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**THE RESEARCH ON GREEN BUILDING DEVELOPMENT IN ARMENIA***Atanes Papoyan, Changhong Zhan*

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The paper is predetermined by the fact that educational reform in the field of green building sector cannot be completed without doing a deep research about green architecture for Armenia, with providing the necessary conditions for life and work. At the moment, around the world, the new requirements of a human being are to provide the safety of climate, ecology. Doubtless, this has an influence on the national economy and governance in any condition since protection of the environment related to economic security is an essential part of security at the national level.

**Keywords:** green building; Armenia; evaluation system; green technologies; energy efficiency; LEED; BREEAM.

**ИССЛЕДОВАНИЕ РАЗВИТИЯ ЗЕЛЕННОГО СТРОИТЕЛЬСТВА В АРМЕНИИ***Атанес Папоян, Чжань Чанхун*

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Работа предопределена тем фактом, что реформа образования в области зеленого строительства не может быть завершена без глубокого исследования зеленой архитектуры Армении для обеспечения необходимых условий для жизни и работы. В настоящее время во всем мире новые требования человека заключаются в обеспечении безопасности климата, экологии. Несомненно, это оказывает влияние на национальную экономику и управление в любых условиях, поскольку охрана окружающей среды не только напрямую связана с экономической безопасностью, но и является неотъемлемой частью безопасности на национальном уровне.

**Ключевые слова:** зеленое здание; Армения; система оценки; зеленые технологии; энергоэффективность; LEED; BREEAM.

**Introduction.** There is no doubt that with the progress of mankind, culture cannot constantly develop linearly or according to a single, universal scheme. The reference point of modern architecture is the realization of the ideas of new spaces, using new materials and the latest high technologies. Modern designers and architects create and develop urban space, continue to change in all possible options and directions.

At present time in many countries, the meaning of “green building” is not quite clear. The author of this work, based on the basis of the historical materials and field studies, was able to collect a lot of information. Green building is a qualified project of heat preservation, ventilation systems, water conservation inside the building. Contemporary ventilation systems allow you to purify the air within the building, to avert the ingress of dust and its circulation of detrimental volatile matters, allergens and microbes [1]. Water conservation makes it possible to collect rainwater. The result of this is that rainwater is collected on the roof and used to water crops and other everyday necessity [2]. To preserve the heat inside the building and prevent it from superheating, facades are lined with repulsive panels [3, 4].

Buildings play an important role in meeting the challenge of sustainability. In developed countries, buildings consume more than 70% of the electricity produced and 40% of the primary energy. 75-90% of the buildings currently in operation worldwide will still be in operation by 2050, and in addition, developing countries need to address the housing needs of 2.4 billion new urban dwellers. These challenges and others were addressed during the "Most Energy Efficient Buildings" workshop in Yerevan on November 21-22, 2019, convened by the United Nations Economic Commission for Europe (EEC) and the United Nations Development Program (UNDP) Armenia Office, as well as the Passive House with the support of the International Association (IPHA) and the Passive House Institute. The purpose of the event was to inform industry professionals about the specifics of building design, targeted building materials and special construction methods, as well as new practical methods and approaches to heat insulation, thermal bridges, air quality and heat recovery. As a result of a series of panel discussions and networking, as well as separate workshops for technicians, more than 80 participants gained insight into the principles, experience, and challenges of building energy-efficient buildings in Armenia. The local team of the GEF project in Armenia also took part in the discussions on financing and business models taking into account the environmental and social impact.

Investing in energy-efficient buildings, whether it is new construction or complete renovation of an existing building, has great but untapped potential for jobs, growth, and a transition to a "low carbon" society. Energy efficient investments in buildings in Armenia can be achieved through legal acts, mobilization of private finances, as well as through the use of sustainable and innovative financing mechanisms.

**Green Building Technologies.** Energy saving and renewable energy are relatively new concepts in Armenia. A few years ago, Armenians were skeptical of both the financial and environmental benefits of green technologies. Now it is difficult to find an Armenian village, at least without solar water heaters. In recent years, the Green Growth Fund (GGF) and the European Union (EU) have been actively promoting the development and dissemination of energy efficiency and renewable energy in Armenia. GGF is an EU-funded specialist fund that promotes energy efficiency and renewable energy in neighboring EU countries, including Armenia. In addition, a number of EU-funded projects are supporting the country by expanding its energy-saving and security capabilities. GGF provides special financing to businesses and households by partnering with financial institutions (banks, credit organizations, leasing companies) to provide further lending to their clients. Since 2012, 4 Armenian financial institutions have been cooperating with the fund. GGF has also provided technical assistance to these companies to build capacity, save energy, raise awareness of renewable energy, design credit products, and promote them in the local market. The EU is actively promoting energy efficiency and employment opportunities for small businesses in the region. In total, Armenia has received more than 41 million euros from the EU through GGF for energy saving and renewable energy financing.

The thesis is predetermined by the fact that educational reform in the field of green residential building sector cannot be completed without creating an efficiently functioning adaptation model for Armenia, providing the necessary conditions for life and work [5]. The foregoing requires a systematic study, generalization and critical rethinking of the existing residential building experiences with a full theoretical justification for adapting the methodology of green technologies to regional circumstances [6]. On average, each family needs 120-240 liters of domestic hot water per day. This demand can be met without burning fossil fuels and greenhouse gas emissions. The principle of operation of the solar water heater is that water passes through a collector or panels that heat the water. The solar water collectors vary in size, construction, specifications, service time and cost. They can be with flat and vacuum tubes. Photovoltaic converters use the effect of photo-electricity when the sun's radiant energy is converted to

electricity, bypassing the intermediate phase of heat energy generation. In photovoltaic cells, the radiation of AR is converted to a constant current, the magnitude of which depends on the flux of the radiation. Such a typical home system usually has a peak power of 1.5 to 3 kW.

In these days of ecological crisis, "green" has become a symbol of energy-saving, environmentally safe construction. BREEAM (Building Research Establishment Environmental Assessment Method), established by the British company BRE Global in 1990, is one of the leading systems for environmental assessment and classification of "green" buildings in the world. More than 200,000 buildings outside the UK have received BREEAM certification, and around 1 million are in the process of being certified.

By the way, the BREEAM certificate was first brought to Armenia by the Dilijan International School, which has been operating since 2014. Obtaining a BREEAM certification implies the provision of high standards in the three main stages of the structure: design, construction and post-construction.

Armenia's first BREEAM-certified building is an earthquake-resistant international school. The environmentally friendly UWC Dilijan College (Figure 1) earned an international BREEAM "Good" rating for its design, but also focuses on encouraging collaborative learning and promoting self-motivated learning with attractive and welcoming architecture.

London-based Tim Flynn Architects designed the international school to work in harmony with the environment. Green roofs and living walls made from native vegetation cover large sections school's main academic building to beautify the structure and tie the building back to its surroundings in the National Park of Dilijan [7].

A natural materials palette integrates the modern academic structures into the natural environment. Armenia's famous local tufa limestone was used as the main building material and is complemented by 4,750 square meters of landscaping on the wavy, mountain-inspired roofs and 1,500 square meters of living green walls on the facade. Non-standard lawn and native plants were used to vegetate these areas so that the building will change appearance as the seasons change.

The interior is filled with natural light and centered around two atria. Since UWC Dilijan College is built in a seismically active zone, the school is designed with earthquake resistance in mind. A drainage system was installed on-site and retaining walls were built to protect against landslides.



Fig. 1. UWC Dilijan College (Armenia)

UWC Dilijan College demonstrates the best of diversity of roof and wall landscaping opportunities, taking into account environmental education issues.

It is important for the Armenian economy to adopt an energy saving policy and apply measures to it. Energy saving is the key element that can ensure the targeted and efficient use of the supplied energy.

Depending on the import of too much fossil fuel, electricity, which is not used by the citizens, enterprises and infrastructure of Armenia, is the cheapest, cleanest and safest energy resource.

The policy of the Government of Armenia is to promote energy efficiency in all economic spheres, in accordance with the provisions of the Law on Energy Saving and Renewable Energy (2004), as well as the National Energy Saving and Renewable Energy Program (2007), the Action Plan of the Government of the Republic of Armenia. (2010), Presidential Decree approving the Electricity Security Concept of Armenia (2013), Electricity Safety Action Plan for 2014-2020 (2014) and long-term (up to 2036) development paths of the Armenian electricity sector (2015) in the documents existing processings. In addition, on February 2, 2017, the Government of Armenia approved the Second Energy Saving Action Plan for 2017-2018. The amendments to the Law on Energy Saving and Renewable Energy include some minimum energy saving requirements. According to the amended law, economic sectors are classified according to their level of energy consumption (high, medium and low) and mandatory requirements for energy saving and energy management are set for new buildings and state-funded construction or reconstruction.

**Conclusion.** The research of further implementation is to provide a knowledge base that helps architects, engineers in the future when designing green buildings and improving the internal environmental quality, through the development and application of design building mechanisms in acute failure and improve housing depreciation, limited financial resources, existing in Armenia. The initial phase of the research identifies a detailed description of the standard drivers expected in new projects for residential buildings.

At first, it was difficult to introduce green technologies to customers because they were skeptical. However, seeing the success stories of neighbors and relatives, they wanted to try. Energy-saving technologies, among other things, beneficially affect the financial flows of citizens. To be responsible to our Earth, we all need to use eco-efficient equipment that not only promotes production but also reduces emissions, as well as being safe for the environment.

The potential for energy efficiency in all sectors has been repeatedly assessed and remains high, despite the relatively low energy consumption of the economy. Whether laws have been passed and policies adopted to promote efficiency through various programs, the opportunity to improve energy efficiency is not being fully exploited. Along with the rise in energy prices, the urgency of using energy saving in the entire economy of Armenia is also increasing.

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