Natural materials in sustainable architecture building system

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Abstract. Modern architecture is increasingly in need of solutions that form a sustainable environment. One of the important techniques is the use of natural materials. The diversity of natural building materials, its uniqueness in terms of both physical and decorative properties, environmental friendliness, ease of use - are undeniable advantages for the formation of sustainable architecture. The article reveals the role of natural building materials both from the point of view of energy efficiency and from the point of view of their role in ensuring the originality of architecture and preserving its connection with the historical and natural aspects. It emphasizes the importance of natural materials as a link between architecture, style and its individuality.

1. Introduction

More recently, architectural structures were built and designed exclusively from natural materials. Natural building materials belonging to a certain natural strip, determined certain trends in architecture and construction. Thus, the architecture of different countries and peoples acquired individual features. Over time, the construction of natural materials more and more improved, and built architectural structures became not only examples of highly artistic craftsmanship. First of all, they were distinguished by durability, reliability, provided comfort and served a man for more than one century. We still have the opportunity to admire the architecture of many centuries ago, dive into its history and draw inspiration from the beauty and uniqueness of ancient buildings.

2. Relevance and significance. Tasks

Modern synthetic materials that have entered the architecture and construction have begun to harm the environment. In addition, the introduction of similar materials in some respects depersonalized architecture of different countries. Consequently, in the age of environmental degradation, lack of resources, destruction of nature, the task of forming an environmentally friendly architectural environment, as well as preserving its identity, becomes extremely important, which is possible primarily with the use of natural building materials [1-5]. Having analyzed the uniqueness of natural raw materials from the point of view of environmental friendliness, we will be able to identify the special role of natural materials in sustainable architecture [6-8].

3. Theoretical part

It should be noted that the construction of natural materials begins to be actively introduced into the modern architecture of many countries. To enhance the natural properties of natural materials and for
the universality of their application, modern technologies are constantly being developed. Some of them are based on the rich experience accumulated over centuries of using natural materials (an example is the construction of straw blocks, etc.) (Figure 1). Other modern technologies make it possible to move to a new level of using natural raw materials (wooden brick, technology for building multi-storey wooden houses) (Figure 2). The strength and environmental friendliness of such structures from natural materials is achieved by a combination of natural properties and the technologies used.

![Figure 1. Thatched roof device](image1)

1- straw (reed), 2- mesh, 3- tile, 4-reed, 5- rail, 6-wire possessive, 7-truss system, 8- wire mounting, 9-gland plate,10-pincher, 11- clamp, plate, 12-rib stiffness, 13-vapor barrier, 14-OSB-list.

![Figure 2. A wall of wooden bricks](image2)

For example, the construction of straw blocks is characterized primarily by high economic performance, since the house of straw panels can save up to 90% of energy, as the architectural company Modcell proves in particular. Dwellings from straw blocks were especially widespread in France, Holland, Switzerland, USA. Along with the design of private houses, straw blocks are also used for the construction of multi-storey buildings.

In housing construction, wood is traditionally used, and wooden houses are steadily in demand due to high consumer properties. Wood is particularly well proven in structures that are exposed to aggressive environments. Interesting the works of the French construction company Brikawood, developing projects of passive houses made of wooden Lego-bricks. Since wooden bricks can have different shapes and sizes, the design provides a wide scope for the creative work of architectural thought.

It is interesting to consider the various properties of basic natural materials used in architecture and construction. At the same time, each of them has special operational characteristics. For example, the strongest are stone, brick, wood. Thermal conductivity is best provided by expanded clay, wood, flax, straw and other materials. For sound insulation in the first place it is recommended to use expanded clay, varliculite; Aluminum powder, drying oil, bitumen varnish are used to protect metals from corrosion. The listed properties of natural building materials are indicators of both energy efficiency and, at the same time, environmental safety. In addition, all these properties are included in the list of estimated parameters for the environmental certification of buildings and the materials themselves. Thus, natural materials are widely involved in creating a comfortable and clean architectural environment [9-11].
The role of natural building materials is not only to maintain environmental sustainability. Forming eco-friendly space, natural materials form various architectural styles. As in nature itself, everything has its own individuality, so houses made of different natural materials bring their own distinctive style to the building. We present the model of a house created in Autodesk Revit, to which we have applied three different materials: wood, stone and straw. Each of the models obtained has its own individual appearance and its own architectural image, which vividly illustrates the above thought (Figure 3).

![Model home. Autodesk Revit](image1)
![Rendering a model with different textures](image2)
![Shibored roof earthen house](image3)
![Wooden house](image4)

**Figure 3.** Formation of various styles depending on the use of materials.

The architectural style of building is very important from the point of view of historical succession. In addition, the old buildings up to the present time is the object of admiration for its beauty and peculiar grace. It is not by chance that in many countries historic quarters are preserved from modern new buildings, and the ancient streets themselves are the pride of the inhabitants and attract the special attention of foreigners. Not uncommon in architecture can be seen an imitation of historical styles. In both cases, it is natural materials that play the role of a bridge between architecture, style and originality (Figure 4).

4. **Conclusions and practical significance**

Thus, natural materials solve the problem of energy efficiency, as much as possible meeting environmental standards; thanks to its own properties and modern technologies ensure the strength and durability of the building; form the exterior of the house, its decorative decision, style; provide communication with historical traditions in architecture; create an environmentally friendly environment that is extremely relevant now[12-16] (Figure 5).

Not so long ago, the construction materials used were environmentally friendly, as they were used in their pure form. Environmental problems associated with the construction process did not exist. The materials used solved only the construction and decorative tasks in architecture, formed the
appearance of the building. Currently, pure "green" materials are used much less frequently, which affects the ecology of the environment, as well as the ecological comfort of the internal space of the buildings being erected. For this reason, great demands are being placed on materials in a sustainable architecture. "Green" materials should not only save energy and conserve resources, but also have the obligation to make the house green. In this is their role. And this role should work for the future.

![Figure 4. Thatched-roof earthen house.](image)

![Figure 5. Natural materials in conjunction with the traditions of different countries.](image)
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