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The Use of Solar Panels in Public Buildings.

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Abstract

This article discusses the currently relevant problem of designing environmentally sustainable objects of the environment, namely with the use of solar panels. The author investigates and analyzes the introduction of solar panels into objects of the environment: provides brief information about the types of solar panels and their design; names the factors that must be taken into account when introducing solar panels into objects of the environment, related to their technological features, and also analyzes the solutions and methods of working with these factors used by architects and designers, using examples of implemented objects.

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Introduction. The use of solar energy today is possible on a variety of scales: from a solar battery in a wristwatch to solar power plants that occupy vast areas comparable to agricultural ones. The introduction of devices that convert solar energy into another: electrical or thermal energy, into the fabric of the urban environment in which people live and interact with, is carried out by specialists in sustainable architecture. Sustainable architecture is architecture, buildings and structures designed and constructed according to the principles of sustainable development [1].

The introduction of devices that convert alternative energy from renewable sources into another energy needed by humans, and accumulate it into environmental objects and architectural elements is precisely at the intersection of engineering and design issues related to aesthetics and architectural image. In this regard, there is a request for a methodology for the design of such objects, buildings and structures; the question of the appropriate harmonious integration of alternative energy devices from renewable sources remains open.

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The use of solar energy in architecture and environmental design has two ways: the first is the introduction of solar panels into objects, the second is solar collectors.

A solar battery is a device that converts the energy of sunlight into electricity [2]. A solar collector is a device for absorbing solar radiation energy and converting it into thermal energy [3]. Simply put, batteries generate electricity, and collectors accumulate and then release heat. Hence the different purposes of these devices: solar panels supply electricity to various devices, mainly lighting, and solar collectors are used to heat water for domestic and drinking needs and heating [4].

In this article, the author explores and analyzes the introduction of exclusively solar panels into environmental objects, since in the field of environmental design their use is more developed than the use of solar collectors. This is due to the fact that environmental objects in those areas where the use of solar energy is more efficient, as a rule, do not require heating.

Today, three types of solar panels are produced:

1. monocrystalline solar panels.

2. polycrystalline solar panels.

3. thin film solar panels.

All solar panels have a modular structure, that is, they consist of modules - photocells.

Monocrystalline photocells are made from single crystals of silicon. They are characterized by a homogeneous, uniform structure. Due to this, they have a higher efficiency compared to polycrystalline and thin-film photocells. Their cost is also slightly higher, which is due to a more expensive production process.

Polycrystalline cells are made from silicon polycrystals; as a result, such cells have a heterogeneous structure and absorb the solar spectrum a little worse. Their efficiency is somewhat lower than that of monocrystalline photocells, but they are also cheaper. In this regard, with the same power, the area of polycrystalline solar panels is larger.

Thin-film photocells are a layer of silicon deposited on a thin substrate - film. These photocells are flexible, so a thin-film photocell solar panel can be installed on curved surfaces. However, they have a significant drawback - their efficiency is approximately 2 times lower than that of mono- and polycrystalline photocells; accordingly, with the same power, the area of thin-film solar panels will be several times larger [4, 5, 6].

Here are the factors that need to be taken into account when introducing solar panels into environmental objects. In other words, these are the tasks facing architects and designers related to the technological features of solar panels:

1. Solar panels have certain dimensions and, accordingly, area, depending on various factors, primarily the minimum amount of energy required for generation and storage. The dimensions of solar panels depend directly on the size of photocells and their number.

It is worth saying that, in principle, the dimensions of solar panels vary quite greatly: from several

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square centimeters to hectares of fields of connected solar panels.

The smallest solar panels are those made of thin-film cells. For example, architect Akihisa Hirata created the installation Energetic Energies for Milan Design Week 2013, composed of thousands of small solar panels with an area of 30 cm^2 (Fig. 1).

Figure 1. Installation of Energetic Energies. Solar panels have a certain shape - rectangular. In this case, polycrystalline photocells of solar panels are a rectangle or square, and monocrystalline ones are a square with beveled corners. They are more fragile, and this shape allows you to avoid a large number of defects in production - chipped corners. Solar panels on a thin-film basis can theoretically be of any

shape, but focusing on consumer requests, manufacturers produce such solar panels of an elongated rectangular shape - they usually cover the roofs of houses. Therefore, only rectangular solar panels are available on the market, but architects and designers have the opportunity to fit a rectangular solar panel into elements of an object of any other shape (Fig. 2).

Figure 2. Possible and impossible options for working with the shape of solar panels.

2. Solar panels have a certain color, which is determined by the natural color of the semiconductor material used in the system.

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Typically, silicon is used as a semiconductor; its color varies from dark blue to bright blue depending on the production method (monocrystalline and polycrystalline) [5]. Also, the color of a solar panel is affected by impurities added to the silicon - usually boron, which is brown, silver-gray or black [7], and arsenic, which is black [8].

In addition, solar panels can be translucent - those consisting of thin-film photocells. The small thickness of the semiconductor layer (silicon with impurities) deposited on a thin transparent substrate makes the photocell translucent, but with the same dark tint that mono- and polycrystalline photocells have.

3. Solar panels must be installed at a certain angle and must be oriented towards the Sun.

There are two options for installing solar panels: permanently and with a solar tracking system.

If the solar panel is installed permanently, then it should lie in a plane perpendicular to the rays falling from the average trajectory of the Sun per year in a given area (Fig. 3). In fact, the angle of inclination of the solar panel plane coincides with the geographic latitude of the area.

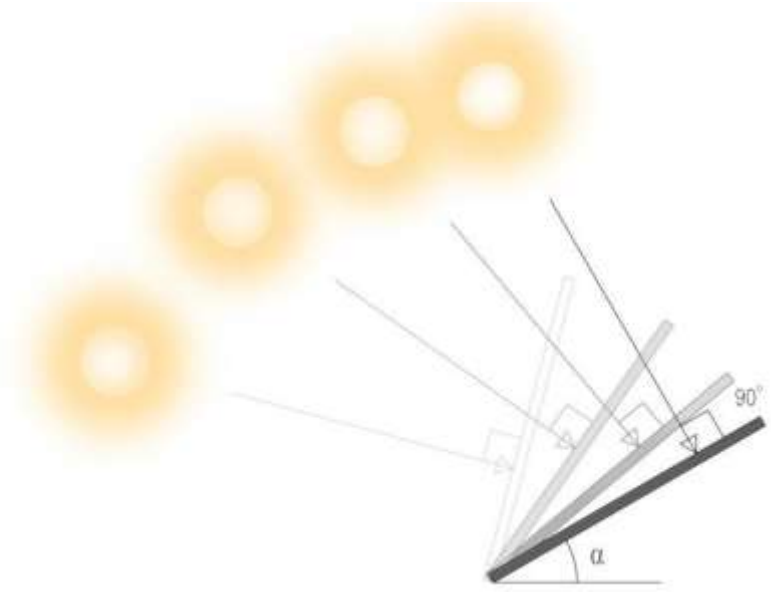

Figure 3. Dependence of the inclination angle α of the solar panel on the latitude of the area.

Solar panels are oriented predominantly to the south. It is also possible to orient the panels to other sides of the world - along an arc from east to west. But in this case, do not forget about the decrease in the efficiency of solar panels.

Conclusion.

The most important aspect in sustainable architecture and construction is the environmental friendliness of the building, its energy efficiency and autonomy, which allows you to develop a project in a variety of places and not depend on city networks. The independence of an object can significantly simplify our lives and improve the environment.

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