Types of ecological relationships in the system “nature, artificial environment, humans”. Peculiarities of modern eco interior development

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Abstract. The article addresses the main ecological trends of the environmental protection in the field of architectural design and construction, which are united under the common name of eco-construction. The article analyses various types of environmental relationships according to the degree of harmfulness of their impact on the artificial environment, nature and humans because of their construction activities. A graphical model is proposed, which clearly demonstrates how ecological relations (harmless, conditionally harmful and harmful) interact with nature, humans and the artificial environment. The human being as a component in the chain of relationships is present in all these spheres; in the artificial environment factor - as motivation and the main driving force, and in the natural factor - as part of its creation, it always balances between nature and the artificial environment. The search for a solution to the global environmental problem has led to the emergence of such concepts as ecological interior and eco-style. Based on the author’s classification, the peculiarities of the formation of a modern ecological interior are explained. The difference between the concepts of ecological interior and eco-style is revealed, a new kind of eco-style is proposed in the classification of eco-directions - pseudo-eco-style, its features are considered.

1. Introduction

The issues of the relationship between humans and nature are the subject of study of such a scientific discipline as social ecology. Social ecology studies the interaction and relationships of human society with the natural environment and is based on the belief that almost all our modern environmental problems come from rooted social issues [1]. However, the qualitative difference between a human being and other creatures is that it is a human being who has these social problems. Moreover, only humans, besides a purely biological, direct metabolism and energy interchange with the environment, have a different type of exchange based on the results of labor activity and material production. The architectural field of activity is the main and the most extensive component of material production in the creation of an artificial human environment.

As a result of burning of all types of fuel (gas, petrol, firewood) the concentration of CO$_2$ is growing. Humans disrupt the carbon dioxide balance by mass deforestation, high industrial activity, increased transportation, urban growth. The Scripps Institution Oceanic Institute has published the latest CO$_2$ measurements taken daily since 1957 on the Mauna Loa volcano. Over the past 100 years, the
concentration of CO$_2$ has increased by 40%, this is the highest level in 650 thousand years. To date, the level of CO$_2$ in the Earth’s atmosphere has reached the highest levels [2]. The growth of CO$_2$ levels leads to global warming, since carbon dioxide, methane, water vapor - greenhouse gases, are the cause of an increase in the global temperature on the planet. This leads to the following: the melting of glaciers, an increase in the number of natural disasters (floods, hurricanes, typhoons, droughts), the extinction of the entire populations of insects, plants and animals. A human being is at the end of this chain and is directly connected with all these processes, continuing to excessively consume and increase in number. It is assumed that in the future the absolute amount of goods will decrease, and the number of buildings will double by the middle of the century, which will lead to the rapid growth of cities. Cities sprawl, capturing arable land, destroying forests and water sources, emitting even more CO$_2$ into the atmosphere.

To stop, or at least to slow down the population growth on the Earth is problematic, if not to say, impossible. The same goes for calls to reduce consumption. There is only one way out - to direct the efforts of mankind to the invention of technological innovations (the use of renewable energy sources and closed environmental production cycles).

2. The specifics of ecological relations between the artificial environment, humans and nature
The ecology of the Earth was taken notice of only in the middle of the last century, and visible efforts were beginning to be made only about 50 years ago. If we compare this half-century with the time span of human existence on the Earth, during which we mercilessly tormented her natural resources, it becomes clear that it is extremely difficult to overcome all the negative outcomes of human activity in the time allotted by nature. Fortunately, the humankind is already beginning to understand that taking steps in this area is vital.

In the contemporary world, scientists of all disciplines conduct researches on the problem of reducing the load of human activities from the natural ecosystem. Let us consider the main ecological areas of environmental protection in the field of architectural design and construction, combined under the general term ecological building, or sustainable building. Its goal is to reduce the level of energy and material resources consumption throughout the entire life cycle of the building: from choosing a site for design, construction, operation, to repair and demolition [3]. At the same time, it is necessary to maintain or even improve the quality of buildings and the comfort of the internal environment. Sustainable building extends and complements classical building design with the concepts of economy, usefulness, durability and comfort with a minimum load on the ecosystem. Among the techniques for designing and operating sustainable building, the following are the most common:

- subsurface buildings (energy costs for heating are reduced since the earth keeps more or less stable temperature throughout the year);
- smooth, streamlined forms of construction (this ensures savings in operation due to a decrease in the building’s resistance to wind load);
- the use of alternative and renewable energy sources (as opposed to oil, coal or gas, they are practically inexhaustible, accessible and do not harm the environment);
- landscaped roofs, facades and interiors (except for the original design, landscaping protects against overheating in summer, plants on the surface of walls and the roof of the house contribute to creating the most comfortable indoor microclimate in any weather, moisturize the air and clean it of harmful elements, improve the quality of the environment by filtering water and air);
- the availability of equipment for the collection, processing and secondary use of rainwater (water scarcity is a global problem for mankind, over 25% of the world population suffers from a shortage of drinking water [4]);
- optimal thermal insulation and orientation (a well-developed system of insulation and orientation with respect to the cardinal directions of the house will save on heating in winter and spend less on air conditioning in summer);
- modern technologies that provide for the reduction of electricity consumption during the construction and operation of a building.
The listed techniques have their advantages and disadvantages. Innovative technologies in sustainable building are being developed and improved. We hope that soon the feasibility of energy saving techniques will increase without harming consumers and, most importantly, the environment.

Considering the problem of conservation of natural resources from the point of view of the relationship between humans, nature and the artificial environment, we conclude that the known methods of energy conservation have different effects on the nature and mankind. If we try to depict ecological relations and bring everything to a single model, we will get a graphic model of the relationship between nature and the artificial environment. (Figure 1). A human being as a component in the chain of relationships is in all of the listed points; on the part of the artificial environment - as motivation and the main driving force; on the part of the natural factor - as a piece of its creation.

**Figure 1.** The model of ecological relationships between the artificial environment, humans and nature.

Thus, a human being balances between nature and the artificial environment created for herself. She cannot exist without them. Moreover, both environments must be loyal to her, that is, not to inflict harm by their impact. Hence the expression "environmentally friendly natural material". The term can be applied both to natural material and to a product from it. The oldest and the most widespread example of human interaction with nature is to take what it can give us (building material, water, air, etc.) and use it for our life. It would be ideal if, after utilization, nature would receive the same clean, non-polluted waste. With a reasonable balance of consumption, humanity would not have environmental problems. However, a couple of centuries were enough for a human being to disrupt the natural balance and face
the threat of its existence. And yet, using sufficient and necessary efforts to clean up the waste of their life, humanity can return to nature at least conditionally harmless waste.

The term “conditionally harmless” waste should be understood as the waste that will not cause any significant harm to the nature, the nature will cope with it over time, using natural self-cleaning. The situation can be improved by reusing building materials. This will save both natural and energy resources.

The next block of energy efficiency techniques is the latest technologies that allow the conservation of natural non-renewable energy sources (gas, shale, peat). Among the list of the most common methods of energy efficiency are: alternative energy sources; modern construction technologies; optimal thermal insulation and orientation; smooth, streamlined forms of construction; maximum recess. The last three depend as much as possible on the will of the designer and will dictate the final architectural solution. Two more techniques from the list of “green technologies” should be considered separately. This is the maximum use of sunlight and landscaping of facades and roofs. Both techniques also actively influence architecture, but at the same time they have the maximum indicator of harmlessness of impact on the natural environment and even strengthen the positive natural factor. In addition to the decorative effect, plantings improve the indoor climate in any weather, increase air quality, saturating it with oxygen and purifying it from harmful elements. The undoubted advantages of vertical gardening are thermal insulation and sun protection, which positively affect the level of power consumption of the building, as well as a significant reduction in noise load [5].

Let us turn to the most controversial method - the use of artificial building materials and products. Artificial materials include brick, cement, reinforced concrete, glass, etc. They are obtained from natural and artificial raw materials, by-products of industry and agriculture using special technologies. During the production of artificial materials, a natural component is also involved, but in much smaller quantities, which means with less damage to the natural environment. It would seem that the ideal option was found, however, it should be remembered that some artificial materials can emit toxic substances during operation, and the production of such materials is based on the release of waste harmful to nature. Any effort to reduce the harmful factor leads to an increase in the cost of production, which is almost impossible in a market economy. In addition to the environmental awareness of the manufacturer, it is necessary to have strict legislation governing this area of production. Let us hope that in the nearest future the new technologies will appear that will make it possible to produce artificial materials without harmful effects on both humans and the environment.

3. Varieties of eco-directions in interior design

However, it should be noted that the harmless human impact on nature as a result of its construction activities is only part of the global environmental challenge. At the center of all efforts and thoughts is the human herself, with her desire not only to not harm the environment, but also to be in an environment that does not have a harmful effect on her health. Such an environment is the interior - the internal area of the building, the architectural and artistic design of which provides a person with aesthetic perception and favorable living conditions [6]. Interior components: the outer shell (floor, walls, ceiling) and subject content (furniture and equipment) ensure the implementation of the functional processes for which this interior space is created. The outer shell and subject content have the same ecological interconnections as in large construction. The search for a solution to the global environmental problem has led to the emergence of concepts such as ecological interior and eco-style. Ecostyle is one of the modern styles in the interior. It includes interiors where natural elements are visually present in one form or another - from natural components of the interior to graphic, outwardly naturalistic natural forms and objects (trees, rocks, sea). However, the concept of "ecological interior" is much broader than the concept of "eco-style". The proposed classification will help to understand the peculiarities of the formation of various environmental trends in interior design. (Figure 2).
Figure 2. Classification of environmental trends in interior design.

Three major branches: eco-style, ecological interior and pseudo-eco-style share common ground and significant differences. Ecological interior is a trend and technology of designing. Essentially, any interior can be ecological if only environmentally friendly materials are used in it. Materials can be
either natural or artificial materials (wood, clay, natural stone, brick, natural stone, glass, textiles, etc.), or synthetic, or artificial ones that do not harm human health. This is probably the main factor due to which the interior can be considered ecological. The ecological effect can be obtained by using the methods already mentioned in sustainable building (streamlined forms of construction, subsurface buildings, the availability of equipment for collecting, processing and recycling rainwater, the use of alternative energy sources). The mentioned methods have a different degree of manifestation in the interior. The interiors of buildings with streamlined shapes with their internal space repeat the geometry of the external. The interior space of subsurface buildings reflects with their geometry the technological feature of construction and non-traditional approaches to its lighting. The availability of equipment for the collection, processing and secondary use of rainwater and the use of alternative energy sources have no special effect on the formation of the interior.

The most striking and expressive ecological technique used by the branches of the "ecostyle" and "ecological interior" is the use of green spaces. With their help, you can not only transform the aesthetic appearance of any interior, but also beneficially affect the general condition of a person. In such a room, the microclimate improves, the air is cleared, it is easier to breathe, better to work, there is a feeling of peace of mind and balance. However, living plants put forward a number of requirements, such as: timely watering, lighting, temperature, the presence of a horizontal surface. Innovative technologies for the production of moss for the interior have come to the aid of designers. Artificially created moss can be placed vertically, and its diverse color scheme gives unlimited possibilities to designers. (Figure 3).
of wood, clay, brick can be obtained on artificial materials as well. This aspect shows the main contradiction between the concepts of "eco-style" and "ecological interior".

There is another powerful ecological aspect where the interior can be considered ecological, although at first glance it does not always look like that. This aspect is the use of recycled materials. Nowadays, innovative technologies for processing production waste and even the food industry are gaining momentum. More and more new, most unexpected offers appear on the market of this segment. The list of materials used for recycling is replenished every year with new, sometimes quite exotic ones (for example, fabrics imitating skin are made from the stomach of a cow). In recent decades, a whole list of architects working in this direction has appeared [7].

Another eco-principle is the use of bionic prototypes, when the forms imitate natural objects and have their own functional purpose. This principle does not provide for direct savings of material or natural resources. Rather, it aims to draw attention to the problem of ecology. The only condition for the manufacture of objects is the use of environmentally friendly, natural materials that do not harm human health. This principle has been named "organic functionalism." Its founder is the Finnish architect Alvar Aalto, whose fruit vase has glorified the style and spread the concept of "Finnish glass" to the whole world. A vase made in the form of curvature, repeating the pattern of the shores of the Finnish lake. The vase has become one of the most famous glass objects and is now in the collections of many museums in the world.

The imitation of natural forms in interior design when designing eco-style can be presented in two different versions. The first is the use of bionic prototypes in an accurate, realistic image. With this approach, the interior goes into the biostyle category. The second approach is the deliberate stylization of bionic prototypes using nature-specific colors and shades. This approach can be called a pseudo eco-style. Although, as mentioned earlier, such an interior can essentially be ecological when it is made from environmentally friendly materials. (Figure 4).

4. Conclusions
The above techniques for the design of the interior in eco-style do not provide for the completeness of possible options. However, the presented classification of eco-directions provides the necessary understanding of the structural relationships of various approaches and outlines some contradiction that arises between the concepts of "ecological interior" and "eco-style." The suggested model of ecological relations between nature, the artificial environment, and humans gives a general picture of the mutual influence of these three components. Such an understanding of the situation facilitates the task of the world community in the struggle to improve the ecological state of our planet Earth.

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