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Editors

Luis Agustín-Hernández
Escuela de Ingeniería y Arquitectura
Zaragoza, Spain

Aurelio Vallespín Muniesa
Escuela de Ingeniería y Arquitectura
Zaragoza, Spain

Angélica Fernández-Morales
Escuela de Ingeniería y Arquitectura
Zaragoza, Spain

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From Color Representation to Scientific Practice. Educational Application in the Master's Degree in Preservation of Architectural Heritage of the ETSAV (UPV)

Ana Torres-Barchino^(✉), Jorge Llopis-Verdú,
Irene dela Torre Fornés, and Anna Delcampo Carda

Department of Graphic Expression in Architecture,
Universitat Politècnica de València, València, Spain
atorresb@ega.upv.es

Abstract. From the academic year 2006 to the present, one of the theoretical and practical subjects has been taught in the Master's Degree in Preservation of Architectural Heritage of the ETSAV. It is entitled: Advanced Technology Applied to the Preservation of Architectural Heritage-Chromatic Applications.

This subject, is an elective class that allows to study both a base of the techniques and instruments applied to the restoration, as well as the theoretical concepts about color in architectural heritage.

According to the general objectives of the Master's degree: professional specialization, initiation to research and heritage management; it is expected to give a practical educational training from a previous study based on the presence of color in architectural projects and artistic works of the past that help to understand, recognize, preserve and protect the historical-architectural heritage.

Therefore, the subject starts from the chromatic recovery studies in European historical centers. Its study methodology and scientific research allow to structure and develop its contents. Firstly, a previous study defined by the analysis of the graphic representation (illustrations, works of art, manuals, treaties, etc.). And, on the other hand, the experience in observation work and scientific practice in the laboratory in order to obtain the original color of the historical buildings.

Keywords: Color · Architecture · Heritage

1 The Study of Color and Its Representation in Historical Documents

The studies of the Master's Degree in Preservation of Architectural Heritage begin in 2006 at the ETSAV. A diversity of modules and subjects based, fundamentally, on the theory and practice for the preservation of historical architecture are contemplated. The Department of Graphic Expression in Architecture (DEGA) is one of the six departments that compose this Master's Degree and, it is present in both compulsory and optional subjects. The task of the DEGA is to disseminate the study of architectural heritage by addressing different fields in the core and optional subjects.

The study of color in heritage is one of the topics that are addressed within the structure of the Master's Degree, represented by the teachers of the DEGA. One of the disadvantages of this type of master's degree, in general, is a high percentage of theoretical lessons compared to the practical lessons. It is obvious that theoretical lessons are an essential part of any field of study. That is why our reflection and analysis, arises from the need to test, experiment, touch with our hands, at the same time that we read, observe and study the sources and documents, enriching our knowledge about heritage at all times.

The representation of color in all types of historical and contemporary documents is one of the topics that is approached in a structured practical way to know the process of restoring, preserving and protecting architectural heritage. Therefore, and from the research carried out by the Research Group [1], two essential aspects are contemplated: firstly, to make known the color knowledge through the history of graphic representation and, secondly, to identify by scientific-technical methods the color of the original material of the work that is studied in order to establish objective results through analysis and assessment procedures [2].

In particular, the subject entitled Advanced Technology Applied to the Preservation of Architectural Heritage-Chromatic Applications, offers a methodology based on the search and examination of graphic material: images located in archives of historical manuscripts and museums, that were made by various authors (artists and architects) during different time periods. These reveals the wide variety of texts and paintings colored from direct observation of the natural landscape, representing panoramic architectures with frequent chromatic compositions, which are testimony of the proximity of reality, such as: Canaletto's drawings and paintings with their famous views (Veduta) of Italian landscapes; plans and graphic documents of architectural projects; architectural competitions that describe urban environments and unique buildings and define, in particular, an architectural polychromy full of details, such as the examples shown in the archives of historical manuscripts and collections of the Royal Academy of Fine Arts of S. Fernando in Madrid or in the Royal Academy of Fine Arts of San Carlos in Valencia.

To resort to treaties, workbooks and/or illustrated documents that include ornamental details, colored elevations, graphics and color charts according to the style and architectural composition, is, without a doubt, a material that helps to understand formal, aesthetic and design considerations in certain architectures and monuments.

At the same time, scientific and illustrated documents, based on the materials and chromatic compositions, created by different authors and historical periods, increase the knowledge about the practical procedure, analyzing the criteria of application of color [3] (Fig. 1).



Fig. 1. Treatises of Cennino Cennini, 1398, and Friedrich von Thiersch, 1879

Some notable examples, where the concepts are explained and the knowledge of color in the architectural practice is represented, are, among others, Leonardo da Vinci in his Treaty of Painting (16th century), Vitrubio, Alberti, Lomazzo or Fèlibiène, who dedicated part of their works to polychrome architecture [4].

In the same way, the contributions of successive treatises, published from the 16th to the 19th century, show the notions of color in architecture [5] in a variety of authors, whose contributions [6], in favor of preserving and recovering the color in architecture, allow to deepen restoration theories in a graphic, expressive and, at the same time, debatable way; like Hittorff, JI (1792–1867); Owen Jones (1809–1874); Semper, G. (1803–1879); Ruskin, J. (1819–1900) or Viollet-le Duc himself, E. (1814–1879) (Fig. 2).



Fig. 2. Owen Jones (1809–1874). Studies of polychromatic architecture. Colorist of the Crystal Palace, built by Joseph Paxton in 1851

The origin of more recent studies on color plans in cities, particularly European, during the twentieth century until now, show the student a particular concern about the recovery of color in urban environments and unique buildings, respecting their historical value [7]. The chromatic guidelines in urban color plans, demonstrate a significant advance, with an increasingly elaborated scientific rigor. The historical value of heritage and studies and works on color in certain European environments and cities, carried out by interdisciplinary groups, analyze the different color palettes that are most appropriate in order to revitalize the historic city.

As highlight examples are the works on color plans carried out by Andreï Efimov in the city of Moscow, towards the 70s. They include not only the color distribution organized by neighborhoods, highlighting a heritage color palette based on its architectural stylistic forms, but also a color association based on the historical, urban, and social aspects of the city (Fig. 3).



Fig. 3. “Color plan of Moscow” by L. Antokolski, 1929 (reconstruction of A. Efimov, 1976). Variant I, concentric zones; variant II, districts; variant III, main traffic routes.

Another remarkable study is the work developed by Giovanni Brino in the city of Turin and in other Italian regions in the 90s onwards. He analyzes preserved historical documents, pictorial techniques on facades, carrying out a more artisanal work, elaborating color palettes based on scientific notations such as the Munsell system, collecting the original materials and colors used in the construction of the building. In the same way, and for the same dates to the present, it is worth highlighting the chromatic recovery work in France, carried out by Jean-Philippe Lenclos (Fig. 4) or Tom Porter, among other specialists, that allow to show special sensitivity to the construction materials and the dominant colors of nature, by reproducing color palettes based on the knowledge and testimony of rural, or industrial architecture, close to the urban centers subject of chromatic recovery [8].

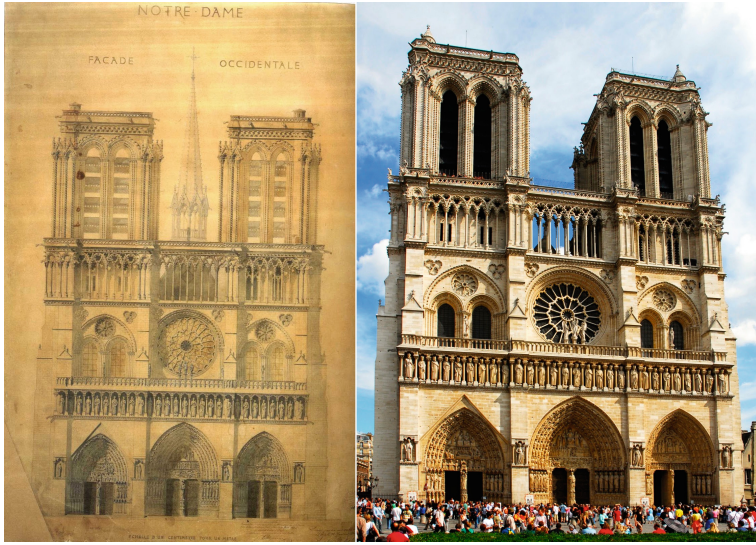


Fig. 5. Viollet-le-duc sketch. Facade of Notre Dame de Paris

The knowledge of color from the scientific perspective is a fundamental condition in the elaboration, organization and coding of color charts that, through different graphic representation systems, allow to guide the restorer in the recovery works. Color palettes incorporate the original name of natural colors, and are a support for developing new colors in the chemical industry.

The most technological part in the restoration processes, such as the instruments of measurement and color control, are useful for the formulation, comparison and objective analysis of the samples (strata and layers of pictorial material) to study.

3 The Scientific Practice of Color

The representation of color offers a structure based on the basic concepts of science and technique of color. These contents are developed based on the chromatic identification of historical architectures, as well as some considerations on surface cleaning techniques in the original materials that constitute the constructive elements [10]. It implies a certain methodological innovation due to the few subjects that deal with aspects of color and ways of representation. Likewise, the formula established in the subject consists in addressing the practical study of the materials as well as establishing their objective considerations. That is, a reading of the graphic project and chromatic proposal for its intervention, based on the instrumental technique provided in the laboratory. Thus, the practice is carried out in parallel with the theoretical part, analyzing the most necessary chromatic methods.

3.1 Practical Work

Once the different graphic documents that identify the essence of the project have been analyzed, two practical parts are carried out in the laboratory:

Firstly, the chromatic study of architectural elements highlighted in historical facade. In this first phase, it is intended to reason and realize about the importance of respecting the logic aesthetic of the buildings and of the historical relevance of them, since they are an imprint of urban culture and evolution. For this, color is understood as an unavoidable part of the formal logic of architecture itself, of each historical facade. It is sought that the student be able to identify these formal characteristics in which inevitably they involve chromatic variants [9].

In the second part, a search and data collection reflected in a mapping of pathologies and presence of colored material is carried out. Finally, a determination of color is carried out, using colorimetric instruments, optical microscopy and scanning electronics, among others [11] (Fig. 6).



Fig. 6. Academic work carried out in the subject Advanced Technology Applied to the Preservation of Architectural Heritage-Chromatic Applications. Students: Anna Delcampo Carda and M^a Verónica Gómez Granero. 2016–2017 academic year

These studies allow to know in an exact way the specific composition of the materials of the chosen facade, both its material composition and the pigments used for chromatic characterization. In this way, the student develops an analytical knowledge of the colored materials.

These tasks allow to exercise the ability to obtain the essential information and data from the perspective of the architectural heritage, as well as analyze and represent the

built architecture, considering the most appropriate science and technology for a multidisciplinary learning. In this way, the objectivity of the results, obtained throughout the entire study, is guaranteed.

As a final phase, the technical development of a color chart for heritage architecture is proposed. The Munsell System [12] (Fig. 7) is chosen as the chromatic notation system to be used.

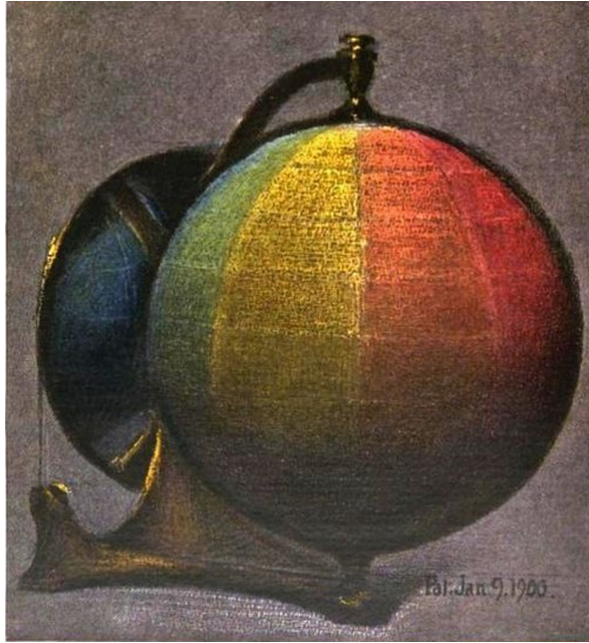


Fig. 7. 1905 Munsell color model

The principle on which this system is based, is that any color is ordered so that the perception of the chromatic difference is always constant between the adjacent colors in the three spatial directions. The suitability of the applicability of this system derives from the correspondence with the colors of the mineral territories, origin of the pigments applied in the chromatic treatment of historical finishes, prior to the introduction of modern industrial pigments.

Therefore, the master student, at the end of his teaching practice, is able to capture an architecture that must be represented from an effective graphic management, in tune with current technological development, as innovative tools in the graphic expression of heritage (Fig. 8 and 9).

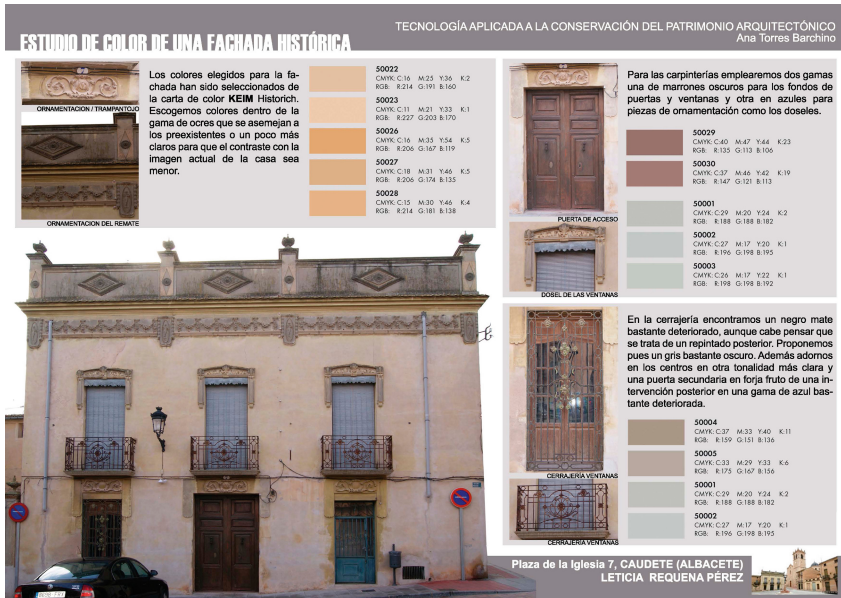


Fig. 8. Work done in the subject Advanced Technology Applied to the Preservation of Architectural Heritage-Chromatic Applications. Student: Leticia Requena Pérez. 2017–2018 academic year



Fig. 9. Practical work in the laboratory with the students of the master. 2017–2018 academic year.

4 Conclusion

The historical and graphic architectural representation based on previous studies, allows us to know that color is a language that takes place in a defined context. The recovery of color in architecture and its practice in conservation processes not only consist in an adequate technical application, but in establishing criteria of composition and harmonic combination in an urban complex, architectural features such as shape, proportions, time of construction and style.

Do not forget to announce the importance of knowledge of color from its identification in the natural landscape or in the urban landscape, where the particular environment of the constructions of our cities that give it the most cultural character of each place is visible. The integration and quality of color in architecture and the respect for natural materials, application of techniques and instrumentation as a methodology in recovery and restoration work allow an encounter with our heritage.

With the proposed teaching practice, it is intended to raise awareness among students, to understand the relevance of color as an imprint of the formal and symbolic culture of cities. Color as something objective that is the result of a territory, a technology and a history. A methodology based on the practice, science and technology guided to the student of Master in Preservation of Architectural Heritage for the use of graphic documentation and representation of color in architectural heritage as current research methods, as a support for color recognition in the architectural work prior to its restoration, focused on professional practice for future architectural heritage projects [13].

It is a practice that generates sensitivities for and to restore and recover, in a reasoned way, an architecture that reflects a society. This awareness is transferred to professional practice, increasing the number of restoration studies and construction works based on respect for the features of historical buildings and their historical landscape.

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