

*Oleh Rybchynskyi*

## PROBLEMS OF RESTORATION OF NATURAL STONE MONUMENTS LOCATED IN THE CITY PARKS

*Lviv Polytechnic National University  
12, Bandery Str., 12, 79013 Lviv, Ukraine, zoroleh@gmail.com*

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**Abstract.** In the given article the problem of restoration of natural stone monuments, located in the city parks, is analyzed. The main causes of stone deterioration, as well as programs and techniques of conservation and restoration of monuments, located in city parks, have been determined.

**Key words:** natural stone sculptures, small architectural form, restoration, city park.

### 1. Introduction

Today, natural stone monuments in the city parks are in a very poor condition. The City administration, utility companies and the local communities have no worked-out programs for restoration of decoration elements, located in the city parks, or of other small architectural forms. In the contemporary world natural stone monuments in city parks are protected by law and preventive measures for restoration of these must be taken.

Preservation and renovation of deteriorated monuments; the repairing and upgrading of the technical infrastructure; development of the sphere of consumer services; the reviving of traditions and culture of design of natural stone works, all of these, belong to the urgent tasks of city parks management in Ukraine. Identifying problems of restoration of natural stone monuments provides a basis for preservation of urban parks.

The article is based on an analysis of the latest research and publications. The results of the research show that restoration work on natural stone monuments must be performed according to the requirements of State Building Codes of Ukraine [1], and the Methodological Guide on Conservation and Restoration of Architectural Monuments [2].

Such foreign researchers as Domaslowski W. [3], Malachowicz E. [4], Koss A. [5], Lukasiewicz J. [6], Tajhman J. [7], Ciabah J. [8], Ważny J., Karys J.; Foyutowski A. [9], Saunders D. [10], Brandi C. [11] thoroughly investigated the problem of restoration of natural stone objects.

In their research works objects, arranged in architectural ensembles and complexes, are analyzed. However, monuments located in city parks have not been the subject of a separate analysis, so far.

In this article, the natural research methods, measurements, photofixation, analysis of the existing state of monuments before and after restoration have been applied. When determining problems of parks located in the historic cities of Ukraine, the method of systematization of cartographic material, the study of archival and literary sources, interviews of witnesses about the presence of monuments in parks have been used.

### 2. The main material research

A city park is a public space formed under the influence of ideological, economic and artistic factors. Ideological and economic and natural factors influence the scale and the size of a park. Only then the artistic factor is applied in the planning of the environment. The urban park space consisted not only of gardening compositions and walking trails, but also of sculptures, small architectural forms, monuments, etc. During the

18<sup>th</sup> and the mid-20<sup>th</sup> centuries the main material for sculptures and small architectural forms in parks was natural stone. In the second half of the 20<sup>th</sup> century it was replaced mostly by concrete mixture. For example, natural stone monuments were used in the arrangement of such parks and places of residences as: the residence of Metropolitan of Bukovina and Dalmatia, the Italian park in the village of Pidhirtsi, in the Vyshnivtsi palace park, in Khrystynopol (Chervonohrad), the village of Liashky Murovani, the town of Rozdil, the village of Obroshyno, the town of Burshtyn, the Sofiyivka park in Uman, the Alexandria park in the town of Bila Tserkva, and others.

During the second half of the 20<sup>th</sup> century natural stone monuments, located in the city parks, were not protected and suffered damage and destruction. In most cases, they used Portland cement mixture for the repair of natural stone monuments. Given the growing space requirements for urban parks it is important not to disturb their historical image. Conservation of natural stone monuments should be based on the principles of restoration. Therefore, before proceeding to restoration works it is necessary to carry out measurements, visual studies and to determine the extent of the previous repairs identifying the causes of stone deterioration.

The main causes of natural stone deterioration are as follows:

1. Influence of water (chemical processes, biological fouling, physical destruction)  
– dissolution, softening and wash-out structural elements of stone.
2. Effect of atmospheric gases and air pollution  
– oxidation, reduction, hydration and dehydration, hydrolysis, carbonization.
3. Impact of of water soluble salts  
– crystallization and increase the volume of crystals.
4. Effect of changes in temperature and humidity regime.
5. Effect of mechanical factors  
– abrasion, cracking and separation.
6. Influence of biological factors.

On natural stone monuments of city parks we can often see losses of authentic polychrome covered, instead, by oil paint multi-layer coating. The oil paints stop the exit of gases and moisture from the stone and activate deterioration of the monument's plastics. During the cleaning of monuments, the oil paints must be taken off according to the following requirements: the clearing method should not violate the original surface of the stone, its dimensions and structure must be left intact, and no harm to the environment should be done.

Most natural stone monuments located in urban parks are highly humidified. At the bottom of the pedestal, on the bases and on sculptures there are visible stains formed due to the capillary moisture. Due to the excess of moisture and the shadiness the softening and abscission of the stone is noticeable. On top of the monuments, because of the resin and juices dropping from tree branches, stains appear on the stone surface. Problems of humidification may be solved by the waterproofing of bottoms of monuments and the hydrophobic coating of surfaces.

Excessive moisture can activate the stone's salinity. Water-soluble salts adversely affect a monument, i.e. they accelerate their destruction. An analysis of the presence of water-soluble salts on the sights must be confirmed by laboratory tests [1, 3]. Natural stone sights are aggressively affected by the following agents: water-soluble salt sulphates, nitrates and chlorides. Extrusion of stone salts is best carried out using compresses of distilled water and cellulose. The process of removing salt can be done in two or three stages. After this procedure it is necessary to strengthen the structure of stone by organosilicon substance.

Monuments, located in city parks, have numerous caverns and chips; transverse cracks; their condition risks being broken down into pieces; on the surface of the stone there is a dense and strong contamination and a black "false" patina; on the carved curvs one can see vast colonies of mosses and lichens, grout and putty of portland cement, layers of bird droppings, as well as numerous mechanical damages caused by vandalism.

Thus, restoration works were carried out at the monument to Jan Kilinski, located in the Stryiskyi park (Lviv), in 2009. However, a few years later, the monument was covered again with numerous colonies of lichens; the upper part was covered with layers of bird droppings, tar stains and tree juices; and the lower parts of the pedestal were affected by humidification. The visual inspection of the retaining wall of the spring in the Stryiskyi park has revealed a serious problem of moisture and salinity of the stone. The

joining and numerous additions of portland cement adversely affect aesthetical properties, as well as the structural strength of stone masonry.

The monuments of the Alexandria park in the town of Bila Tserkva, i.e., garden houses, bridges, pavilions also present similar problems to those in Lviv, namely: an active use of portland cement, tar stains and tree juices, moisture of monuments' lower parts, biological fouling, etc.

The park in Sofiyivka (Uman) revealed the following problems: moisture, bio-fouling, tar stains and tree juices, sculptures covering an oil paint, cracks, chips and unprofessionally complemented fragments of monuments.

The parks' sculptures in the villages of Pidhirtsi and Obroshyno have numerous damages, such as: cracks, an overall black "false" patina, large colonies of mosses and lichens, patches of tar and tree juices.

The field-research shows that most sculptures are made of stone while sculpture pedestals are made of bricks. Traditionally, as a coherent element lime and sand mixtures were used in laying monuments. During later repair works mostly cement was used. As a result of visual inspection, it was found that pedestals are damaged mostly by strong moisture, bio-fouling, salinization, and due to the cement putty joining preventing evaporation of moisture.

Due to a lack of resources laboratory studies to identify the percentage of salinity have not been conducted. However, a visual study revealed growths of crystals and salt stains. Therefore, during the working-out of the concept of restoration of natural stone monuments the first stage should include extrusion of salts.

In addition, the study of iconographic material is important for reproduction of lost objects or fragments of preserved monuments. For example, a scientific research will help to establish stylistic and artistic features of sculptures and small architectural forms in the parks of Krakivec, Radehiv, Burshtyn, Kukeziv, Teofiopol, Rivne, Skala-Podilska, Horohiv, Vyshnivec, Tulchyn, Antoniny, Nemyriv and other.

In spring 2016 restoration works of the memorial plate of Arnold Röhring in the Stryiskyj park were conducted. The monument was in a poor condition. A visual inspection of it showed a solid cement layer over the plate, absence of several letters in the main inscription and some unclear letters in the auxiliary text on the plate (Fig. 1).



**Fig. 1.** The memorial table before restoration.  
Photo by the author

Before starting restoration works a restoration program was worked out:

1. Preliminary examination;
2. Diagnosis status and material of monument;
3. Conducting conservation work;
4. Structural strengthening of monument;
5. Implementation of local reconstruction;
6. Expressiveness of forms and details of monument;
7. Implementation of glazing;
8. Blocking the cement inserts and putty.

The method consists of such restoration stages:

1. Water and dry cleaning of the surface of volatile contaminants;
2. Steam cleaning of the surface from sustainable chemical, biological and atmospheric formations affecting the monument surface;
3. Chemical cleaning of the surface from persistent pollutants;
4. Removal of later aggressive and cement inserts;
5. Filling-in of cracks and caverns with selected materials;
6. Implementing of additions to lost fragments with compatible materials;

### 7. Implementing the glazing of silicon-organic solutions and mineral pigments.

As a result of the undertaken restoration works, the surface cement coverage of the slab has been taken off, additions of the damaged parts have been made, the lost letter inscription was restored, as well as the auxiliary inscriptions (Małopolskie Tow. Ogrodnicze). 60 % of the surface plates have been restored. Also, the filling-in of edges around the plate's perimeter was done to protect it from excess moisture that comes through the capillaries of the spring. (Fig. 2) After the clearing the memorial plate got back its authentic dark-ocher color.



**Fig. 2.** Memorial plate after restoration. Photo by the author

In case of static deformation of natural stone monuments an arrangement should be provided for conservation of the monument by banding. In case monuments have an exceptional artistic value the technique of micro-sandblasting or laser cleaning of stone should be used [10, 11].

## Conclusions

Monuments of natural stone are important and valuable elements of the historic environment of city parks. Improper treatment causes a loss of the initial appearance and an unsatisfactory technical condition. Therefore, a number of key problems concerning their restoration should be identified: an inventory of lost elements made by scientific research; periodic preventive restoration works carried out (clearing from mosses, bird droppings, resinous stains and juice greenery, enhancement of resistance of stone coating by biocide solutions); prevention of damaging the environment (pruning trees and bushes); prohibition of the use of portland cement mixtures in repair works; performance of restoration works carried out only by specialists in restoration of stone art works.

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As the next stage of repair works, a thorough restoration of the wall to which is fixed the memorial plate must be carried out. It requires the applying of waterproof barrier, restoration of authentic relief composition, etc.

Each monument located in the park needs an individual program of restoration. The impact of greenery must be considered, as well: destruction of the foundations of small architectural forms by roots of trees and shrubs, protection from falling branches.

*Олег Рибчинський*

**ПРОБЛЕМИ РЕСТАВРАЦІЇ ПАМ'ЯТНИКІВ З НАТУРАЛЬНОГО  
КАМЕНЮ, РОЗТАШОВАНИХ У МІСЬКИХ ПАРКАХ**

***Анотація.** Проаналізовано проблеми, які виникають під час реставрації натурального каменю, розташованих у міських парках. Були визначені основні причини руйнування каменю, програми та техніки консервації та реставрації монументів, які розташовані у міських парках.*

***Ключові слова:** пам'ятники з натурального каменю, малі архітектурні форми, реставрація, міський парк.*