https://doi.org/10.59849/2310-5399.2024.4.44
UOT 7.05

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"GREEN WORLD" SOLIDARITY IN PRESERVING ARCHITECTURAL MONUMENTS

Abstract. The article highlights the significance of ecological factors and «Green World» solidarity in preserving architectural monuments. It examines the impact of climate change on historical structures, including material erosion, natural disasters, and other environmental challenges. The use of sustainable approaches, such as renewable energy sources, is proposed to enhance the resilience of monuments. The article also emphasizes the role of tourism, integration of natural landscapes, and sustainable development concepts in preserving cultural heritage.

Key words: architecture, ecology, climate, restoration, energy

Introduction. The successful hosting of COP 29 by Azerbaijan, under the theme «Solidarity for a Green World,» once again emphasized the importance of unity in addressing global climate change. Climate change continues to impact all aspects of the world we live in. Considering the human factor as the primary element, the effects of these changes on human life are vividly evident.

Today, one of the pressing issues is the impact of climate change on the preservation of architectural monuments that bear the marks of human history. Monuments and ecology are two interconnected and mutually influential fields. Historically, architectural heritage, constructed with consideration for landscape and climatic features and categorized into architectural schools, is now gradually deteriorating under the influence of climate change. Temperature fluctuations, in particular, accelerate the erosion of construction materials, causing negative effects.

The role of ecology in monument preservation encompasses many modern-day challenges and can be evaluated in terms of both protecting the natural environment and safeguarding cultural heritage.

1. Protection of the Natural Environment: Architectural monuments are often closely tied to their natural surroundings. Ecology helps ensure the sustainability of ecosystems in the areas where these monuments are located. Protecting the ecosystem also aids in the preservation of monuments, as disruptions to natural conditions (e.g., rising or falling temperatures, increased precipitation, pollution, or soil erosion) can lead to the rapid deformation of these structures.

2. Climate Change and Monument Resilience: Climate change has a significant impact on natural and cultural heritage worldwide. Many monuments that have withstood the test of time, especially those that are more vulnerable, may suffer damage due to these changes. Global warming, rising sea levels, stronger storms, and extreme weather events can adversely affect the physical condition of monuments.

These environmental factors gradually cause significant structural and visual changes to monuments:

a) Rain and Humidity: Rain and moisture lead to corrosion and erosion of construction materials, fostering the growth of fungi and algae on surfaces, which in turn affect the quality and deterioration of stone. These effects result primarily from humidity, water exposure, frost, sunlight, and washing caused by precipitation. In summer, extreme heat, and in winter, freezing cold, cause the expansion and contraction of building materials used in the construction of monuments. Rain and snow seep into cracks, weakening the materials and accelerating shrinkage and cracking. Rainwater infiltrates these cracks and small openings, creating foundational issues for the structure. Over time, this can lead to the collapse of walls and, eventually, the entire structure.

Weathering from Efflorescence: Salt-based materials (sulfates, carbonates, nitrates, etc.) penetrate porous limestone along with water. Once the water evaporates, salts remain within the stone. While the crystallization primarily occurs on the surface, the remaining deposits are known as efflorescence. This phenomenon is common in Azerbaijan's warm climate zones due to high evaporation rates. Even when evaporation occurs rapidly on the surface, the rate of evaporation often exceeds the material's ability to absorb water into its capillaries. In such cases, salt-based

materials accumulate beneath the surface layers and crystallize, leading to the formation of cracks.

Weathering from Freezing: This type of degradation occurs when small ice crystals penetrate cracks and openings. As water freezes due to frost, it expands, causing the cracks to widen. The repeated occurrence of this natural process leads to an increase in cracks, eventually resulting in the collapse of the monument.

Corrosion-Induced Metal Decay: The use of metal in the restoration of monuments has become common in modern times, but it can lead to corrosion between the metal and the surrounding materials. Metal reacts with water, losing its properties, and the most common reactants—such as oxygen and liquid chlorides—accelerate the corrosion process. Corroded metal, in turn, exerts a destructive effect on the stone.

Damage Caused by Atmospheric Pollutants (Pollutant Gases): In urban environments, monuments are exposed to wear and tear caused by atmospheric pollutants, such as carbonates and silicates, generated from fuel emissions. These pollutants negatively affect construction materials, leading to the gradual degradation of the monument.

Wind Effects: Monuments exposed to wind experience erosion, particularly in areas along the Caspian Sea coast. The strong Khazri wind carries sand and small stones, striking the facade of monuments and causing surface abrasion. When rain and wind occur simultaneously, the windward side of the wall is subjected to intense, angled rain. In addition to washing away particles, the mechanical impact dislodges fragments from the wall's surface, causing them to fall away.

Material Degradation from Sun Exposure: In summer, extreme heat—exacerbated by a 1.5-degree temperature increase in recent years—causes construction materials to expand during the day. At night, cooler temperatures trigger contraction. This repetitive physical process over extended periods accelerates the formation of cracks in the monument's structure and the deterioration of material quality.

Earthquake Damage: Another cause of material degradation is earthquakes. Vibrations and shifts in geological layers generate waves that move the walls, disrupting their balance. The reaction to these vibrations shakes the walls, and if mortar is insufficient, the walls may collapse. This issue is particularly pronounced in older structures with minimal plaster. Climate change-related factors have contributed to an

increase in earthquake frequency. Historically, in the seismic region of Shamakhi, hundreds of rare monuments have suffered damage or complete destruction, with the city itself being entirely devastated in the Middle Ages and the 1830s.

Damage Caused by Living Organisms: One of the reasons for the deterioration of monuments is the nesting of insects and birds in cracks and openings. The damage stems from the waste products of these insects and birds. The materials used by birds for nesting and the acids in their waste react with construction materials, causing unexpected damage to the monument. This was observed during the 2012-2013 restoration and conservation of the Maiden Tower in Icherisheher. Birds nesting between the weathered stones of the centuries-old tower had contributed to their erosion over the years. To address this issue, conservation work using the «vacuum» method was carried out on the tower's walls, and birdhouses were constructed nearby as an alternative.

Impact of Vegetation: While greenery positively contributes to improving the environment, design, and reducing carbon emissions, uncontrolled vegetation growth can sometimes negatively affect the integrity of architectural monuments. Castles and Christian temples built deep in forests or mountainous areas often face neglect, leading to uncontrolled growth of trees and shrubs. Trees growing within monuments damage foundations with their roots, load-bearing walls, and roofing structures with their sprawling branches. Unfortunately, addressing such vegetation issues can only be undertaken by the Ministry of Ecology. In general, large trees should be planted at a certain distance from buildings, in accordance with regulations, depending on the tree species.

External ecological factors, even a few of them, can significantly impact immovable cultural heritage over time. The relationship between architectural monuments and green energy is one of the critical topics of modern times. This connection is essential for finding solutions that preserve historical and cultural heritage while promoting environmental protection and sustainable energy use.

3. Renewable Energy Sources:

Improving heating and electrical systems in buildings reduces energy consumption and lowers carbon emissions. Equipping architectural monuments with green energy not only demonstrates environmental responsibility but also ensures their preservation for future generations. This approach aligns

with contemporary demands while showing respect for history. Renewable energy sources, such as solar panels, wind turbines, and geothermal energy, can meet the energy needs of historical buildings. This ensures that the original character of the monuments is preserved while making energy usage more efficient.

An example is the “Smart City” and “Smart Village” projects related to the «Great Return» initiative in the Karabakh region. Applying solar panels to monuments can provide interior and nighttime lighting, offering both economic and ecological benefits. However, such implementations must not compromise the monument’s appearance. Panels should be installed discreetly, such as on rooftops where they remain invisible. Examples from global practice include the Louvre Museum in Paris, the Colosseum in Rome, Sheikh Zayed Mosque in Abu Dhabi, the Railway Station in the UAE, and in Azerbaijan, the GobustanNational Historical and Artistic Reserve, Maiden Tower, and the Quba Genocide Memorial Complex.

4. Green Roofs and Facades:

Adding green roofs and plant-covered facades to historical buildings can both visually revitalize these structures and support the ecosystem. Green roofs not only enhance the energy efficiency of buildings but also improve thermal insulation and positively influence urban climates.

5. Environmental Protection and Natural Beauty:

Architectural monuments play a crucial role in preserving the natural environment. Monuments built in harmony with natural landscapes become part of cultural heritage by integrating both aesthetically and functionally with their surroundings.

6. Choice of Construction Materials:

The ecological aspects of the materials used in the restoration and preservation of architectural monuments are of great importance. Selecting eco-friendly and sustainable materials ensures the longevity of monuments while minimizing harm to the environment.

7. Tourism:

The role of ecology in the preservation of architectural monuments also extends to the tourism sector. Protecting historical sites promotes the development of sustainable tourism practices, attracting visitors while maintaining ecological balance and preserving monuments for future generations.

Conclusion. Thus, ecology and the preservation of architectural heritage are two complementary fields that must be considered together to ensure the transmission of monuments to future generations. Several measures should be implemented for the protection of monuments, including developing strategies for adapting to climate change, monitoring the current condition of monuments, utilizing modern technologies for restoration, and fostering global collaboration.

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MEMARLIQ ABİDƏLƏRİNİN QORUNMASINDA «YAŞIL DÜNYA» HƏMRƏYLİYİ

Məqalə memarlıq abidələrinin qorunmasında ekoloji amillərin və «Yaşıl Dünya» həmrəyliyinin əhəmiyyətini vurğulayır. İqlim dəyişikliklərinin tarixi abidələrə təsirləri, tikinti materiallarının aşınması, təbii fəlakətlərin yaratdığı ziyan və digər ekoloji problemlər təhlil edilir. Ekoloji yanaşmaların, o cümlədən bərpa olunan enerji mənbələrinin istifadəsi, abidələrin dayanıqlılığını artırmaq və gələcək nəsillərə ötürmək üçün təklif olunur. Məqalə həmçinin, abidələrin qorunmasında turizm, təbii mühitin inteqrasiyası və davamlı inkişaf konsepsiyalarının əhəmiyyətini qeyd edir.

Açar sözlər: memarlıq, ekologiya, iqlim, bərpa, enerji.

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СОЛИДАРНОСТЬ «ЗЕЛЕНОГО МИРА» В ЗАЩИТЕ АРХИТЕКТУРНЫХ ПАМЯТНИКОВ

Статья подчеркивает важность экологических факторов и солидарности «Зеленого мира» в защите архитектурных памятников. Рассматривается влияние изменения климата на исторические сооружения, включая эрозию материалов, воздействие природных катаклизмов и другие экологические проблемы. Применение экологически устойчивых подходов, включая использование возобновляемых источников энергии, предложено для повышения устойчивости памятников. Также акцентируется внимание на важности туризма, интеграции природной среды и концепции устойчивого развития в сохранении культурного наследия.

Ключевые слова: Архитектура, экология, климат, реставрация, энергия.

FIGURES:

Fig. 1. Shikh Baba Mausoleum.

Fig. 2. The Palace of Gara Boyuk Khan in Shusha.

Fig. 3. The Bathhousein Lankaran.