

PAPER • OPEN ACCESS

The Problem of Preservation, Restoration and Reconstruction of the World Architectural Heritage

To cite this article: D V Gnezdilov *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **698** 033022

View the [article online](#) for updates and enhancements.

You may also like

- [Monuments in the Structure of an Urban Environment: The Source of Social Memory and the Marker of the Urban Space](#)
N. Antonova, E. Grunt and A. Merenkov
- [Application of Integrated Photogrammetric and Terrestrial Laser Scanning Data to Cultural Heritage Surveying](#)
Przemyslaw Klapa, Bartosz Mitka and Mariusz Zygmunt
- [Improved vertical displacements induced by a refined thermal expansion model and its quantitative analysis in GPS height time series](#)
Kaihua Wang, Hua Chen, Weiping Jiang *et al.*



245th ECS Meeting • May 26-30, 2024 • San Francisco, CA

[Learn more & submit!](#)

Present your work at the leading electrochemistry & solid-state science conference.

Network with academic, government, and industry influencers!

Submit abstracts by December 1, 2023



The Problem of Preservation, Restoration and Reconstruction of the World Architectural Heritage

D V Gnezdilov*, E V Kapnina, E S Martynyuk

Belgorod State Technological University named after V.G. Shukhov, 46 Kostukov Str., Belgorod, 308012, Russia

E-mail: gnezdilowd@gmail.com

Abstract. The article is devoted to the relevance of preserving monuments of the world architectural heritage. The question of the importance of architecture for the future generations is raised. The new possibilities of restoration and reconstruction of the architectural monuments, their historical development and prospects are considered. It is shown that the importance of the world architecture monuments preservation problem cannot be underestimated.

Introduction

One of the most important areas of the scientific research is currently turning to the problems of the cultural heritage. The task of preserving history concerns both individual cities and the world as a whole. The Russian philologist Dmitry Likhachev accurately stated the essence of the problem: “A person who does not like to see old photos of his parents does not appreciate them, and if a person is indifferent to historical monuments, then he is indifferent to his country” [3]. The most important activities aimed at this problem solving are the reconstruction and restoration of buildings and architectural monuments. Preservation of history is the basis for shaping the future.

To further understand the research topic, it is necessary to study the key concepts. Restoration is understood as the strengthening and restoration of historical monuments, culture and art, distorted, damaged or destroyed by time, harmful conditions of existence, destructive or inept effects. Another type of labor is reconstruction. This is the complex construction and finishing works activities aimed at qualitative changing the building's indicators. The reconstruction, in contrast to the restoration, primarily restores the functional qualities of the building, not its appearance.

Such types of activities as design, production, research, engineering and other works performed on immovable monuments of history and culture have long been attributed to the restoration. In the process of restoration, the structure of the monument is strengthened with the use of materials similar to the original ones; modern means are also used if they do not damage the monument.

During the building reconstruction, the following activities are envisaged: full or partial reorganization of the object and change of its structural and technical characteristics, additional construction works (superstructure, extension), complete replacement of utilities and reinforcement of supporting structures.

In antique times the attempts were made to restore the architectural monuments, but up to the XVIII-XIX centuries they usually boiled down to a simple repair or upgrade of the object. Until the middle of the 19th century restoration meant the repair of buildings and structures.

In order to determine the problem better, let's look at a few examples.



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Saint Isaac's Cathedral

One of the grand buildings of Russia is St. Isaac's Cathedral. This is the largest Orthodox church in St. Petersburg. However, no matter how great the structure is, it, like a person, ages over time and requires treatment. During the Great Patriotic War, the cathedral suffered significant damage from bombing and shelling. The fragments of bombs and shells left traces on the outer marble facing of the walls, some parts of the roof, many columns were damaged, and the parapet of the southwest corner of the building was damaged. Even in wartime, the population tried to do everything possible to preserve this magnificent building, because it is a historical heritage not only of Russia, but of humanity as a whole.

Each individual part of the cathedral is of artistic, historical and cultural value. Only the relationship of these parts gives a holistic view of the structure. Therefore, it is important to save every sculpture, stucco and mosaic. High reliefs on the gables tell about the life of Isaac Dolmatovsky. Philip Honoré Lemer immortalized the plots "The Resurrection of Christ" and "The Meeting of Isaac of Dalmatia with the Emperor Valens"

In order to make the temple look decent, it is restored not only inside but also outside. Experts have already updated the monumental painting, it literally played with new colors. To reduce the heat loss, insulation is mounted around the dome. This is a kind of "blanket" for the design. The most difficult work was carried out on a lantern with stained glass windows. They demanded fine work of restorers.

The covering of the cathedral was also damaged. It had many cracks. A large number of divergences of the butt joints, through which water fell inside. The decoration under the natural stone was all tarnished, weathered and sprinkled.

To save the copper plating, the restorers cleaned the surface and eliminated defects. A lot of work was carried out on the "bare" lantern: heavy windows were cleared here, each weighing about 300 kg, and the windows were replaced, and an additional light dome was mounted.

The cast-iron cross on the lantern is the highest point of Isaac. Once it was the main religious symbol of the Russian Empire. The cross was also put in order: they strengthened the base and restored the casing.

During the restoration work, the state of the cathedral was restored, but it is impossible to forget about the planned restoration work. Its preservation is important for the cultural education of the future generations.

Notre Dame de Paris

The most discussed event that shocked all residents of France and the whole world is the fire in the Cathedral of Notre Dame. It was a clear demonstration of the protection, preservation and reconstruction of the architectural heritage to be a very important issue. Grabar I.E., a famous Russian painter, said: "Time is estimated as a directional process, having a beginning and an end, a past and a future. This implies the possibility of the irretrievable loss of those values that form the basis of culture, and hence the requirements for their unconditional preservation" [1, p. 32]. After all, it was not only the cathedral that was burning, but the traditions, culture and ancestral memory were burning along with it. This event underlines the urgency of the problem of preserving the architectural heritage.

In recent years, the experts have identified some significant problems of Notre Dame de Paris construction: the deterioration of the cathedral's structures, the partial destruction of the masonry. The chief architect of the historical monuments of France Philippe Villeneuve expressed the opinion that the main culprit of the situation is the "environmental pollution". The Ministry of Culture of France estimated the repair work costs of the cathedral at 150 million euros in 2014. In April 2019 the repair work was already carried out on the cathedral spire, their cost was estimated at 6 million euros. Perhaps, if the cathedral had been reconstructed earlier, it would have been possible to avoid the high costs of the restoration. "France was the first European country to launch a wide range of the activities for the restoration and protection of architectural monuments; in the middle of the XIX century it was a model staged by the protection of the ancient buildings, but later fell somewhat short of the general course" [4].

Notre-Dame-de-Paris is inscribed on the UNESCO World Heritage List in 1991. Having existed for more than 850 years, the cathedral could disappear completely in an instant, but for the well-organized actions of the firefighters. The spire and roof structures collapsed during the fire. The frame of the spire consisted of 500 tons of wood, covered with 250 tons of lead plates. Because of their melting at high temperature, the lead melted and partially sublimated into vapors, becoming a source of toxic smoke. Two thirds of the roof were destroyed, built of wood in the XII – XIII centuries. The part of the interior was affected. The two towers of the cathedral, as well as medieval stained-glass windows and rosettes were preserved. The organ in the cathedral was not affected by the fire, but was damaged due to the fire extinguishing. Some paintings were damaged due to heavy smoke. They are planned to be delivered to the Louvre for restoration. Steel scaffolding was erected around the perimeter of the roof, and stone, copper and bronze statues, which included sculptures of the twelve apostles were removed a few days before the fire, thus they were able to be preserved.

Emergency services saved the structure of Notre Dame from the complete destruction. The investigation of the incident circumstances was launched. Now we are working on the restoration of the cathedral. Designers and architects from around the world offered their creative solutions to the French authorities. Let us consider the most popular options.



Figure 1. Green roof.
Roof option from the
bureau “Arcas architects”.

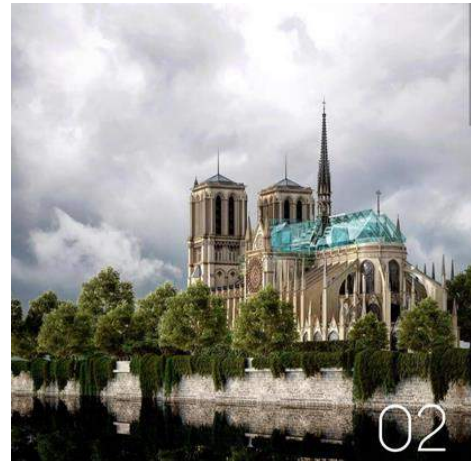


Figure 2. Glass roof

Russian architect Alexander Nerovnia proposed to recreate the spire as close to the original as possible, and make the roof completely glass. (Figure 2).

French designer Mathieu Lehanneur refused to spire, similar to the original and offered to perpetuate the flame, which took its place on April 15, 2019.



Figure 3. Flame instead of spire



Figure 4. Light beam dissecting the sky



Figure 5. Crystal roof

Designers Vizumatelier from Bratislava propose to replace the ruined spire with a weightless tower with a beam of light directed straight up, cutting through the sky. As the architects explain, this was precisely the main Gothic architecture idea - to touch the heaven. High technology makes this dream a reality.

Italian architects “Studio Fuksas” propose to build a modern roof and a spire of Bacarra crystal over the cathedral, which will be highlighted in the evening.

3D modeling

The research and studies of the new technological developments in the field of chemical and construction industry are currently underway. The use of such developments allows to solve the complex problems of preventing the destruction of historical heritage. With the help of the new developments, it is easier to cope with the problem of bringing the historical uniqueness to the architectural monuments of world importance.

3D modeling has gained popularity in recent years. It gives an opportunity to reconstruct the building with the help of computer graphics, can help in restoring the appearance of many monuments. 3D modeling creates three-dimensional models of an architectural monument at any stage of its existence, leaving the real structure unchanged, allowing to recreate the original building view. This becomes possible after careful study and measurement of all the building structure’s elements. “The computer models’ creation is possible for any historical monument, partially preserved or completely lost. For the spatial positioning, first of all, a planned solution is necessary, and the further accuracy of the 3D model is directly dependent on the completeness of the historical material collected by the researcher” [2, p. 7].

UNESCO, being interested in promoting scientific knowledge, encourages the development of 3D reconstructions of the architectural heritage. In Europe and the United States, the process of developing and expanding research centers in international projects for the preservation of cultural heritage is proceeding at the fast pace.

Summary

Cities inevitably change, every individual building changes respectively with the time. These changes lead to complication, meanings saturation, as a result, they give the opportunity for further positive transformations. The correct approach to the restoration of architectural heritage is necessary not only to preserve, but also to increase the significance of the building for any person. Memory is a mediator between eras. The achievements of the past generations give rise to the new research, thereby helping to enrich and multiply the achievements of the modern world. Therefore, it is important to preserve the best traditions for the progressive society development.

References

- [1] Grabar I E 1919 *For what it is Necessary to Protect and Collect the Treasures of Art and Antiquities* (I.N. Kushner and Co. Publishing house, Moscow).
- [2] Kalnitskaya E 2005 *Three-Dimensional Modeling as a New Tool of the Architecture Historian* (Saint-Petersburg).
- [3] Likhachev D S 1983 *The Land is Native* (Moscow).
- [4] Mikhailovsky E V 1971 *Restoration of Architectural Monuments (Development Of Theoretical Concepts)* (Moscow).