

**Article Arrival Date**  
26.02.2024

**Article Type**  
Research Article

**Article Published Date**  
20.06.2024

## SMART AND GREEN TECHNOLOGIES IN BUILDING AND URBAN PLANNING

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### Abstract

The technological development that is increasing in the world has its influence on all sectors. One of these areas is the tourism industry. Effective use of technological capabilities is important for providing the best urban planning in tourism. The paper aims to study the use potentials of smart and green technologies in the urban planning of tourist complexes.

Currently, the main goal of developing tourism in the region is to make tourism one of the leading areas of the economy. As it is known tourism is one of the most profitable areas in the world. Azerbaijan has enough favorable potentials and opportunities for the development of tourism. It is possible to turn tourism into the most developed industry. There are natural, geographical, technological, social, and other factors that encourage the development of tourism.

The article shows the importance of the transition from traditional technologies to green technologies in projects implemented in the sustainable modern construction sector, and also identifies important factors and problems in the use of green technologies in urban planning. The criteria that make a building “green” are discussed. The impact of “green” construction on the environment, ecology and economy is analyzed. Sustainable design principles are proposed using the example of tourist complexes in the Sheki - Zagatala economic region of the Republic of Azerbaijan.

**Keywords:** “Green construction”, renewable energy sources, smart cities, ecology, solar energy, tourism complex.

### 1. INTRODUCTION

“Green building” involves the construction and operation of buildings without impact on the environment. Currently, the “green building” industry is an intensively developing part of construction [1]. Its main task is to reduce the level of consumption of energy and material resources over the entire life cycle of a building - selection of a design site, construction work, operation, repair, demolition, etc. Important criteria in “green building” are saving water and energy, using environmentally friendly and renewable building materials, minimal impact on the building site during construction, proximity to transport systems, natural lighting and ventilation.

In “green building”, waste is recycled, disposed of, insulating materials and alternative energy sources are used, waste warm air is used for heating, etc. The main goal of “green building” is to reduce the negative impact on the environment by reducing the amount of waste, increasing energy efficiency, improving design for reducing the amount of resources consumed, etc.

In addition, “green construction” provides another goal - improving the quality of construction, materials and comfort of the internal environment.

One of the principles of “green building” is that the design of the construction site as a whole is related to the environment. It is very important to take into account the location of the construction zone, and it is also necessary to take into account that the building can be integrated with local or regional transport networks, connected to city water supply systems, electricity, gas, etc.

Engineers and scientists around the world are developing technological solutions to reduce and eliminate all causes of global warming and climate change.

Today, “green construction” has entered a stage of exponential growth. For wider dissemination of green energy technologies and concepts such as “green building”, green energy standards and requirements need to be developed and certifications applied. Tens of thousands of buildings in 135 countries around the world undergo green certification. The total area of these buildings exceeds 1 billion square meters.

The advantages of “green building” technologies include all areas of bioclimatic technology. Such houses are considered economical, since the owners of such houses will be able to save on heating, water and electricity bills. In addition, eco-facilities have unusual green spaces on their facades.

The main disadvantage of green construction is the price - the introduction of innovations is often more expensive than traditional technologies, but in the future, during operation, the cost of providing buildings decreases.



Fig.1. Dependence of the cost of “green construction” on time.

In the near future, “green standards” will be a mandatory norm from the point of view of legislation and vital necessity.

## 2. APPLICATION OF GREEN TECHNOLOGIES FOR EFFICIENT USE OF ENERGY

## ON CONSTRUCTION SITES AND URBAN PLANNING

“Green technologies” applied in urban planning and construction have a great impact on the environment, and this technology has become an integral part of sustainable construction projects [2,3]. It is efficient and universal, bringing significant benefits when used on projects built on both innovative construction projects and existing structures. The main purpose of the article is to show the importance of the transition from traditional technologies to “green technologies” in projects implemented in the sustainable modern construction sector, as well as to identify important factors and problems in the use of “green technologies” in urban planning.

Solving sustainable design problem is very important in construction, and energy efficiency can be improved by eliminating unnecessary energy use and reducing energy costs by up to 30%. In most developed countries, such as the USA, China and the UK, construction work is increasingly being carried out using green technologies. Since the 21st century, the greatest attention has been paid to sustainable development. This confirms that the application of green technologies in construction projects is key to achieving sustainable development goals in any country.

In order to get the most out of green technologies, the following factors are necessary:

1. Construction work must be carried out using specially produced building insulating materials and minimize heat and energy losses of buildings and structures;
2. Intelligent systems and sensor control should be used in heating, hot water supply and energy supply of the apartment using high technologies. These intelligent control systems will help reduce energy and heat losses precisely through effective management;
3. An important factor is also the quality of the building materials used.

Building materials and “green technologies” selected in accordance with the requirements of the standards managing this area will remain effective for a long time.

In order to further improve the standard of living in the globalized modern world, taking into account maximum protection of nature without harming the environment, new ideas appear every day, projects “ecosystem”, “smart villages”, “smart cities”, “smart houses”, “warm houses”, etc. are applied.

A "green building" is a building that, when designed, constructed or operated, reduces or eliminates negative impacts and can have a positive impact on the environment. Green buildings protect valuable natural resources and improve quality of life. The use of smart and environmentally friendly technologies makes life even more efficient.

There are a number of features that can make a building “green”. There are 10 examples of green technologies. These include:

- Application of green building technologies in construction projects. Use of insulating materials to reduce heat and energy losses;
- Efficient use of energy and water resources through the use of energy and water saving technologies;
- Self-sufficient buildings using “green technologies”: use of renewable energy sources such as solar energy, wind energy and wave energy (hydropower);
- Actions to reduce pollution and reduce waste, waste management, ensuring reuse and recycling, the principle of “Waste to Energy”;
- Wastewater treatment and management;
- Elimination of industrial emissions;

- Cars that do not emit gas;
- Improving indoor air quality;
- Use of non-toxic, environmentally friendly materials;
- Taking into account the environment and quality of life of residents during design, construction and operation;
- Designing to adapt to a changing environment.

### 3. SUSTAINABLE DESIGN PRINCIPLES

Solving sustainable design problems includes principles of sustainable development in the field of ecology, economics, social sphere, etc., which should be used in standard design guidelines (Fig. 2).

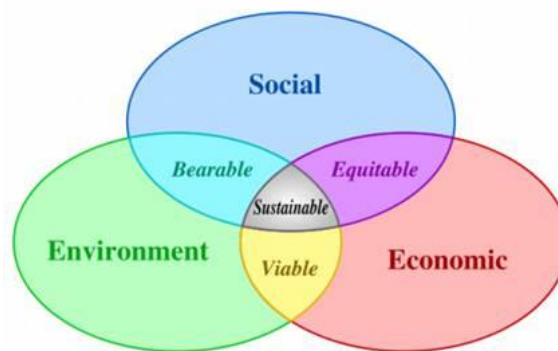


Fig. 2 Components of sustainable design

Of course, environmental principles and requirements must also be taken into account during construction and energy supply. To ensure the balance of the ecosystem, it is necessary to control the influence of climate, to protect biological species, to preserve genetic diversity in ecological principles. Anticipating these principles explains how ecological design principles are effective when the natural system becomes the basis of the design, thereby creating efficient, healthier, and less toxic and more sustainable buildings, landscapes and technologies.

Human rights and nature coexist. Therefore, interdependence must be taken into account. Any design decisions must be accountable, ensure safety by eliminating design waste, create sustainable value, but recognize design limitations.

It is known that when the structure of non-recyclable materials used in construction breaks down, a lot of capital is required for production, application and waste generation. This waste creates landfills. However, the requirement to build a very large incinerator is not cost-effective. As a result, it is less efficient, non-toxic and durable in construction work.

Selecting materials that have been formed or processed through a lower energy process is critical. In addition, the use of less energy-intensive and energy-efficient industrial materials in construction can help reduce the greenhouse effect by minimizing greenhouse gas emissions. Energy-efficient materials are vital not only for workers, but also for the environment. Because non-renewable and traditional energy sources are expensive and pollute the environment. In construction, it is best to use materials that can be reused and recycled. Therefore, materials, methods and systems must be designed to provide market value for recycled materials from construction waste. In addition, durability must be of the highest quality materials construction.

Sustainable design principles used to solve tourism and urban planning problems should be followed:

- The building must be designed as efficiently as possible and provide a comfortable environment for tourists - office areas must have 100% access to daylight, year-round fresh air and views of the city.
- Achieving energy efficiency through advanced architectural design (layout and building form), natural ventilation systems, efficient lighting and automated control systems;
- Providing energy for alternative modes of transport, special bicycle parking and charging stations.
- Use of an efficient sewerage system, drip irrigation and leak detection system for efficient use of water;
- Providing a magnificent landscape and biodiversity with the flora of other regions with the same climate; the new ecosystem enriches the territory, gives it aesthetic appeal, etc.

#### **4. THE BEST "GREEN TECHNOLOGIES" IN NEW AND EXISTING CONSTRUCTION**

The use of green technologies in construction is an efficient way to use resources that can achieve energy efficiency, waste reduction and sustainable development. Today, there is a wide range of renewable building technologies that can directly contribute to the high performance of a building. For example, cool roofs are specifically designed to reflect the sun's rays. Cool roofs reflect more sunlight than any regular tile roof. This prevents hot or cold air from entering the very top of the building. In the summer, under the scorching sun, the temperature of dark tile roofs can reach 65.5 degrees Celsius. The reflection of a cool roof can reduce this temperature by more than 50 degrees. Reducing roof temperatures is definitely a benefit.

There are different principles of ecological building design:

Todd's Principles:

1. Design must follow the law of life, and not vice versa;
2. Biological equity must be taken into account in design;
3. Renewable energy sources should be used;
4. The concept of design constraints must be well understood;
5. The design must demonstrate compliance with the bioregionalization concept;
6. Responses to climate change must be carefully considered.

Hanoverian principles:

1. Use of low-toxic or non-toxic materials;
2. Use of energy-saving materials;
3. Waste disposal should be a major focus of the project;
4. Dependence on natural energy flows;
5. Acceptance of responsibility for any consequences of design decisions.

Other principles:

1. Use of reusable and recyclable materials;
2. Materials must be developed taking into account market prices for secondary materials;
3. Durability should be the highest quality of design. Design must harmonize with nature and the environment and complement each other.

Any building of hotels, tourist complexes, sanatoriums, holiday homes or any other structure that has the characteristics listed above can be a "green building".

However, it should be noted that not all green buildings are created equal. Different countries, different regions, regional climate conditions, unique cultures and traditions, different types of construction, timing of production or broad environmental, economic and social priorities each create a different approach to “green building”.

### 5. PROSPECTS FOR THE CREATION OF “GREEN TOURIST COMPLEXES” IN THE SHEKI-ZAGATALA ECONOMIC REGION

“Green technologies” are already being used by construction companies in Azerbaijan [4]. For the first time, the Azerbaijan Diplomatic Academy presented a “green campus” project in this region. The Fairmont Hotel and Baku White City in Azerbaijan have also been certified according to “green” standards. The office building of the State Oil Fund of Azerbaijan SOFAZ Tower was built according to “green” standards too.

It should be noted that Azerbaijan experiences 9 of the 11 climate types available in the world. The main climatic factors influencing architecture are wind, sun, air humidity. These factors must be taken into account in the architectural design and construction of all buildings and structures.

The Sheki-Zagatala economic region in Azerbaijan, due to natural geographic factors, cultural and historical heritage, and excellent climatic conditions, is a promising area for tourism development. This economic region includes four administrative regions: Sheki, Gakh, Zagatala and Balakan. It should be noted that, despite these conditions, the tourism sector here is not developed compared to other regions. Especially the Zagatala and Balakan regions, having excellent opportunities for the development of tourism, do not have a single sanatorium or recreation area, and there are a very small number of hotels in the region. It is necessary to develop infrastructure to create conditions for the urban planning organization of tourist complexes, taking into account green and smart technologies [5-8].



Fig.3 Sheki - Zagatala economic region

Taking into account the principles of sustainable design used to solve the problems of designing hotels and tourist complexes in the Sheki-Zagatala economic region, it is possible to create a comfortable and environmentally friendly condition for tourists’ recreation. Designing “green tourist complexes” in the Sheki-Zagatala economic region requires an individual approach to its implementation.

The application of the above “green technologies” in the urban planning organization of tourist complexes in the Sheki-Zagatala economic region, as well as in the construction of hotels and

recreation complexes in the region will lead to the development of tourism, the flow of tourists to this region, and most importantly to the cleaning of the environment.

## 6. CONCLUSION

The article analyzes the role of “green construction” in the planning of buildings of tourist complexes as well as urban planning. The design of facilities, including tourist complexes, is generally related to the environment. It is necessary to take into account the location of the construction area, and it is also important to consider that the building can be integrated with local or regional transport networks, connected to city water supply systems, electricity, gas, etc.

The criteria that make construction “green” have been defined: the use of insulating materials, the efficient use of energy and water resources, the use of renewable energy sources, the reduction of pollution and waste, the use of non-toxic, environmentally friendly materials, etc.

The impact of “green building” on the environment, ecology and economy is shown. Based on existing principles of ecological building design, measures are proposed for the sustainable design of tourist complexes in the Sheki-Zagatala economic region.

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