The study of the Military Church monumental painting materials technology in the Starocherkasskaya village

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Abstract. This article is devoted to the monumental painting technology study of the Transfiguration (Warrior) Church in the Starocherkasskaya village. The temple was built in the middle of the XVIII century. The preserved wall painting dates from the turn of the 19th and 20th centuries. The state of monumental painting, the determination of its preservation degree, the development of methods for its restoration, including disclosure from marks, strengthening, tinting, and making up for losses, are examined. In order to develop the proposals for restoration, a study of its fragments was carried out by the X-ray phase analysis on an “ARL XTRA” diffractometer to determine the composition of plaster, soil and paint coat. As a result of the analysis, it was established that wall paintings are oil painting on gypsum soil. Based on the studies, it is proposed to carry out the following works: cleaning from whitewash, removing the surface contaminants, strengthening the paint layer.

Introduction
The relevance of the study is due to the fact that at present, the monumental temple painting of the second half of the XIX - early XX centuries, due to insufficient knowledge, is far from always recognized as a worthy object of historical and cultural heritage. As a result, it was destroyed naturally in idle temples, and in existing ones it is often destroyed and replaced by a modern, inappropriate style of temple architecture and inferior to the original in artistic level. This process, especially large-scale in provincial temples, in the long term may lead to the irretrievable loss of a valuable layer of domestic cultural heritage.

The scientific research and the articles affecting the technique and technology of paintings restoration were published in scientific collections of the State Research Institute of Scientific Research. These are the articles of N.A. Printsev “Prerequisites for the use of modern technical means in the restoration process”, S.V. Filatov “The method of quick disclosure of icons from the late layers”, N.V. Nazarova and T.S. Fedoseeva “Problems and prospects of using new materials in the practice of paintings restoration and the objects of applied art”, T.M. Borodina “The experience of using new restoration materials and techniques in the restoration of oil painting in the Novgorod Museum-Reserve”. The monograph of L.P. Balygina and A.P. Nekrasov “The use of new synthetic materials for the restoration of the monumental oil painting works” very carefully examines the entire process of the work restoration from the initial stages to completion, describes in detail the work technology.

Some problems of the oil painting restoration technology are discussed in detail in the articles of the RRIFM employees (Moscow): T. S. Fedoseeva “Synthetic materials for the oil painting restoration”, T.N. Bodliina “Experience in the use of new restoration materials and techniques in the oil painting
restoration in the Novgorod Museum Reserve”, S.V. Kuznetsov “The problems of the monumental painting conservation of the XIX-XX centuries”.

To study the technologies of wall painting restoration in architectural monuments, the publications of the Russian researchers were also used when writing this work: V.P. Buryi “The problems of the multilayer murals restoration of the XVII-XX centuries.”, M.M. Tseitlina “The architecture monuments monumental painting fragments restoration principles of different times in Belarussia”. To understand the current state of temple painting, the dissertation of the Doctor of Art Criticism L.V. Shirshova “Modern monumental painting of the Russian Orthodox Church (based on the materials from the Savior Christ Cathedral reconstruction in Moscow)” 2012. The research methodology is based on the unconditional preservation concept of the author’s painting and minimization of restoration interventions, as set out in the works of G.I. Vzdornov, Yu.G. Bobrov, L.A. Lelekov.

The aim of the study was to study the building and the artistic materials as well as the painting technology of the Warrior Church in the Starocherkasskaya village, modern methods of monumental oil painting restoration and the development of the work algorithm to recreate the picturesque decoration of the Church of Art in Starocherkasskaya on their basis.

The objectives of the study include:
- the study of the monumental painting current state of the Military Church in the Starocherkasskaya village;
- the technique study of the execution, style, iconography, mural system of monumental temple painting of the late XIX - early XX centuries;
- the study of domestic experience in the monumental painting restoration based on modern methods and the study of examples of the modern methods use in the monumental temple painting restoration in the Rostov region;
- the study of the performing monumental oil painting technique of the late XIX - early XX centuries;
- the development of an algorithm for the military church preserved painting restoration in the Starocherkasskaya village;

The military church is one of the architectural sights of the Starocherkasskaya village. This is one of the oldest surviving churches of the Don region. After the revolution, the temple was abandoned, services were not conducted in it, and it came into ruined emergency condition. In 1970, after the adoption of the decree on the organization of a reserve in the Starocherkasskaya village, the restoration was carried out. The author of the project is I. Makovetsky, the Doctor of Art Criticism, in collaboration with the specialists from the Rost-restavigation association. The architect Y. Yanovich studied residential and public buildings in Starocherkassk for two years. It was supposed to repair all the churches of Starocherkass, including Ratnaya. At this time, a team of restoration artists led by M.E. Sokolenko performed the restoration in Starocherkassk. The plan of the temple corresponds to the “ship” type. The bell tower in the plan is a square, a refectory, a temple and an altar – the rectangles. The altar on the east side is complemented by a semicircular ledge. The walls are brick, mortar, plastered. The roof is iron. The remains of the roof structures and cranes of the 19th century are preserved. During the restoration work, the iron rafters from the domes’ frames with the stigma “1751” were found. The foundations are of limestone. In 2005-2008, the temple was restored by the design organization “SevkavNIPAgroprom” according to the project of M.A. Chestnov. The project included strengthening the structures of the main building and the bell tower. The interior has not been restored.

The monumental wall painting has been preserved only in the upper part. Plaster in many places collapsed and crumbled, which led to the paint layer destruction. The dome painting was not preserved, the ornaments of the piers remained in only a few places.

During the study, the plots of all surviving images were identified. In the ruined state, the painting of the sails was preserved: they show the images of evangelists traditional for these parts of the interior. The composition “Descent from the Cross” is located in the upper register on the southern wall, and “Christ and the Sinner” in the lower register. On the north wall in the upper register is “Salome with the Head of John the Baptist”, in the lower one - “Saint Nicholas stops the execution”. On the western wall in the upper register there are “Fathers of the Church” (“Cathedral of the Saints”), in the lower - “Prophet
Elijah on a chariot”. On the eastern wall at the top, the image is lost. Above the windows, the ornaments with a cross included in the composition are preserved. Between the windows and sails – the images of the Old and New Testaments symbols are preserved. The compositions of the upper register and lower registers, as well as those placed in the sails, are enclosed in frames presented as an image of a roller braided by a ribbon. The gaps between the compositions are filled with a floral ornament of a greenish-turquoise hue with stylized acanthus. In general, the paintings color is academically rigorous, concise, with a predominance of calm deep tones of brown, blue, ocher and purple. The compositions are complex, multifaceted, spatial, the camera angles are diverse, dynamic. Picturesque style, is of no doubt academicism.

Starting from the 17th century, the West European illustrated Bibles often served as an important source of iconography for the frescoes in Russian churches, the most famous of which is the Face Bible of the Piscator. At the moment, it has been possible to establish the source of one of the picturesque decoration compositions of the War Church - “Ascension of the Prophet Elijah”. It is performed on a woodcut by the German artist Julius Schnorr von Karolsfeld (1794-1872) from the Bible in Pictures, published in 1852-1860 in Leipzig and containing 240 illustrations. In addition, a close analogue of the composition “Christ and the Sinner” was revealed in the mural paintings of the church in the Koy village, Tver Region. It was established that the composition “Descent from the Cross” is a free copy of the composition of the same name by V.P. Vereshchagin in the Christ the Savior Cathedral.

**Materials and Methods**

Currently, the painting of the temple is significantly damaged. The paint layer is thinned, it is possible that the paints peel off and crumble, on the plot compositions the paints are almost matte finely peel off, in the ornaments a little glossy, the peeling scales are larger. The subject images and ornaments are covered with a whitewash layer. Ground and stucco under the images are preserved. The soil under the compositions and ornaments is white, firmly attached to the plaster. The lower part of the walls without paintings. Plaster is damaged in some places. There is no plaster at the bottom of the walls, damage to the brickwork is visible: potholes and talus of bricks.

The masonry was damaged in some places in the cupola, the stucco layer was not preserved, it is not known whether the painting was performed there.

The masonry was preserved on the sails, the plaster layer is destroyed, it crumbles, there is a loss of the paint layer, the surviving paints peel off, crumble, on the paint layer there are the traces of moisture drips, surface pollution, white spots.

On the northern wall with the composition “St. Nicholas stops execution” on the upper part of the wall there is a violation of brickwork, a scree of plaster. The paint layer is damaged in places, it crumbles. There are traces of moisture drips, surface pollution, whitewash, loss of the paint layer on it, in two places the plaster layer is destroyed to brickwork, at the window level the plaster layer is destroyed, it crumbles, the plaster layer is not preserved at the wall base, the masonry is destroyed in some places.

Above, as already mentioned, the composition “Salome with the Head of John the Baptist” is placed. The paint layer is damaged in places, it crumbles. There are traces of drips of moisture, surface pollution, white marks on it. There is a loss of the paint layer.

On the eastern altar wall in the upper part of the wall, masonry violation, stucco, painting on the altar wall was not preserved, at the level of the windows the plaster layer was destroyed, crumbling, the plaster layer was not preserved at the base of the wall, the masonry was destroyed in places.

On the southern wall with the composition “Christ and the Sinner” in the upper part, a violation of the brickwork, a scree of plaster. The paint layer is damaged in some places, it crumbles, there are moisture drips traces, surface contamination, streaks, there is a loss of the paint layer. There is the “Descent from the Cross” composition above. The paint layer here is damaged in places, it crumbles. There are traces of drips of moisture, surface pollution, white marks on it. There are also losses of the paint layer. At the window level, the plaster layer is destroyed, it crumbles. At the base of the wall, the plaster layer was not preserved, in some places the masonry was destroyed.
On the western wall with the composition “Elijah is ascending to heaven in a chariot” on the upper part there is a violation of brickwork, a scree of plaster. The paint layer is damaged in places, crumbles. On the paint layer there are traces of moisture drips, surface pollution, whitewash. There is a loss of the paint layer. In the images of the evangelists, the paint layer is damaged and crumbles in some places. On the paint layer there are traces of moisture drips, surface pollution, whitewash. There is a loss of the paint layer.

At the window level, the plaster layer is destroyed, it crumbles. At the base of the wall, the plaster layer was not preserved, in some places the masonry was destroyed. There are stucco moldings above the windows. In the eaves of windows ornaments from the crosses. The plaster raise flakes, the paint is showered. The color of the walls is light blue, which is traditional for this period and style. The style of architecture and the interior of the baroque, the style of painting frescoes is academicism.

In order to develop the scientifically based proposals for the restoration of the preserved monumental paintings of the Church of the Rat, a study of its fragments was carried out to establish the composition of plaster, soil and the paint layer. A study of the sample materials taken by the author of this dissertation was carried out at the Building Materials Department of the Faculty of Civil Engineering at the Dagestan Technical University, and the interpretation of the analysis results was carried out in the laboratory of the Geological and Geographical Faculty of SFU. The study was carried out by the X-ray phase analysis on an ARLX'TRA diffractometer. The particular device used “adds” to the X-ray diffraction pattern additional lines associated with the radiation of Kβ copper and Lα tungsten. On the interpreted X-ray diffraction patterns, these reflexes are indicated by the blue and brown arrows. The results provide the links to the phase cards from the PDF International Powder Database, which are analogues of phases identified in the analyzed material.

Sample 1 - stucco with cornice
The sample contains gypsum (PDF: 21-0816), anhydrite (PDF: 37-1496), calcite (PDF: 05-0586) and possibly (at the level of the analysis error) quartz (PDF: 46-1045). The gypsum intensities in the X-ray differs slightly from the card indexes due to the texture of the sample; there are also unidentified weak reflexes indicating the other phases slight admixture presence on the X-ray.
Sample 2 - plaster
The sample contains quartz (PDF: 46-1045) and calcite (PDF: 05-0586), in a very small amount of impurities of other unidentifiable phases.

Sample 3 - paint
The sample contains calcite (PDF: 05-0586), quartz (PDF: 46-1045), barite (PDF: 24-1035) and, probably, hydro-cerassite (PDF: 13-0131), but the calculation card for the latter is very different in intensities.
In the first sample, the interplanar spacings are typical for gypsum (7.28 - 4.28 - 3.06 - 2.87 - 2.68 - 2.08 - 1.89 - 2.21 - 1.80, etc.), i.e. the only information from this dimension is gypsum plaster. The second one shows the quartz reflexes (3.34 - 4.26 - 1.82, etc.) and aqueous ferrous sulfate (such as melanterite).

Wall oil painting is gluing the paint layer to the soil and the stucco base (ABV-16, AK-211, AK-251).

**Discussions and Results**

The studies conducted using these methods have made it possible to obtain the reliable data on plaster, binders and soil.

It was found that wall paintings are not a mural, because there are no binders characteristic of fresco painting. Murals are not tempera painting either, since the binders’ characteristic of it are also absent. With a high degree of probability, it can be argued that oil painting was used.

The plaster contains calcite and quartz calcite (PDF: 05-0586), quartz (PDF: 46-1045). The paint contains calcite (PDF: 05-0586), quartz (PDF: 46-1045), barite (PDF: 24-1035), and probably hydrocerussite (PDF: 13-0131).

At the end of the 15th century the artists in Italy started using oil paints for wall painting, they performed their works on lime plasters, and to prevent them from absorbing the paint, they were covered with primers and later they came up with the idea to add gypsum to them.

In Russia, monumental oil painting appeared at the beginning of the XVIII century. The composition of the plaster was lime-gypsum binders. Later, cement mortar with mineral additives started being used.

Plasters and soils in monumental oil painting are multi-component. The soil was usually impregnated with hot linseed oil to prevent absorption of the binder from the paintings. Thanks to the Italian artist of the XVI century Rafael Borgini the recipe stucco soil became popular. The basis in it is gypsum (calcium sulfate), marble chips, lime and glue. Later, sand, stone powders, animal and vegetable glues and other substances began to be added to cements. The lime plasters with gypsum components and a linseed oil layer are typical for Russian monumental painting of the XVII-XIX centuries.

The lime composition includes limestone, chalk, dolomite, shell rock; all of them contain calcium carbonate and magnesium carbonate and are obtained by burning carbonate rocks. Oil painting on lime plasters quickly collapses.

From the literature the use of plaster of gypsum, applied on top of the plaster is known. Then the surface was covered with a layer of white in linseed oil. The resulting primer was ground.

Gypsum plaster has a neutral chemical environment and refers to quick setting - it hardens in 6-10 minutes. Hardened gypsum dissolves in water and therefore, when temperature and humidity change, it comes to the surface through the painting layer’s craquelures. When humidity changes, gypsum impregnated with moisture turns into powder - the layer is shed. A positive property is the acceleration of the plaster hardening, increasing its strength. These advantages and disadvantages of plasters and primers with the addition of gypsum are directly displayed on the preservation state of the painting performed on them.

In the XIX and early XX centuries, stucco solutions were made up with a very diverse ratio of the lime-gypsum binders. A sample of typical stucco of that time can be examined by painting in the building of the Historical Museum (Moscow, XIX century): the bottom layer of stucco contains 5-7% gypsum, the second is 30% gypsum, the filler is quartz sand, the third is lime-gypsum with an addition vegetable glue, on the top of which drying oil and soil were applied, which included some kind of pigment (most often white or ocher) and a binder, linseed oil.

Based on the data on the historical plasters composition of the XIX century and the X-ray analysis of materials taken from the walls, it can be concluded that the white coating on the paintings of the Warrior Church is gypsum crystals that came to the surface as a result of changing the temperatures and constant humidity in the room, and namely therefore, shedding of the paint layer. The dullness of the paints comes from a lack of binder - the layer of drying oil is insufficient for the preliminary primer - as a result, the gypsum plaster has absorbed the oil from the paints. The presence of the mineral hydro-
cerassite plaster (2PbCO3·Pb (OH) 2) in the analysis indicates that lead whitewash was used as the soil for painting, since this mineral is formed as a by-product upon receipt. It is also known from the literature that it was sometimes used as a white pigment.

Summary
1. Monumental painting of the Transfiguration (Warrior) church Starocherkasskaya is currently in ruin. The painting of the skufu dome has been lost, the masonry is damaged in some places, the plaster layer is missing. On the sails, the brickwork was preserved, the plaster layer is partially destroyed, it crumbles, there are losses of the paint layer. The soil is white in color, firmly attached to the plaster. Plaster is damaged in some places. At the walls’ bottom it is absent, masonry damage is visible. The paint layer everywhere is thinned, partially washed off, with whitewash traces, the colors peel off and crumble.
2. The study of the plaster, soil and the paint coat samples was carried out by the X-ray phase analysis on the ARLX'TRA diffractometer. As a result of the study, it was found that the painting was done on gypsum plaster and soil on the basis of zinc white with oil paints. White plaque on the paint layer surface is gypsum crystals that have come to the surface as a result of changing the temperatures and constant humidity in the room. The paints’ dullness is explained by the lack of drying oil in the layer preceding the soil.
3. Based on the studies, the following work algorithm is proposed:
   - Clearing of deposits with an aqueous solution of K-42
   - Surface contamination removal: wipe with a composition of pinene and vegetable oil in a ratio of 4-5 hours to 1 hour of oil.
   - Strengthening the paint layer: primary treatment - alcohol-pinene solution (1: 1). LEDs for restoring the strength of the paint layer and soil, and VA 2EGA - for gluing behind the particles
   - Loss tinting: tinting with oil paints with multilayer glaze.
   - Preservation: application of dammar varnish with the wax addition and the possible coating defects’ elimination.

In conclusion, it must be emphasized that the restoration algorithm proposed a priori can and should be adjusted if applied to the studied monument, especially in terms of the proposed compositions’ concentration, and the implementation of any work should be started with trial operations in inconspicuous places of the temple’s interior architectural ensemble.

References
[1] Lelekova O V 1991 Preservation of the paint layer of the paintings of Dionysius in the village. Nativity of the Virgin of the Ferapontov Monastery (Moscow, Ferapontovsky collection 1).
[2] Nekrasov A P, Balygina L P 1997 Materials and methods of restoration of monumental painting (Vladimir).
[3] Nekrasov A P, Balygina L P 1975 Strengthening the paint layer of ancient Russian monumental painting (Moscow, Art Heritage) 1 126–132.
[4] Filatov V V 1994 The purpose of synthetic materials in the conservation of wall painting Preservation and restoration of historical and cultural monuments (Moscow, Express information) 5 1—9.
[5] Zharikova Z F, Golikov V P 1994 Investigation of the spatial distribution of natural and synthetic consolidants in chalk blocks. Technological problems of the restoration of monumental painting Conservation and restoration of historical and cultural monuments (Moscow, Express information) 5 27 — 32.
[6] Ivanova A V 1977 Restoration of wall painting using synthetic polymeric materials Restoration, research and storage of museum art values: Ref. Sat GBL. – Moscow. 2 27–28, 37–41.
[7] Kishkinova E M 2011 Small temples of Starocherkassk: the problem of style Materials of the international scientific-practical conference "Architecture of a sustainable society" (Rostov-on-Don: SFU) 112-114.
[8] Kishkinova E M 2018 Neo-Greek style in the historical and cultural context of the Southern region of Russia on the example of the cities of Rostov-on-Don and Essentuki (scientific article in English) Materials Science Forum. 931 705-710.

[9] Subbotina R A 2002 The Byzantine tradition in the temple architecture of the south of the Russian Empire in the second half of the XIX - early XX centuries Bulletin of the Russian Humanitarian Science Foundation 4 128-140.

[10] Egorova A V 2015 Features of the restoration of monuments of wooden architecture of Russia. Traditions and innovation in the monumental painting of Byzantine-style temples of the Lower Don and the North Caucasus, Bulletin of the Rostov State University of Civil Engineering 1 19 (19) 128-133.

[11] Kishkinova E M 2006 Problems of iconography: a training manual M-in education and science of the Russian Federation Federal Agency of the Russian Federation (Rostov state. Acad. architecture and art. Rostov-on-Don).

[12] Pishchulina, V V 2001 Historical and theoretical foundations of the restoration of regional cult architecture Transactions of the Rostov State Academy of Architecture and Art (Yearbook) 1 18-21.

[13] Pishchulina V V 2020 A comprehensive methodology for dating objects of the Anakopia fortress (Abkhazia) by mortar Scientific almanac number 2-2 (64) 155-163.

[14] Pimenova E V 2018 The architectural formation of school buildings in the context of continuing education: higher education International Conference on Construction and Architecture: Theory and Practice of Industrial Development, CATPID 2018; Rostov-on-Don; Material Science Forum Volume 931 810-816.

[15] Pishchulina V V 2018 Medieval lime mortars for dating monuments (on the example of objects of Abkhazia from the II to XI centuries) Actual problems of architecture, civil engineering and environmental economics, TPACEE 2018; Moscow Regional State University Moscow 91.