido reconocido por las ciudades más grandes y las empresas industriales con el fin de minimizar la contaminación ambiental. Se llama la atención sobre algunas fuentes de energía alternativas y sus aplicaciones en diseño ambiental y diseño ecológico. Se proponen los sistemas más efectivos que cumplen con los requisitos del diseño ambiental. El nuevo concepto de diseño sostenible es un concepto multifacético que incluye niveles tales como "diseño armonioso", "ahorro de recursos naturales" (madera, agua y energía), "cuidado de la salud" y "seguridad de las personas". En otras palabras, es una optimización de todos los componentes de la disposición de un hogar, oficina y cualquier otro objeto. Los autores concluyen que enfocarse en el objetivo del diseño ambiental, donde el éxito se mide mejorando la salud y el bienestar de las personas, otros seres vivos y ecosistemas, puede contribuir a un ambiente más sostenible que se adapte mejor a la minería, el cambio climático y cambio económico.

**Palabras claves:** Diseño ecológico, diseño verde, sostenibilidad, desarrollo sostenible, medio ambiente, medio ambiente urbano.

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## Resumo

Este artigo discute vários métodos para projetar um design de produto sustentável e discute projetos implementados com sucesso. A sustentabilidade do design é baseada em três componentes principais: social, econômico e ambiental. Nos últimos anos, o conceito de "design sustentável" tornou-se muito relevante e foi reconhecido pelas maiores cidades e empresas industriais com o objetivo de minimizar a poluição ambiental. Chama-se a atenção para algumas fontes de energia alternativas e suas aplicações em design ambiental e design verde. Os sistemas mais eficazes que atendem aos requisitos de design ambiental são propostos. O novo conceito de design sustentável é um conceito multifacetado que inclui níveis como "design harmonioso", "economia de recursos naturais" (madeira, água e energia), "cuidar da saúde" e "segurança das pessoas". Em outras palavras, é uma otimização de todos os componentes do arranjo de uma casa, escritório e qualquer outro objeto. Os autores concluem que o foco no objetivo do design ambiental, onde o sucesso é medido pela melhoria da saúde e bem-estar das pessoas, outros seres vivos e ecossistemas, pode contribuir para um ambiente mais sustentável que possa se adaptar melhor à mineração, mudanças climáticas e mudança econômica.

**Palavras-chave:** Design ecológico, design verde, sustentabilidade, desenvolvimento sustentável, meio ambiente, meio urbano.

## Introduction

Sustainable (or environmentally sustainable) design is a design that takes into account the interests of the natural environment.

In most cases, the products of "green" environmental design are difficult to classify as beautiful as an aesthetic concept. Green design attracts attention, and there is a feeling of satisfaction and harmony with the awareness of the functionality of the subject. Sustainable design symbolizes the harmonious attitudes between nature and man. By the term "sustainable design" is meant any design aimed not at reflecting harmony, but at being the very harmony of a person's relationship with the non-technocratic world around a human, by the example, the high-touch style in a minimalist improvement.

Many people are negative about products from recyclables; however, the new life of used things in the name of preserving the environment can be wonderful. However, sustainable design involves not only the use of recycled materials, but also the creation of conditions for a good ecological progression, the use of alternative energy sources and new design solutions.

For the first time, the sustainable design and energy efficiency concept entered a broad consciousness following the energy deficit in the 1970s and 1980s. Influenced by the ideas of energy independence, many designers in Europe and North America were looking for ideas and strategies that could help in creating energy efficient buildings and even whole cities. Some of them have explored the environmentally sensitive elements of traditional architecture in

the process of finding suitable design solutions, while others have developed new solutions that utilize the achievements of modern technologies and high-strength materials.

According to the World Commission on Environment and Development, sustainability is "a form of development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Akhmetshina et al, 2017).

Efficient sustainable design is an integrated approach to the selection and integration of products and processes that take into account long-term customer satisfaction and environmental sustainability.

The purpose of this paper is to analyze the basic concepts that characterize sustainable design, history and analysis of areas of modern application in architecture.

The methods of research are theoretical analysis of scientific and philosophical literature on the problem; study and summarize the mass of best practices in the implementation of sustainable design; and also observation.

## Methods

Ecological design is one of the most frequently touched topics in various fields of science that have some bearing on the creation of an artificial environment. The importance of "green design" increases day by day, as the world population increases, and the amount of natural resources decreases (Aktas, 2011). The paradox of our

time is to raise people's living standards while reducing the consumption of natural resources.

Environmental design in many ways contributes to the formation of a careful attitude to the environment: saving resources, striving for the durability of things around a person, as well as creating safe and favorable conditions for the physical and mental health of a person (Pankina and Zakharova, 2012).

Stability is basically a process associated with a product. The observation of sustainable design as a process allows "green" designers to better assess and predict the environmental, economic and social consequences and costs of building products.

Sustainable development is the model of resource use which is aimed at meeting human needs while preserving the environment, so that these needs can be met not only for the present, but also for future generations (Kryukova et al, 2017). The Brundtland Commission came up with this term; it became the most commonly cited definition of sustainable development as development that "meeting the needs of the present generation, without compromising the ability of future generations to meet their own needs."

The Brundtland Commission, formally the World Commission on Environment and Development (WCED) known by the name of its Chairman Gro Harlem Brundtland was convened by the UN in 1983. The Commission was created as a result of growing concern "about the rapid deterioration of the state of the environment, human and natural resources, and the consequences of the deterioration of economic and social development". When creating the Commission, the UN General Assembly recognized that environmental problems are global in nature and determine that it is in the common interest of all countries to develop policies for sustainable development.

Back in the 1970s, the term "sustainability" was used to describe the economy "in balance with the basic ecological support systems". Environmentalists pointed to "limits of growth", and represent, as an alternative, "a stable state of the economy" in order to solve environmental problems.

According to the Oak Ridge National Laboratory, it is necessary to ask the following questions to determine whether a design is sustainable:

1. How long is the service life of the product?
2. Does it save energy?
3. Does it increase the service life of other objects?
4. Does it contribute to the waste stream?
5. Is it renewable and recyclable?

As you know, ergonomics focuses on the study of a person's life space based on the optimal and harmonious arrangement of objects (Akhmetshina and Kadyirova, 2017). The involvement of end-users is one of the key aspects of ergonomics (Rakhimova, 2017). The design of the urban environment should correspond to the average age of residents; take into account the influence of the environment. Each architectural detail can be optimized to provide comfort and user satisfaction (Shove et al, 2008).

The basic principles that underlie environmental design in architectural design and the construction industry are:

- ✓ saving existing material resources;
- ✓ increase energy efficiency of buildings;
- ✓ measures to reduce heat losses;
- ✓ the need for more efficient installations and equipment;
- ✓ providing a hierarchy of premises requiring a different temperature regime and corresponding to each room orientation relative to the countries of the world;
- ✓ the need for renewable energy (solar, geothermal);
- ✓ ensuring the optimal natural ventilation (Shu-Yang et al, 2014).

Planning of sustainable design covers not only specific buildings or systems. It should start with society, at the regional level, include detailed explanations of how people are planned to move inside the urban environment, how buildings will be built and run, how green space will be designed and accessed. Planning for sustainable design requires interaction between the local community, the municipal committee and a project team. Careful integration of infrastructure, public space, forms of development, the natural system are crucial for the creation of sustainable cities. The planning and design process should be inspiring and livable.

Ecological (sustainable) design implies a holistic approach to the design of any objects that are associated with human activities, from miniature objects used in everyday life, to the design of buildings, cities and landscapes (Uvarov, 2010).

The city of Bremen in Germany, having a population of more than 540,000 people, is often cited as an example of a truly integrated and balanced transport system.

Its municipal government controls and coordinates an integration strategy that combines the bicycling means together with the use of cars and taxis at key sites throughout the city. The city integrated bicycling into its standard mode of transportation for both passengers and tourists, provides safe bicycle parking throughout the city, rental, repair and other support in the central streets. The municipality also actively encourages a private campaign to exchange a car for a bicycle.

Cyclists are given priority on the streets of the city. Such a program has successfully earned, that over time led to the fact that 60% of residents move by bicycles, public transport or walk.

As for Germany, this is one of the first countries that introduce a ban on the entry of diesel cars into cities. The problem of air pollution in large cities is familiar to all developed countries. Limits on emissions of harmful substances into the atmosphere have been exceeded for many years in a row. First of all, the high concentration of nitrogen oxides in the air harms human health. It leads to irritation of the airways, diseases of the cardiovascular system and increased mortality. One of the main sources of these harmful substances is diesel engines.

The next vivid example of the use of sustainable design is Hammarby Sjöstad located in Sweden. This place is the restructuring of the former industrial site on the waterfront of Stockholm, after its construction there will live 20 000 inhabitants in an area of 350 000 m<sup>2</sup>, in a new guise, with walkways, biking and hiking areas. Environmental friendliness and economy have come to the forefront in the design of this complex.

Sustainable design can be applied not only in architecture and transport sector, but also in planning public streets. In 1993, the Danish architect Jan Gale began studying the city of Melbourne, Australia, and subsequently made his recommendations for improving their urban environment.

One of the first steps he took was the restructuring of the Business Center into a cultural activity center, what secured a 24-hour format for the city center, from office and commercial buildings to restaurants, bars, clubs and theaters. The sidewalks were replaced by paved sandstone. The street light was modernized using energy saving lamps and supplied with alternative energy sources. Large investments were invested in gardening and installation of small architectural forms. New parks and squares were created. The results of these efforts were staggering; in the period from 1992-2004 in the center of Melbourne there is an increase in residents by 830%, the number of people who began to visit cafe increased by 275%, and the number of those who walked and rest in parks and pedestrian streets increased by 71%. These changes were extremely positive, and progress in pedestrian traffic particularly demonstrated the importance of the public sphere in sustainable design.

Light rail (rapid tram) has become an integral attribute of the urban environment in many countries around the world.

In 1981, the Light Rail line in the city of Calgary, Canada, called CTrain, welcomed the public and now it has the highest passenger traffic in North America. In 2001, it was decided to switch the power source from coal and gas to electric wind turbines. CTrain is already an incredibly effective way of transporting people, the program reduces emissions almost to zero. This is an excellent example of the synergy of transport and alternative energy.

Environmental design is an important concept in a rapidly changing and developing world. In an artificial environment created on the basis of the principles of "green design", the interior spaces are of great importance, since these are the main places for people to stay (Khvorova, 2016).

## Results and Discussion

The need to introduce sustainable design-related developments at the project phase has been discussed for a long time. However, the system approach to include "sustainability" at the early stages of design is still not being applied and is not being considered.

The overall goal is to minimize the consumption of natural resources and energy, and the subsequent impact on the environment. A small number of cities and countries have begun to

introduce "sustainable design" in the objects of architecture, transport system, public and residential complexes, and have demonstrated efforts to develop an environmentally friendly product using various systematic approaches. Development of sustainable design can be achieved only by efforts to integrate economic, environmental and social requirements into the product development process (Hassan et al, 2011).

The environment is affected by social, economic and cultural factors. A city is a product of the history of different periods, and the continuous evolution has made every city a single in its diversity, therefore new developed products of eco-design should be a bridge between the past and the future.

### Summary

Changes in the surrounding world and development are perpetual processes, but the question is how to act today remains quite acute. The direction of sustainable urban development provides us with a new concept that emphasizes factors such as culture, economy and ecology. Change is the driving force of culture, and society, and makes its own adjustments in its own way (Feng and Xingkuan, 2011).

It is important to note that sustainable development includes not only buildings, infrastructure and public places; it also includes the human community and cultural experience. We should be kinder to the Earth and the environment, and pay attention to successful examples of sustainable development of regions taking their experience.

### Conclusion

More and more popularity in the design environment is acquired by projects that include innovative environmental solutions. Today there is a growing demand for projected landscapes - from public parks to the yard of a residential building, so that they are not only beautiful and functional, but also sustainable. Sustainability means not only saving energy and resources; it requires integration into real life and its application. The principles and practical application of sustainable design greatly facilitate rapid and tangible progress in achieving those goals.

There are not so many countries using and implementing the principles of sustainable (ecological) design to date, however, the

successful projects cited in the paper and implemented in Germany, Canada, and Australia give a chance that sustainability in the design of the urban environment will come to the fore, and this is their planning we must start today, because every year the ecological situation in the world will only get worse.

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