

STRUCTURAL AND TECHNOLOGICAL ASPECTS OF CONSERVATION OF STREET ART ON BUILDINGS DAMAGED DURING THE WAR

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Abstract

Using the example of graffiti created by famous artists on the walls of buildings and structures damaged during hostilities in Kyiv and its suburbs, the article analyzes and summarizes the factors influencing the lifespan of street artworks. Special conditions for dismantling graffiti and changing the exposure are considered. Examples of measures taken to preserve art objects are given. The study provides recommendations for additional protection of building structures, which are the basis of murals, taking into account their condition and degree of destruction. The authors provide photographic materials and results from some of the most common objects. Also provided are constructive schemes for strengthening the building elements or their fragments and options for technological solutions for protection, preservation and further dismantling. The article also includes materials from already implemented projects: applications of street art, which were saved using these other methods and techniques.

Keywords: Street art; Strengthening of structures; Conservation; Destroyed structures; Dismantling technology

Introduction

The democratization of human society has influenced all components of its existence: from the political system and economic systems to trends in creativity. The desire to equalize opportunities has led to the need to possess knowledge equally as a planetary heritage. This also applies to art. The works of the old schools, written according to the canons and for the needs of bourgeois society, caused dissonance with reality in the newly born democratic personality. Therefore, in contrast to the fundamental work, the time of work, which was calculated in years, a new rapid creation was created, relevant only today and here and accessible to everyone.

The current conditions were the impetus for the development of this type of urban painting as street art [1]. The proclaimed manifesto of the futurists in 1918 read: “Let the streets be a festival of art for everyone” [2].

There are several directions of street art: street painting itself and so-called public art – “legal” art. One of the differences between them is the degree of preparation of the work site. The public art object has a thoughtful (official) display space that connects it with the surrounding urban environment. To create these works, for example, in the form of murals, city authorities attract well-known and emerging artists, providing prepared sites - walls. In Kyiv, in

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2014, a whole program was introduced to improve the surrounding urban space. Over four years, 28 artists from different countries created more than 140 murals on the walls of city buildings. Three of them were included in the list of the best works from around the world in 2017. The most famous of them, according to the magazine "Street Art Today" (Netherlands), is the architectural painting "Rise from the Mud" by the artist BKFoxx (New York).

The canvas for a painting or the platform for an installation in the street art style are most often elements of the urban landscape – walls, sidewalks, ruins and even garbage [3, 4], which are played out by the artist. The concept of street art is most often associated with illegal and unauthorized actions in public spaces [5, 6]. It should be noted that the main type of non-mobile street art is graffiti (otherwise known as spray art) and stencils made with coloring materials with different performance properties. As stated earlier, the basis for the paintings are elements of the urban landscape-building structures [7, 8]. The surfaces of such structures, due to their physical and chemical properties and technical conditions, are most often not prepared (or not intended) for artistic purposes. Why do authors go to the extent of artistically expressing their opinions with low-quality "instruments"? Due to the ideology of street art, it is a "rebellion against the rules" [9]. Or to popularize your name: "Bad advertising is also advertising". M. Gomez [10] and M. Chatzidakis [11] in their studies point out a very fine line in the direction of street art in the price range between a justified shock to social demand and vandalism. But such objects also have worldwide fame and very often arouse the admiration of millions of people for their relevance in highlighting the problems of society no less than works created specifically for this aura. City authorities, as a rule, are interested in preserving these works, since they cause an information boom and attract tourist flows [12, 13].

However, there are several problems in preserving street art. Most of the problems lie in the "unauthorization" and "illegality" of the work, which lead to a violation of the technological component of the creation of the work [14, 15]. All this does not contribute to the successful preservation and further exhibition of architectural paintings or requires enormous costs for conservation [16]. Therefore, the problems of preserving street artworks should be divided into categories of occurrence–cause. Methods and techniques for solving problems also require ranking by stages of implementation technology. This paper presents the results of an analysis of the state of graffiti and murals in Kyiv and the Kyiv region and provides proposals for the preservation of art objects and examples of implemented projects.

Materials and methods

During the study, general scientific methods were used.

A. Search and analytical - for the analysis of sources that describe the problem of preserving works of art in the open air, methods of preserving the protective layer of structures, techniques and methods for reconstruction, restoration, and conservation of objects or their elements. The work involved sources covering the following aspects:

1) diagnostics of the condition of surfaces and structures – Z. Gao *et al.* [17] and S.A. Ruffolo together with A. Macchia *et al.* [18];

2) computer projection of an existing image during analysis and modeling of the behavior of the base structure during restoration work - articles by M. Zhang [19] and A.I. Calero-Castillo *et al.* [20];

3) processing and cleaning methods - articles by M. Bertasa *et al.* [21], L. Luvidi *et al.* [22], Sandu [23], Deak *et al.* [24], W. Shank and D.H. Norris [25];

4) the use of preservative and protective compounds - articles by A. Macchia *et al.* [18], M. Chatzidakis [11], X. Gong *et al.* [26], M. Baglioni *et al.* [27], J.S. Pozo-Antonio *et al.* [28, 29], H.H.M. Mahmoud [30] and M. Furtak *et al.* [31];

5) constructive techniques for protecting graffiti and murals – articles by E.M. Alonso-Villar *et al.* [32], A. Pawłowska *et al.* [33] and I. Kirizsán [34].

When examining objects located on the territory of the city of Kyiv and the Kyiv region, we directly used:

- B. visual method - to determine the technical condition of art objects by external signs;
- C. analytical method - to assess the technical condition of the object being tested;
- D. instrumental – for studying the physical and mechanical properties of structures.

It should be noted that the works considered in the work are up to ten years old. Therefore, a classification of the reasons for the deterioration of the condition of works in the short term has been carried out. An analysis of the sources studied showed that for most murals, due to their scale, the main cause of deterioration is ultraviolet radiation. Protection from sunlight for such works ultimately depends on the physico-chemical characteristics of the original paint compositions and the protective layer that must be applied for preventive purposes to increase the life of the mural.

The main reason for the deterioration of graffiti is a poorly prepared (or unsuitable for painting) base. Therefore, the shortening of the life span of graffiti should be directly related to the “spontaneity” of the painting movement itself.

A special place among the analyzed works of this study is occupied by works created in the Kyiv region on the ruins of buildings and structures. The themes of these works and their emotional content are directly related to the location of the exhibition. Some graffiti was created on the rubble of destroyed structures that were in a static position and no longer posed a threat to the surrounding area.

For example, the works of the French street artist Christian Guemy, working under the pseudonym C215, appeared in Borodyanka (Fig. 1a and b) and Bucha (Fig. 1c). These works are classified as artistic graffiti with historical and social significance. But the territorial reference – the exhibition – in these works is expanded to the scale of the city and country. The graffiti discussed below, according to the authors, can be exhibited simultaneously as an associative triptych “Faith. Hope. Love”.



Fig. 1. Mural Christian Guemy in Borodyanka and Bucha. [Photo by Christian Guemy]

An elderly couple kissing on a piece of debris (Fig. 1a) hanging over the collapsed ceiling of a building is a reminder to the author of faith in oneself and those around you. The

portrait of Lesa Ukrainka, an outstanding Ukrainian poetess (Fig. 1b), does not have an individual basis for the city of Borodyanka. Here it is rather a message for the whole country in the context of L. Ukrainka's poem "Hope". These two fragments could technically be removed from the ruins and moved to a safe area for conservation. The portrait on the wall of the apartment (Fig. 1c) is a direct association of place and time. Shown here is fashion designer Lyubov Panchenko, an honorary citizen of the city of Bucha, who died in 2022 during the Russian occupation. The project to preserve this graffiti requires a preliminary survey.

Often, the emergency condition of structures was one of the priority criteria for placing graffiti in Kyiv and the region. The conservation of such art objects directly depends on the sustainability of the structure as a whole. The task of conservation is already divided into several stages: preserving graffiti for the duration of restoration work; restoration of the object (or parts); restoration work directly from graffiti. With such a complex of works, special constructive measures are often developed to strengthen and preserve the work, which is a part of the structure that is subject to restoration or dismantling and subsequent movement to the exhibition site.

The analysis of the studied sources became the theoretical basis for arguing recommendations for strengthening and preserving structures that serve as the basis for works of street art.

Results and Discussions

In November 2022, the pages of many publications reported that in the liberated Borodyanka, Kyiv region, graffiti appeared on the wall of a destroyed building. The authorship of the works was immediately attributed to the famous underground artist Banksy, which he partially confirmed by publishing some of the photographs on his Instagram. The works of an artist who works primarily in the style of template graffiti are considered works of art and are valued very highly. When some cities decide to paint them over, this causes outrage and accusations of vandalism from city authorities. Ukrainian authorities, both central and local, have taken a course towards preserving graffiti. Also, works appeared in the cities of Gostomel, Irpen and village Gorenka. However, Kyiv became a pioneer in preserving Banksy's works.

The work revolves around an obscene image in the basement of a house on the street. Bolshaya Zhitomirskaya. The idea of the drawing is to show the world the insignificance and abomination of the Russian military "Z" machine, both an individual unit and the entire army [33]. But the work, which was the first to be defended in the city, has undergone a double "rebranding". The first transformation occurred within 10 days. An unknown author (or authors) depicted the heroes of a Ukrainian animated series - Cossacks, next to a military vehicle, who, with the help of popular medicine, kept the Russian infection from spreading throughout the world (Fig. 2a). Although the ideological component was clear to every resident of the capital, this caused a wide discussion about the identity and originality of the original plan [35]. To avoid further encroachments on Banksy's work, it was decided to preserve the street art in the original intention of the author (Fig. 2b). For this purpose, the Cossacks were "sketched" and a protective screen was installed and subsequently an alarm system for one of the city's security services (Fig. 3a). However, according to the authors, some design features of the base on which the graffiti is placed are not taken into account.

The house on the base of which is a drawing was built more than a century ago. The building is brick. The basement pylon of the foundation protrudes from the plane of the facade. In addition, there is a water intake pipe at the corner of the pylon. The geometric shape of the

pylon promotes (Fig. 2a) active moistening of the top plaster layer. All these facts indicate increased humidity of the surface of the base during seasonal precipitation. In this regard, it is proposed to use an improved design of the protective frame (Fig. 3b).



Fig. 2. Mural Banksy at Velyka Zytomirska street in Kyiv.
[Photo by t.me/kyiv_polit, V.Kolyakova, 2022]

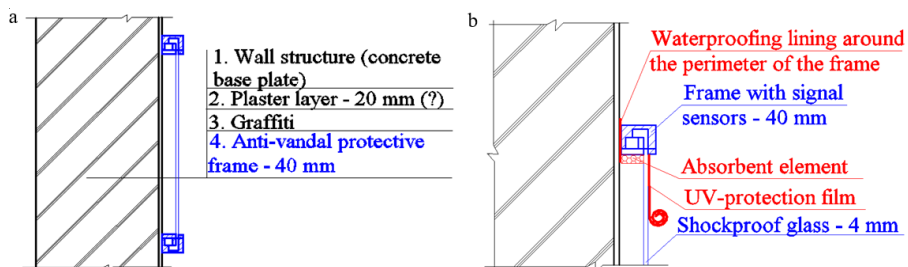


Fig. 3. Protective screen design: a – installed; b – recommended

In addition to the provided anti-vandal glass in the frame, which must fit tightly to the surface of the building's base, it is necessary to take measures to reduce humidity on the surface of the plaster layer [36]. For this purpose, it is necessary to install deep penetration waterproofing along a closed perimeter around the graffiti. Penetrating waterproofing prevents water under pressure from seeping through layers of concrete, brick or plaster and simultaneously increases the chemical and corrosion resistance of materials to many aggressive compounds, including precipitation. Many modern waterproofing compounds can increase the frost resistance of the base material and this is very important in the climatic zone of Kyiv.

In this case, it would be optimal to use a penetrating waterproofing composition with crystallizing action [18, 37]. This material does not create a waterproofing coating on the surface but displaces previously absorbed water from the depths of the protected layer, replacing it with insoluble crystals. Such crystalline formations are not subject to aging, exposure to water and aggressive environments. If moisture re-enters, even though mechanical damage to the surface, the crystals resume growth and replace the opened space. The waterproofing effect is maintained throughout the entire life of the structure.

The technological component of the work is very simple: there is no need to dry the surface to be protected, the composition is applied using simple technical equipment - a sprayer or a paintbrush and the ambient temperature is from +2-5°C.

The use of such a composition as a cut-off waterproofing on a building in Kyiv in November 2022 was quite possible because the average daily temperature then was +5°C.

When the structure is urgently closed from the external environment, a change in humidity occurs in the created microenvironment - under the frame and glass. As a result of heating the glass and the air underneath it and the evaporation of moisture from the base layers, condensation appears. This moisture directly settles on the surface of the drawing and reacts with paints - base and graffiti. Aggressive and often rapid corrosion occurs. Condensation also makes it difficult to display the work.

To neutralize the negative phenomenon of condensation, two main methods are used: drying and ventilation. Practice shows that to protect graffiti, the second option in its simplest form is more often used. A transparent polycarbonate, acrylic or glass sheet applied to the graffiti is mechanically attached to the base through special stabilizing pads. This technique allows you to avoid bending the protective screen made of rigid non-plastic materials and additionally creates a gap between the surfaces of the base and protection, where micro-flows of air are formed, the speed of which is sufficient to dry the condensate.

In the case of Kyiv graffiti, it is proposed to use an absorbent in the protective structure of the frame. The design of the frame holding anti-vandal glass and security sensors is supplemented along the internal perimeter with an absorbent tape made of non-woven material or a plastic box with differentiated holes for loose absorbent (Fig. 3b). In this case, a simple modification of the protective structure allows you to avoid a significant number of problems and increase the durability of the protective screen. Even though the graffiti is located at a height of no more than 90 cm from the sidewalk, the wall is very illuminated in the spring and autumn. Additionally, for a stationary (long-term) display of graffiti, glass with a UV filter should be used or the existing one should be upgraded by gluing an oxide film (Fig. 3b).

The proposed measures to improve protective screens are quite applicable to other graffiti. But... The work discussed above is located on a building that was not damaged by military operations. Works in the Kyiv region was created on the ruins of residential buildings (Figs. 4 and 5). Preserving any of this graffiti requires an individual approach. For example, the graffiti "Man in the Bathroom," is located on the first floor of a destroyed entrance in a five-story residential building (Fig. 4).



Fig. 4. Mural Banksy in Gorenka. Photo by G. Garanich (Reuters), H. Shpakova: a - November 2022; b - after installing the protective screen, February 2023



Fig. 5. Mural Banksy in Gostomel [Photo by PA MEDIA, by t.me/Andrii_nebytov, 2022]

The final decision on the restoration of the house has not been made. Options for partial or complete demolition of the building were considered. The difficulty of preserving the work lies in the design features of the base - artistic wallpaper on a paper basis, a plaster layer, brickwork. To ensure the stability of the base of the plaster layer, silicate-impregnating compounds can be used, injected from the side of the brick wall opposite the graffiti [38]. To maintain the solidity of the masonry during dismantling, it is necessary to create and use a special frame bandage made of rolled steel. But a simpler option is also possible - removing the wallpaper and fixing it on a rigid base. This technique requires a more thorough examination.

An example of dismantling graffiti without a base structure was another notorious work by Banksy in Gostomel - "Woman with a Fire Extinguisher" (Fig. 5). The graffiti was painted on a foam-insulated wall (Fig. 6a). The work was cut from the wall of the house by volunteers who wanted to preserve it. However, their enthusiasm was not shared by law enforcement officers. There is an indictment against the thief. The work itself is located in the Gostomel village council.

The relative ease of dismantling the base can be explained by technological violations during the insulation of the facade. When attaching the insulation layer to the brick wall, the adhesive solution was applied in fragments (Fig. 5b). The structural diagram of the insulated wall is shown in Figure 6a. If the technology for fastening sheet polystyrene foam insulation is followed, it is impossible to dismantle the base with intact sheets. "The Restorers" were lucky in a certain sense.

Before carrying out dismantling work, it is necessary to carry out preparatory work related to strengthening and protecting graffiti from mechanical and chemical damage. Chemical protection functions as a binding (gluing) substance, which creates a chemically resistant film [27]. It blocks chemical reactions between external reagents (humidity, dust, gas) and graffiti coloring compounds [23] and prevents minimal mechanical damage during installation of the surface of a rigid protective panel. The proposed design for strengthening graffiti on a foam base is shown in Figure 6b. It should be especially noted that a reinforcing plaster layer up to 20mm thick in some cases cannot be performed without a thorough assessment of the load-bearing capacity of the base (in this case, polystyrene foam boards) and the quality of adhesion between the load-bearing layers.

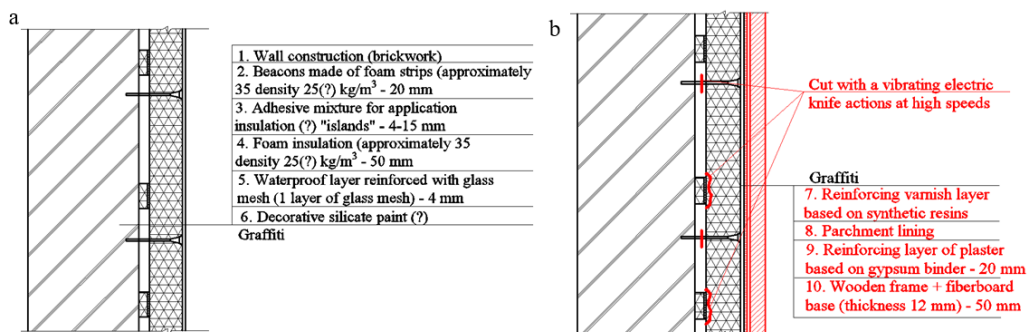


Fig. 6. Base design for graffiti:

a - existing; b - recommended reinforcement of the base before dismantling

In the case of “Woman with Fire Extinguisher,” a visual inspection showed that the adhesion of the insulation to the brick wall was insufficient to carry out the proposed pre-removal reinforcement. For this object, it was necessary to provide for the installation of a persistent horizontal beam under the graffiti, which could take the load from the mass of the protective plaster layer.

Unfortunately, we must state the fact that this graffiti was damaged. Compositionally, the work can be called an installation, since its part included not only burnt windows and walls, but also a chair on which the woman “stood” (Fig. 5a). After dismantling the graphic part, a fragment of the image of the lady’s legs remained on the base of the house (Fig. 5b).

Another unique installation is located in the very center of Kyiv - “Swing” (Fig. 7a). The graphic part drawn on massive concrete foundation blocks plays up the metal anti-tank hedgehog standing nearby. The author’s stylistic idea is grandiose - “Life goes on against the backdrop of what threatens death.” A change in one of the components in space leads to the loss of any semantic load and, as a consequence, the artistic value of the art object (Fig. 7b).

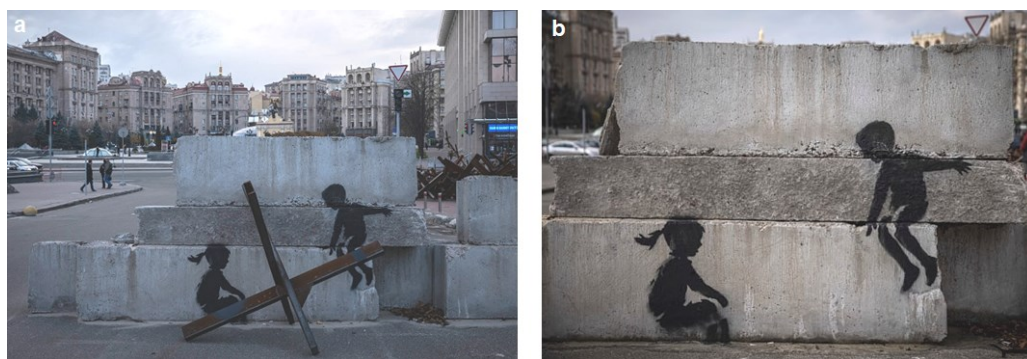


Fig. 7. Installation in Kyiv. Photos by Ed Ram, H. Shpakova, 2022-2023

The complex relocation of this installation can be carried out in several ways: from simple dismantling of individual elements with their subsequent assembly according to risks at the place of exposure to combining the elements. For the second option, a schematic diagram of combining foundation blocks into a single structure has been developed (Fig. 8). It is proposed to combine the functions of a connecting and installation anchor: the through hole is reinforced

with a steel rod and filled with chemical anchors based on epoxy solutions. The resulting connection has sufficient strength. Clamps, friction grips for installation and retaining concrete blocks can be used as additional (safety) means.

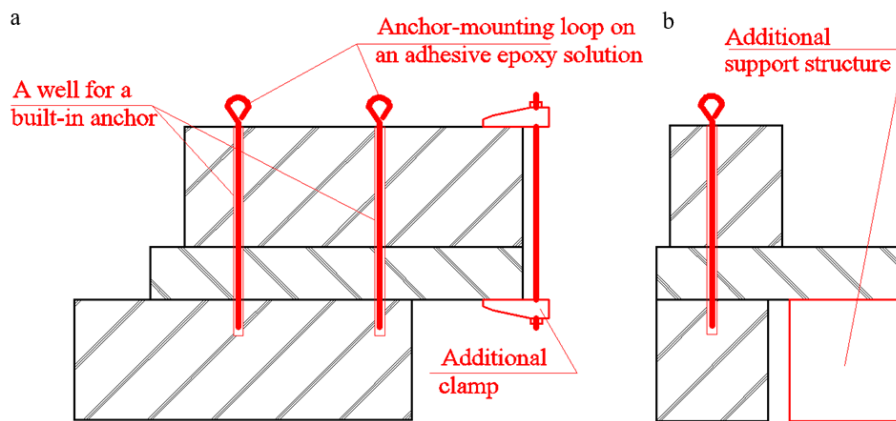


Fig. 8. Schematic diagram of fastening blocks into a single array:
a - front view; b - side view.

To date, work has already been completed to protect several graffiti.

One of the most ideologically significant for Ukrainians is “Judoists” (Fig. 9a), created on the wall of the destroyed boiler room kindergarten “Buratino” in Borodyanka.

The soil base of the work is a paint (lime) mixture for use in interior spaces (internal wall), its physical and chemical properties do not meet the requirements of normal operation in the climatic conditions of Ukraine as for external structures. Therefore, with the beginning of the winter period of 2022-2023, the issue of preserving the work has become very acute. To avoid direct dampening of the graffiti brick wall structures and limestone base, a metal frame for the canopy made of profiled metal was erected (Fig. 9b). Subsequently, to minimize the influence of air humidity and provide anti-vandal protection conditions, a transparent latex fence was installed (Fig. 9), which does not interfere with the view of the exhibition [4, 39].

With the onset of the spring-summer period, sharply negative consequences were expected, associated with heavy aggressive precipitation in the form of rain, likely a sharp increase in air temperature and high levels of UV radiation. It should be noted that in this case, they abandoned the technology of preservation with a protective screen, as was done for other art objects, since the entire structure of the wall is subject to destruction, and therefore requires comprehensive conservation [40, 41].

Therefore, a supporting frame made of rolled steel was proposed, designed and installed. Figure 9d shows a schematic diagram of a frame bandage that can support an element on both sides. To do this, fixing pins are passed through the drilled holes in the element, tightening the frames, and compressing the structure mass. To preserve the integrity of the array and the surface quality of the graffiti, measures are taken to stabilize its chemical state and protect it from minimal mechanical damage (Fig. 6b). For the "Judoists" project, a bandage frame was used and installed on the back side of the graffiti. This decision is due to the condition of the base - a brick wall, which has deviations from the vertical axis [38].

The frame-bandage project was fully implemented during the dismantling of a multi-story residential building in the city of Irpen. The image of a gymnast standing on a black hole

caused by a projectile flying into the basement is located on the end panels of the first floor of the house. According to the structural design, the panels are self-supporting [41]. But their local dismantling was impossible. To preserve the work, a project was developed to carry out the work step by step: 1 - dismantling part of the house, namely all the floors of the end cell above the graffiti, 2 - an attempt to secure the graffiti structure in a bandage frame and dismantle it, 3 - dismantling the remains of the house.

Before the start of the first stage, a structure of prefabricated reinforced concrete blocks was built outside the building under the wall with the image of a gymnast, close to the protective screen, which was supposed to protect the work from falling debris (Fig. 10a and b). The floor structures were dismantled using hand tools. Over five days, the top eight floors were demolished. After this, the protective structure of the graffiti was also dismantled [42].



Fig. 9. Protective structure over the graffiti «Judoists» in Borodyanka: a - november 2022; b - february 2023; c - march 2023; d - schematic diagram of a frame-bandage for a fragment of a wall – front view.

Photos by Ed Ram, V.Kolyakova, H. Shpakova

The implementation of the second stage was complicated by the design of the house: the design is placed on two vertical slabs, the bottom slab is badly damaged, between the slabs, there is a floor panel between the basement and the first floor and expansion joint elements are joined to the slabs. In the second stage, holes were drilled in the end wall panels of the basement and first floor along the perimeter of the graffiti for mounting studs, which secured two panels in a bandage frame on the inside and outside (Fig. 9 and 10). For more reliable fixation, anchor glue was additionally used. The next step was to cut out part of the graffiti structures with diamond discs. The frame bandage was slowly moved by crane into a vehicle for

transport to the storage location. To do this, mounting holes (loops) for gripping hooks, elongated vertical posts with an additional transverse stiffener and a frame with struts were added to the proposed frame-bandage design to allow the installation of the art object in the design position (Fig. 10c and f). The work was carried out in April-June 2023.

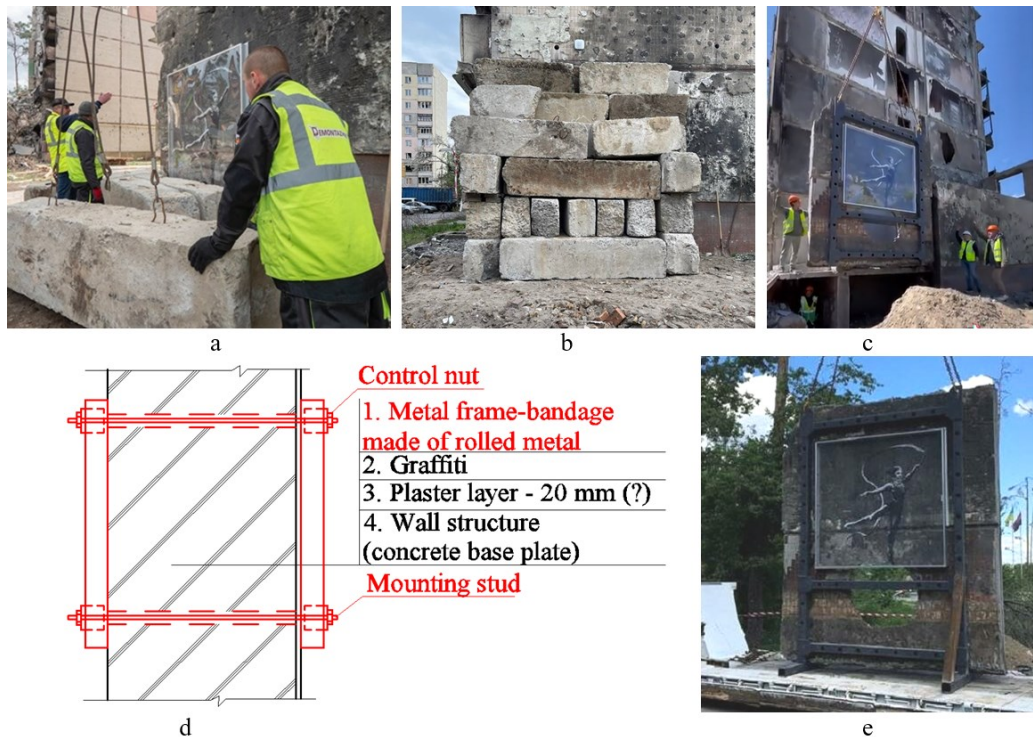


Fig. 10. Dismantling the «Gymnast» graffiti in Borodyanka: a, b – the process of laying the graffiti with protective blocks; c – dismantling graffiti; d – schematic diagram of a metal frame-bandage; e – metal reinforcing frame.
 [Photos by t.me/newsimr/9661, H. Shpakova]

However, there is an art object that is very problematic to preserve. The graffiti was placed at the junction of three internal wall panels on the first floor of a destroyed residential building in Borodyanka (Tsentralnaya, 353). The building is in disrepair, some of the structures are in an unstable condition and are constantly crumbling (Fig. 11a). To protect it from precipitation, the image was covered with anti-vandal film glass (Fig. 11b). Carrying out work to strengthen walls with graffiti according to the previous option is impossible. Firstly, there is no open area in front of the graffiti and creating it is problematic since the existing foundations get in the way [41]. Secondly, working on the front side of the image is dangerous, since there is a high probability of collapse of the overhanging elements of the upper floors. Thirdly, on the reverse side of the graffiti, the rooms between the three walls, forming a T-shaped connection in the plan, are filled with fragments of reinforced concrete structures.

To save work, various options have been proposed, differing in technical complexity. The most rational among the proposed options were two.

The first is a modification of the project in Irpen (Fig. 10). Work on strengthening vertical walls in this case should be carried out only from the outside. The frame bandage fixes two transverse walls. For this purpose, contact chemical anchors with high adhesion must be

used. The fixing studs for the frame should be replaced with pins or (if drilling in the walls is possible) anchors with a rotating head at the end (Fig. 11c). A protective canopy in the form of a metal frame covered with reinforced concrete slabs is installed on the outside to ensure safe working conditions. To install the frame, it is necessary to prepare the installation site in front of the graffiti section by filling the foundation cells of the destroyed section with concrete mixture and reinforcement.

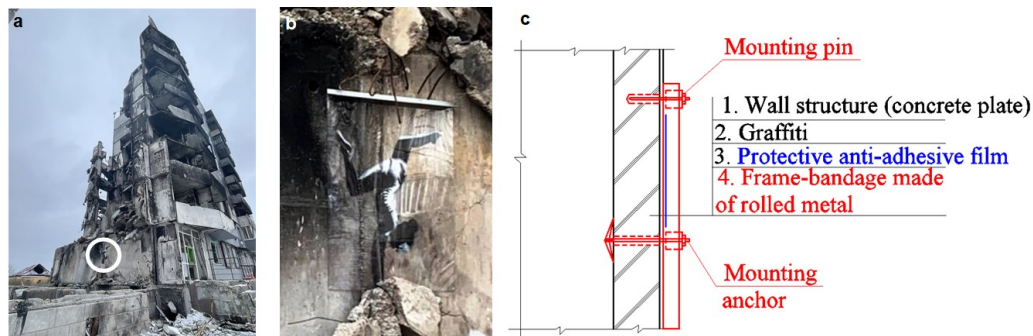


Fig. 11. Mural in Borodyanka. Photo by V.Kolyakova, H. Shpakova, 2023:

a – view of the building (February);

b – protection of graffiti (March); c – schematic diagram of panel reinforcement

In the second option for strengthening the vertical walls, it is proposed to install a monolithic reinforced concrete casing that will completely cover the graffiti during the dismantling of the upper floor structures. To do this, the surface of the graffiti must be treated with a binding protective composition [39]. Afterward, a separating film is fixed on the wall over the image, which will prevent the adhesion of the surface of the image to the concrete mixture. Next, a rigid concrete casing is built up using shotcrete. Additionally, the structure is reinforced with ready-made frames, which are also covered with shotcrete. This option allows you to perform some work at a distance, reducing the time people spend in the danger zone.

The proposed options differ in technical preparation but are the same in economic assessment. Preserving the work of a famous artist will be a very expensive project since each one has unique conditions.

As the experience of many cities on whose territory unique art objects are located, including those by the artist Banksy, has shown, the approach to the preservation of works is different [4]. Often, in difficult cases, authorities prefer to leave the work in place without additional protective measures [36].

Analyzing the scientific works of art historians [17, 19] and the experience of many foreign and domestic galleries [18, 26], the authors propose another option for preserving graffiti - holographic conservation. Holography makes it possible to restore a full-fledged three-dimensional image of real objects. Holography can produce an exact three-dimensional copy of the original object. Such an image, with many angles that change with changes in the viewing point, has amazing realism and is often indistinguishable from the real object. Holograms are indispensable in the production of high-quality reproductions of sculptures and museum exhibits [17, 19, 43, 44]. Although three-dimensional (relief) objects look better on holograms, the definition of these graffiti as installations associated with the place of their display speaks in favor of the holographic conservation of the previously discussed objects.

Conclusions

Graffiti, street art and muralism coexist today in big cities along with all other visual media (for example, advertising) and are confidently entering the public sphere, displacing archaic galleries, art halls and cinema. The Ukrainian capital, as noted above, is annually replenished with new cultural acquisitions of contemporary art. There is even a special application for IOS, which contains information about works of Kyiv Street art. Using this program, you can find your way around the city streets, read a brief description of each art object, and get directions to any point using Google Maps.

Kyiv was and remains a city with its cultural traditions. It combines one and a half thousand years of history and modern creativity, supported, scolded and praised by townspeople and visitors. There are thousand-year-old buildings and modern murals. As many years ago, the responsibility of the authorities was to take care of the preservation of cultural heritage for future generations. In this city, in this country, other people's opinions and work are respected. That is why street art has so easily become commonplace as a means of expressing ideas, a sign of the evolution of society. Graffiti on the ruins will have a special place in the hearts of Ukrainians. Today this direction causes pain, a desire to run away, not to look, not to remember! Until it gets easier. This study is intended to highlight the place of the phenomenon of graffiti and street art in the environment of Ukrainian cities and show the desire, despite all circumstances and problems, to preserve the idea, history and quality of the work. The article presents schematic diagrams of strengthening structures developed by the authors.

The philosophy of street art, as stated at the beginning, is to draw attention to the problem here and now! Therefore, its authors are spontaneous, extreme and partly illegal. Their works look in the context of events and surroundings. Therefore, the relevance (read comprehensibility) of the work exists until the environment has changed: the anti-tank hedgehog has not disappeared (Fig. 7b), the overhanging wallpaper imitating drying laundry has not torn off (Fig. 4 b), the basement with those hiding in it has not disappeared executions by people (Fig. 10 e). Of course, some topics are eternal and understandable to any inhabitant of the planet, and not to a separate urban group: peace, war, ecology, children. Therefore, it is fair that the residents of Kyiv and the region want to preserve the graffiti in question not in the context of the hype value of their author, but in the spectrum of universal human desires - the preservation of peace, the triumph of justice and gaining faith in the future.

References

- [1] J. Ferrell, *Foreword – Graffiti, street art and the politics of complexity*, **Routledge Handbook of Graffiti and Street Art**; Ross, J.I., Ed.; Routledge: New York, NY, USA, 2016; pp. 30-38.
- [2] D. Burliuk, V. Kamensky, V. Mayakovsky, *Manifesto of the Flying Federation of Futurists*, **Futurist Newspaper**, 1, 1918, p. 1.
- [3] I. Sandu, G. Deak, Y. Ding, Y. Ivashko, A.V. Sandu, A. Moncea, I.G. Sandu, *Materials for Finishing of Ancient Monuments and Process of Obtaining and Applying*, **International Journal of Conservation Science**, 12(4), 2021, pp. 1249-1258.
- [4] H. Shpakova, A. Shpakov, *Evolution of technologies for preserving structures using the example of Banksy's work in the Kiev region*, **Buildings and Structures for Special Purposes: Modern Materials and Structures: IV International Scientific and Practical Conference**, April 26-27, 2023, Kyiv. (Original language: Г. Шпакова, А. Шпаков,

- Еволюція технологій збереження конструкцій на прикладі робіт Banksy в Київській області, Будівлі та споруди спеціального призначення: сучасні матеріали та конструкції: IV Міжнародна науково-практична конференція 26-27 квітня 2023, Київ, 101-102).*
- [5] P. Spiridon, I. Sandu, L. Stratulat, *The conscious deterioration and degradation of the cultural heritage*, **International Journal of Conservation Science**, **8**(1), 2017, pp. 81-88.
- [6] T. Rivas, E.M.Alonso-Villar, J.S. Pozo Antonio, *Deterioration of art in public spaces: First assessment of the problems for its conservation*, **In Proceedings of the TECHNOHERITAGE 2019**, 26-30 March 2019, Seville, Spain.
- [7] T. Chackal, *Of materiality and meaning: the illegality condition in street art*, **Journal of Aesthetic and Art Criticism**, **74**(4), 2016, pp. 359-370.
- [8] I. Sandu, *Modern Aspects Regarding the Conservation of Cultural Heritage Artifacts*, **International Journal of Conservation Science**, **13**(4), 2022, pp. 1187-1208.
- [9] A.-L. Cercleux, *Graffiti and Street Art between Ephemerality and Making Visible the Culture and Heritage in Cities: Insight at International Level and in Bucharest*, **Societies**, **12**, 2022, p. 129.
- [10] M. Gomez, *The Writing on Our Walls: Finding Solutions through Distinguishing Graffiti Art from Graffiti Vandalism*, **Journal of Law Reform**, **26**, 1993, pp. 633-707.
- [11] M. Chatzidakis, *Street art conservation in Athens: Critical conservation in a time of crisis*, **Studies in Conservation**, **61**, 2016, pp. 17-23.
- [12] A.-L. Cercleux, *Street Art Participation in Increasing Investments in the City Center of Bucharest, a Paradox or Not?* **Sustainability**, **13**, 2021, Article Number: 13697.
- [13] N.K. Mikhno, *Elements of street art in the semantic-syntagmatic space of the city*, **Scientific and Theoretical Almanac «Grani»**, **22**(12), 2019, pp. 15-22. (Original language: Н. К. Міхно, *Елементи стріт-арту у семантико-синтагматичному просторі міста*, **Науково-теоретичний альманах «Грані»**, **22**(12), 2019, С. 15-22).
- [14] V. Mantrov, *Protection of street art (graffiti) from the perspective of latvian authors'law*, **Culture Crossroads**, **13**, 2019, pp. 84-94.
- [15] I. Szmelter, *Etyka w ochronie i konserwacji dziedzictwa sztuk wizualnych*, **Ochrona Zabytkow**, **75**(2), 2022, pp. 7–37.
- [16] L. Pujia, *Cultural heritage and territory. Architectural tools for a sustainable conservation of cultural landscape*, **International Journal of Conservation Science**, **7**(1), 2016, pp. 213-218.
- [17] Z. Gao, M. Du, N. Cao, M. Hou, W. Wang, S. Lyu, *Application of hyperspectral imaging technology to digitally protect murals in the Qutan temple*, **Heritage Science**, **11**(1), 2023, Article Number: 8.
- [18] A. Macchia, S.A. Ruffolo, L. Rivaroli, M. Malagodi, M. Licchelli, N. Rovella, L. Randazzo, M.F. La Russa, *Comparative study of protective coatings for the conservation of Urban Art*, **Journal of Cultural Heritage**, **41**, 2020, pp. 232-237.
- [19] M. Zhang, *The Application of Computer Augmented Reality Technology in Ancient Murals*, **Mobile Information Systems**, 2022, Article Number: 8114366.
- [20] A.I. Calero-Castillo, A. Carrasco-Huertas, M. Durbán-García, J. A. Durán-Suárez, *Documentation and virtual reconstruction applied to the restoration of large format pictoric works: The mural canvas painting from the Zambrano Pharmacy [Documentación y reconstrucción virtual en restauración de obras pictóricas de gran formato: El lienzo mural de la Farmacia Zambrano]*, **Virtual Archaeology Review**, **11**(23), 2020, pp. 141-152.

- [21] M. Bertasa, C. Ricci, A. Scarcella, F. Zenucchini, G. Pellis, P. Croveri, D. Scalarone, *Overcoming challenges in street art murals conservation: A comparative study on cleaning approach and methodology*, **Coatings**, **10**(11), 2020, Article Number: 1019, DOI10.3390/coatings10111019.
- [22] L. Luvidi, A.M. Mecchi, M. Ferretti, G. Sidoti, *Treatments with self-cleaning products for the maintenance and conservation of stone surfaces*, **International Journal of Conservation Science**, **7**(1), 2016, pp. 311-322.
- [23] I. Sandu, *New Materials and Advanced Procedures of Conservation Ancient Artifacts*, **Applied Sciences-Basel**, **13**(14), 2023, Article Number: 8387, <https://doi.org/10.3390/app13148387>.
- [24] G. Deak, M.A. Moncea, I. Sandu, M. Boboc, F.D. Dumitru, G. Ghita, I.G. Sandu, *Synthesis and characterization of an eco-friendly material for stone monuments preservation starting from the eggshells*, **International Journal of Conservation Science**, **12**(4), 2021, pp. 1289-1296.
- [25] W. Shank, D.H. Norris, *Giving contemporary murals a longer life: The challenges for muralists and conservators*. **Studies in Conservation**, **53**, 2008, pp. 12-16.
- [26] X. Gong, X.-N. Han, K.-L. Chen, *Anti-Aging Performance Evaluation of Acrylate Emulsion Used for Cultural Relics Conservation*, **Spectroscopy and Spectral Analysis**, **43**(7), 2023, pp. 2181-2187.
- [27] M. Baglioni, G. Poggi, D. Chelazzi, P. Baglioni, *Advanced materials in cultural heritage conservation*, **Molecules**, **26**(13), 2021, Article Number: 3967.
- [28] J.S. Pozo-Antonio, E.M. Alonso-Villar, T. Rivas, I. Márquez, *Evaluation of a protective acrylic finish applied to surfaces painted with acrylic paints for outdoor or indoor uses*, **Dyes and Pigments**, **212**, 2023, Article Number: 111141.
- [29] J.S. Pozo-Antonio, T. Rivas, N. González, E.M. Alonso-Villar, *Deterioration of graffiti spray paints applied on granite after a decade of natural environment*, **Science of The Total Environment**, **826**, 2022, Article Number: 154169.
- [30] H.H.M. Mahmoud, *The efficiency of polymeric coatings for the conservation of ancient Egyptian wall paintings, El-Qurna Necropolis, Upper Egypt* [La eficacia de los revestimientos polimericos para la conservación de pinturas murales del antiguo egipto, necropolis de el-qurna, alto Egipto], **Ge-Conservacion**, **3**, 2012, pp. 89-104.
- [31] M. Furtak, J. Kobylarczyk, D. Kuśnierz-Krupa, *Concrete in adaptations and extensions of historic objects (on selected examples from Porto)*, **Wiadomości Konserwatorskie – Journal of Heritage Conservation**, **58**, 2019, pp. 15-22.
- [32] E.M. Alonso-Villar, T. Rivas, J.S. Pozo-Antonio, G. Pellis, D. Scalarone, *Efficacy of Colour Protectors in Urban Art Paintings under Different Conditions: From a Real Mural to the Laboratory*, **Heritage**, **6**(4), 2023, pp. 3475-3498.
- [33] A. Pawłowska, Gralińska-Toborek A., Gryglewski P., Sleptsov O., Ivashko O., Molodid O., Poczatko M., *Problems of expositions and protection of Banksy's murals in Ukraine*, **International Journal of Conservation Science**, **14**(1), 2023, pp. 99-114.
- [34] I. Kirizsán, *The applicability of technical regulations referring to interventions on historic load-bearing structures: Safety versus protection of heritage values?* [Aplicabilitatea reglementarilor tehnice de interventii la structuri portante istorice: Siguranta versus protectia valorilor de patri moniu?], **Transsylvania Nostra**, **36**, 2015, pp. 2-12.
- [35] J. Abarca, *From street art to murals: what have we lost?* **Street Art and Urban Creativity Journal**, **2**(2), 2016, p. 60-67.

- [36] T. Rivas, E.M. Alonso-Villar, J.S. Pozo-Antonio, *Forms and factors of deterioration of urban art murals under humid temperate climate; influence of environment and material properties*, **The European Physical Journal Plus**, **137**, 2022, 1-21.
- [37] A. Macchia, S. Capriotti, L. Rivaroli, S.A. Ruffolo, M.F. La Russa, *Protection of Urban Art Painting: A Laboratory Study*, **Polymers**, **14**(1), 2022, Article Number: 162.
- [38] H. Shpakova, G. Tonkacheev, S. Sharapa, I. Glushchenko, *Masonry restoration technology*, **Ways to Increase Construction Efficiency in the Conditions of the Formation of Market Relations**, **43**, 2020, pp. 124-133 (Original language: Г. Шпакова, Г. Тонкачєєв, С. Шарапа, І. Глущенко, *Технологія відновлення кам'яної кладки, Шляхи підвищення ефективності будівництва в умовах формування ринкових відносин*, **43**, 2020, С. 124-133).
- [39] W. Gu, Y. Wei, B. Liu, L. Hu, L. Zhong, G. Chen, *Polyacrylic Acid-Functionalized Graphene@Ca(OH)₂Nanocomposites for Mural Protection*, **ACS Omega**, **7**(14), 2022, pp. 12424-12429.
- [40] L. Rainer, S. Macdonald, *Under the Los Angeles Sun: The History and Design of Shelters Used to Protect the Mural América Tropical by David Alfaro Siqueiros*, **Studies in Conservation**, **63**, 2018, pp. 414-417.
- [41] B. Wu, R. Maalek, *Renovation or Redevelopment: The Case of Smart Decision-Support in Aging Buildings*, **Smart Cities**, **6**(4), 2023, pp. 1922–1936.
- [42] H. Shpakova, I. Glushchenko, *Technological approaches to the restoration of reinforced concrete frame elements* [Technologische Ansätze zur Sanierung von Stahlbetonrahmenelementen], **II International Scientific and Practical Conference Within the Framework of Multidisciplinary Research: Prospects, Problems and Regularities**, November 26, 2021, Vienna, Republic of Austria, 2, 108-110.
- [43] E.V. Belyak, *Problems and ways of creating volumetric optical holographic information carriers*, **Registration, storage and data processing**, **6**(1), 2004, pp. 5-19 (Original language: Е.В. Беляк, *Проблеми и пути создания объемных оптических голографических носителей информации*, **Рєєстрація, зберігання і обробка даних**, **6**(1), 2004, pp. 5-19).
- [44] X. Zhuang, A. Yan, P.W.M. Tsang, T.-C. Poon, *Deep-learning based reconstruction in optical scanning holography*, **Optics and Lasers in Engineering**, **158**, 2022, Article Number: 107161.
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