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# State-of-the-Art Research Methodology for Restoration of Architectural Monuments

E A Lapshina<sup>1</sup>, Yu I Likhansky<sup>1</sup>, A A Tolkacheva<sup>2</sup>

<sup>1</sup> Department of Designing Architectural Environment and Interior, FEFU, Vladivostok, Russia

<sup>2</sup> Architectural and Interior Design, FEFU, Vladivostok, Russia

E-mail: likhlap@mail.ru

**Abstract.** The article discusses the problems of restoring architectural monuments, and in particular recreating the color of historical interiors and exteriors. It explains why coloristics is integral to the overall artistic concept of interiors and facades in historical buildings. The paper dwells upon the practical aspects of prior research, which is fundamental to competent restoration. It describes the author-developed comprehensive method for restoring the colors in historical interior, which is based on the known colorization methods as well as on the color key method. The proposed method has been tested on the Vladivostok GUM, a department store and a monument of federal significance.

## 1. Introduction

Restoring an architectural monument requires comprehensive prior research. Insufficiently well-prepared preservation orders for restoration projects are the main reason why monuments are lost. One of the systemic errors is that the colors of a monument are not protected [2]. The problem is that the Russian restoration practices have yet to conceptualize colors as an integral part of the architectural style; another issue is that they lack rigorous research methodology for restoring the colors on the basis of objective data.

When restoring the colors of an architectural monument, its very timeline may present a challenge, as documents and other evidence that could have helped make a well-substantiated decision may not be available. Despite the objectively existing difficulties, the law defines adapting a monument [6] as a process that makes the necessary modifications while not compromising the artistic image of the architectural monument, which also applies to its colors [5]. The concept of artistic image links and intertwines the three basic categories of composition: plastics, space, and color [12, 18]. In this regard, the goal of this study was to develop a color restoration method for architectural monument, which would perform well in the absence or lack of historical interior color data.

Architectural research of a monument seeks to expand as much as possible the knowledge of its construction history, to identify the remains of the now gone architectural forms, to find out whether they have been documented well enough for precise restoration; this includes researching data outside the monument per se as well as analyzing it in kind [7].

## 2. Historical, Bibliographic, Archival, and In-Kind Studies

The first step of preparations is to collect iconographic materials: images of the monument itself; images of something else that contain the researched site; and its photographs. Not only do photographs help identify the original decorations, losses, or later additions; they can also carry some insight of the color. Of course, collecting the texts and other documents on how the monument was raised (when, commissioned by whom, architected and built by whom, etc.) and what colors it had (bills of materials, documents on later reconstructions and repairs, interior descriptions, contemporaries' memories, etc.). Studies in kind are two-staged: there is preliminary research and prior research.

Preliminary research (primary inspection) is to describe the site and to compile the so-called defect statement. These materials will be used to draft the Statement of Work for restoration, which is issued



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ble by monument protection bodies. The statement may specify explicitly what has been lost in terms of colors (paintings, stained glass, decorative gilding, ceramic tiles, etc.); it may also draw preliminary conclusions on whether it is necessary to restore the original colors.

Prior studies in kind begin after the SoW has been issued and continue until restoration per se starts; they transition smoothly into the restoration research as such [13]. These studies comprise measurements, probing, pit underpinning, and openings. Probing is performed for various purposes, including "identifying the earlier or original colors of the building or its elements" [14]. Careful scraping with a sharp scalpel in recesses, under eaves and windowsills, as well as at re-entrant corners may reveal the layers of whitewashing and painting. Analysis of the color layers is summed up in a consolidated color map, which covers the facades and each room of the building.

The completeness of data thus collected is what determines the further course of research.

### 3. Laboratory Tests and Analysis

If probing cannot 'shed light' on the colors of the monument, they can be derived from the black-and-white photographs, which is one of the techniques of science-backed architectural restoration. However, reconstructing the colors from a BW image requires special analytical procedures.

Both achromatic and chromatic palette have gradation by light. This is where a method similar to colorization, i.e. restoring the colors of BW photographs and motion pictures, comes into play [15]. This method has been applied to visual arts when they restored the 1913 colors of H. Matisse's *Bathers by the River* (the painter modified the painting multiple times from 1909 to 1917). Interdisciplinary research of Eugène Druet's BW photograph [9] produced a colored version of 95% color accuracy. Colorization was also crucial to reconstructing the Amber Room of the Catherine Palace in Pushkin [4]. However, in that case the material itself (amber) was key to restoring the colors on the basis of the 86 preserved photographs.

State-of-the-art technology can very accurately recreate the complex color solutions from a BW photograph, making it an efficient source of data. However, the degree of accuracy also depends on the photography technology of the early 20th century. The efficiency of colorization also depends on which kind of contrast dominates the interior; contrast in brightness is preferable.

Aside from photographs, this part of research might use archival texts and other descriptions if they mention the colors. However, such descriptions are often emotional and carry situational and associative connotations, making them subjective.

This means the previously obtained data must be aligned to text-based research to validate both. Comparison of different data (contemporaries' memories, historical BW photos and their colored versions, the preserved fragments and chippings) helps produce a rigorous and well-summarized color database. This is essentially a matrix of data of varying reliability, a system that records contradictions. Analysis of previous experience, including the author's own experience of conventional (on-site and archival) research, coupled with the effectiveness of that research indicates that the matrix alone, however informative, is unlikely to suffice for reasonable decision-making. More objective preliminary data is necessary for recreating the artistic image of the reconstructed site, which necessitates additional color restoration methods that will be able to 'fill the gaps'.

### 4. Monument Color Modeling

Modeling uses the most reliable research-generated data and seeks to purposefully fill the gaps of missing or contradictory details. Thus, the third step is to apply the method of analogies to refine the details earlier data collection efforts have missed.

Analogy can be drawn to the color palette of a site that is similar to the restored site in style. Sometimes, colors can be reconstructed using the artistic impression, like Warsaw was restored with reference to Canaletto's paintings [10]. When there's no such material at hand, there is another option, the so-called key method that relies on artworks in the same style. Choice is based on the author-developed guidelines [2]. The color key must be in line with the reliably identified fragments of the site's palette fragments as well as with the role brightness contrast plays in its composition. What ne-

cessitates such advanced search is the need for consistent unity of color and plastics as manifestations of style in art [19].

However, a generalized color scheme of the style and its imposition onto black-and-white photographs [2] are still insufficient for reliable reconstruction, as the color is a symptomatic construct that points to how a number of factors such as national specifics, nature, climate, as well as subjective and personal preferences affect the local interpretation of the style. The color model needs to be adjusted in the context of time and location. Therefore, this step is to further analyze:

- possible local interpretations of the style;
- time-scaled transformations of color perception aligned to the contemporary ideas of color harmony
- changes in the urban role of the monument with respect to how it altered the colors of its environment.

Analysis of how architectural colors could be affected by the local art and culture requires profound knowledge of its history. For instance, they have attempted to apply the preferred national colors to the urban architecture in Kazan [16]. However, the reference was a countryside site, choosing which was proven wrong, as transposing its colors to the urban architecture did not (and could not) yield the desired results. The outcome was negative. Nevertheless, it is commonly recognized that the local art and culture do transform the general style patterns, whether plastic, spatial, or color-related; this is where such concepts as ‘Moscow’ or ‘St. Petersburg Art Nouveau’, or the Austrian secession, or Art Nouveau in France, or Jugendstil in Germany come from.

Basing the decision on the original colors is not always the best choice, especially if a building has multiple historical layers. The restoration specialists affiliated with the Florence Academy of Arts once decided to use the 17th century color scheme instead of the original 14th century colors for better consistency with the today’s view of color harmony.

Changes in the urban environment surrounding a monument and in the color background it has often requires readjustment so that the monument continues to be an effective part of the composition. Restorers might decide to sharpen the color contrasts of the facade or smoothen them for a more holistic silhouette, etc.

## 5. Experimentation

The project to restore the facade colors of the

Far Eastern State Technological University’s Faculty of Geology building (39 Aleutskaya Str.) was based on the brightness contrast of the plastered surfaces and masonry as detected in photographs. When restoring the colors of the brickwork, the specialists had to choose from a palette ranging from the original bright orange as seen in the brick cross-section to the today’s terracotta color the material evolved over time. The decision to restore the original colors was based on the today’s urban environment, as the two-storey corner building had to landmark the intersection of two highways. Given that the building was (and is) surrounded by achromatic residential high-rises, its accent could only be preserved by keeping the structure’s color dominance. The plastered inserts were warm-toned to make the facade color-unified while preserving the diversity and fragmentation of decorations.

## 6. Color Analysis of Historical Interiors: Evidence from the Kunst & Albers Mall in Vladivostok

This research on restoring the colors of historical interiors focused in a federal monument, the Vladivostok GUM, a department store constructed by Kunst & Albers in 1907 (architect: Georg Junghändel, born 1874, died after 1949). The GUM’s interiors were designed with trading functionality in mind and are still impressive, as pointed by German researcher Lothar Deeg [3].

The first step (2013 to 2015) was to analyze the GUM in kind before restorations began; it comprised measurements, photographic, and inspecting all the rooms in the building, from showrooms to the attic, and even the staff-only rooms. The interior has survived fairly well, which helped document some parts of the original color palette on the basis of the ceramic floor tiling; the metal elements

(stairs bearing the stamp of Eisenwerk Joly Wittenberg, the open-work wrought-iron balustrades, the candelabras, the radiator grilles of whimsical patterns, the ventilation grilles, the safes, and even the cash registers), the wooden decorations (carved railings and furniture), the stucco (floral column caps and ceilings), as well as mirrors and stained glass. The interiors were dominated by the ceramic floor tiling, which featured complex geometric patterns as well as active colors (dark olive and maroon as well as similarly bright gray and mustard). GUM certainly had elements that had barely or not at all been discolored over its lifetime; those served as the basis for further analysis. However, they were not enough.

In the absence of probes (multiple prior renovations destroyed the painting layers) or any mentions of the color in archival texts, the archival photographs became fundamental to correct 'gap-filling'. While data was incomplete at best, the colors of the finishing materials the interiors had preserved gave a fragment of the palette that was further used to colorize the achromatic historical photographs, while the dominance of contrast by brightness made coloring more objective. The preserved color data was translated into achromatic palette using Photoshop CS and Elements, then recorded in photographs and videos of the interior. Fragments of modified color (walls, ceiling, and stucco) were highlighted in the historical photographs for more advanced search for the desired color.

To recreate the general color scheme of the GUM's interiors on the basis of early 20th century photographs, the authors hereof applied their own 'color key' method. Unlike the method of analogies (choosing a color palette characteristic of the style), this method helps preserve the regional and author-specific connotations and details of the style, which is extremely important for late Art Nouveau, as that style did not feature a unified color palette. Color keys cannot be applied in restoration efforts solely by choosing an associated artwork; rather, they must make use of stylistically similar buildings or paintings that share their palette with the monument under restoration based on what is known about the latter.

The herein discussed attempt to reconstruct the colors of the GUM's interiors did not focus solely on the style; it also used the known details of the color palette as identified from the preserved elements of the interior. For the color key, the team chose paintings of the Art Nouveau artist Alphonse Mucha, a contemporary of the architect Junghänel. Some of the recovered colors (the tiling and the equipment) was identical to the palette used by Mucha, which secured picking it as the color key. Further use of the color key implied identifying the palette, the color mass balance, and the dominant contrasts that structured the color composition.

Mucha's art was translated into an achromatic palette to compare against the achromatic fragments of the interior photographs. These color manipulations mainly sought to identify the painting fragments whose brightness matched those of the unknown colors of the analyzed interiors. After highlighting those fragments, Mucha's artworks were translated back to a chromatic palette. This produced a color palette for the GUM's interiors comparable to the lost specimen in terms of brightness. As a result, the team was able to make a color map of the department store that was fairly close to a realistic color image of its interiors in the early 20th century. Color keying, being part of the proposed comprehensive research method, can help restore the interior colors and fill the palette gaps that are in tone and brightness harmony with, and stylistically connected to, the reliably identified colors.

Reconstructing interior colors required rigorous evidence of the used colors to restore the artistic image of the site (in this case, the GUM's interiors). The image comprised the entire spectrum of colors used on large-area surfaces such as walls, ceilings, floors, coatings of decorations such as column caps and stucco, interior decorations such as mirrors, metals, and woods, as well as the items and the equipment indoors. The color polyphony of the different-scale decorations, finishes, and items enabled the research team to recreate the original Art Nouveau interiors in the unique style of architect G. Junghänel.

The comprehensive approach to restoring the colors of the monument combines multiple analytical methods and takes into account the author's (architect's) personal stylistics by recreating their artist portrait. Junghänel graduated as an architect from the Technische Hochschule Charlottenburg (Technische Universität Berlin), his advisor being Julius Karl Raschdorf. Mr. Junghänel represented the

German architectural school of the late 19th and early 20th century. His academic watercolor paintings are indicative of his style and speak volumes of the design of the Kunst & Albers Mall in Vladivostok, including the facade and interior colors.

The stylistics manifests itself when comparing the polychrome interiors against the calmer monochromatic facade. It is the more vibrant interior palette that dramatically alters the perception of the colors of a seemingly reserved architectural monument and creates a memorable color image by contrasting interior and exterior colors. Facade and interior colors complement each other, as it is the individual impressions of the building that create a holistic artistic image of this historical monument.

The research team was able to identify the items that had changed their colors in terms of brightness contrasts over time. These were the wall and ceiling surfaces, the stucco, the column caps, the lamps, and the radiators. The latest restoration effort sought to bring the place in line with the modern requirements in sales industry; in an attempt to preserve the tiling, the team coated it with a preservative and then applied modern flooring of neutral achromatic coloring. Thanks to this, the antique tiles can now be reached if necessary without compromising them. There was also a 'quote': small fragments of the old flooring were kept open near the elevators to give visitors an idea of what the Mettlach tiles, which had adorned the place for more than a century, had actually looked like. Extra effort was made to clean and protect the facades, which restored their original colors. The team also restored the historic main entrance from Svetlanskaya Str.

The role this monument use to play in its urban environment could also be reproduced by manipulating the facades and the landscaping around them. For instance, the historical design of the stained-glass windows made use of marquees accentuated by their own color and texture, making them visible on top of the facade. Restoring the colors of red granite pavings could have recreated the color contrasts against the achromatic facade.

However, the use of modern finishing materials resulted in a drastic change in the colors of the interior, which had been ordered by the building's tenant. The preservation and restoration of individual interior components did not help, as the general artistic concept of a historical Art Nouveau interior was not restored. Now, the GUM offers rather ordinary space of achromatic interiors that better accentuate the goods on display. Reconstruction of Vladivostok's GUM makes it clear how the color-related decision-making faces the conflict between the desire to preserve, protect, and restore a monument, and the tenant's utilitarian view. In the GUM's case, the final solution was focused on conservation. Monochrome is a popular conservation tool that was used in the GUM project. Such conservation means that if the monument ever sees changes in how it is used, restoring its original form might still be possible.

## 7. Conclusions

Apparently, the artistic image of a monument does not necessarily require demolition; sometimes, altering something as basic as colors will ruin the scale, tectonics [1], and general style of the structure. Restoring the historical colors requires rigorous research and substantial decision-making. Recreating the original colors is not the only challenge; creating a plausible color image for an architectural monument while also bringing it in line with the today's esthetics and utilitarianism is no less difficult. Whether the color image could be preserved also depends on reproducing the compositional 'sound' of the building silhouette on top of newly constructed buildings, as well as on the facade-interior color contrasts [2]. Use of colors in monument restoration is associated with the illusory properties of color: retouching if the decorative elements have lost the sharpness of their plastics; or imitating the colors and texture of the original construction and finishing materials [1].

If the project lacks objective data, the color restoration solution can be based on other sources. The herein proposed color key method is a part of research and analysis for color restoration; the method attains a more accurate recreation of the monument's artistic image.

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