Colours and materials of historical centers: sustainable conservation and management
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ATTACHMENT

Colour Palette: historical center of Castiglione Olona, via Roma
Colours and materials of historical centers: sustainable conservation and management
The term “conservation” in the history of architecture has had several and sometimes contradictory meanings. First of all a concept must be expressed: a return to the past is impossible. The signs that time has left are indelible and their removal or reconstruction, if and when possible, would alter the architectural authenticity, which consists of the original materials used in the constructive phase and the natural and human marks left on it over time. The Founding Fathers, such as Viollet-le-Duc, Ruskin, Boito, Riegl discussed and elaborated restoration fundamental principles and their teachings have been developed within the International Conservation Charters. In the last decades the concept of “cultural heritage” has evolved: from the only consideration of monumental prominent artifacts and buildings in the territory, up to include the whole historical context in which they are located. Hence the renewed attention for historical centers, considered as a whole, and their materials.

The Seventies and Eighties attended a debate originated primarily from different discussions about the concept of historical buildings’ “finishing material”. On one hand there are, above all, Brandi, Dezzi Bardeschi, Spagnesi and Bellini, advocates of “non-intervention” or at most of “minimal intervention”, who admitted only the conservative treatment in accordance with the respect for the image of the city; on the other hand there are proponents of the restoration with a philological setting, who founded the correctness of their interventions on the existence of archival documents and considered plasters and finishings as “sacrifice surface”, as Marconi and Brino; the last one was the responsible for the realization of the first piano del colore (colour project) for Torino city in 1978.

In Italy the so-called pianotit colore represented a first response to the need for tools to regulate, discipline, control, plan, but also enhance the colour on an urban scale starting from the most homogeneous or representative areas of the city, the historical center. The total absence of control and management by the municipal authorities and institutions responsible for safeguard, together with the modern caesura between colour and material following the introduction on the market of industrial paintings, led to uncontrolled changes of fronts, not just for the so-called monumental buildings, but also for the diffused network of historical buildings.

From these early experiences a cultural debate has resulted - considering Restoration Charters, international conventions and recommendations - and led to the elaboration of Colour Plans and guidelines for the conservation and management of historical centers and to plan the expression of individual taste, considering not only the colourings but also the historical support materials. In Italy the Regional Laws Liguria 26/2003 and Campania 26/2002 and Special Laws are used as references for the management of Colour Plans.

In this work, a method for the conservation project of finishing materials of historical buildings is defined. The procedure takes into account the connection between material, architecture and context. The attention is directed to the elaboration of a project which integrates the material conservation with the chromatic problem, in line with the fundamental principles and ethic codes of conservation, such as compatibility, recognizability, minimum intervention, durability.
The Colour Plan doesn’t create rigidly fixed intervention settings, but it aims at harmonizing the conservation of the historical contexts, an historical center or an organic estate of buildings: for each building, with particular attention to monumental ones, is required a specific analysis and knowledge to propose appropriate and coherent methods for intervention over materials and colours. A Colour Plan, starting from the conservative method for the architectural restoration, consists of research and investigation activities, that in part are known, in part specific for its definition. A general knowledge about the interested object is obtained both indirectly, through historical documentation researches, and directly, through visual materials and degradations survey. But historical investigations and direct surveys alone do not provide information enough about the actual state of conservation of materials and moreover about the different layers of materials that have been applied and used during the centuries on historical buildings. In that case the general state of “health” of the walls must be investigated examining the building techniques (often heterogeneous) and the stratigraphic relationships between the various parts of the building, through the use of diagnostic methods, on-site and in laboratory. In addition the colour of every architectural element in the façade (plasters, decorative elements, windows and doors’ shutters, iron elements, etc..) is instrumentally surveyed.

The knowledge background is fundamental to elaborate colour palettes and procedural guidelines for Colour Plans. The colour palette is the most concise and meaningful representation of all the colours on the exterior façades of a building or set of buildings, and is the benchmark for any future colour choice. It can be reproduced in laboratory or in digital version. The colour palette is submitted to the competent municipal office together with the chromatic project and made available to the operators and private citizens in the intervention phase.

Given the heterogeneity of the urban historical context, the first and substantial consideration to make before proposing any façade intervention, is the buildings distinction into two main categories, with different working procedures: monumental buildings, where the intervention should conserve what exists by using only materially and chromatically compatible restoration materials; and diffused network of historical buildings, where, in case of extreme degradation, the complete replacement of deteriorated architectural elements, such as plaster, by using materially and chromatically compatible restoration materials, is allowed and recommended. In that last case, guidelines for the colour choice should be followed.

The guidelines derive from the chromatic data elaboration carried out for each architectural element that constituted a façade, considering also perceptive criteria - no less important than objective scientific evaluations - as building location, façade illumination and context influence.

The cultural heritage - specifically the historical façades - could be a real resource and, through appropriate integrated management, provide a significant contribution to the local economic development. The redevelopment of historical façades together with the enhancement of local economy, will be achieved by concerted actions in order to recover the lost identity of the historical centers. Identity renewed thanks to a collaborative process established between all the participants - public and private – with an active role both in knowledge and investigative phases and in operative management of Colour Plan. Economic facilitating or tax reliefs may encourage and drive the good realization of the Plan.

The methodology intervention here presented finds a practical application in the case study of the historical center of Castiglione Olena. Castiglione Olena is a fourteenth century old town, renowned example of Lombard Renaissance, that offers both remarkable architectural and artistic values and an heterogeneous diffused network of historical buildings and structures, despite the generally bad conservative conditions of the whole area. Castiglione Olena is nowadays place of experimentation and ideal ground for comparison and meeting between theory and practice, between method and its practical application in a complex reality. On this basis, it is possible to plan a development system for the entire old town, including both public and private buildings.
PART ONE
THE STATE OF THE ART

View from Milan Cathedral
1. THE FOUNDING FATHERS OF MATERIAL CONSERVATION

In the history of architecture the term “conservation” has had several and sometimes contradictory meanings. First of all a concept must be expressed: a return to the past is impossible. The signs that time has left are indelible and their removal or reconstruction, if and when possible, would alter the architectural authenticity, which consists of the original materials used in the constructive phase and the natural and human marks left on it over time. Then conservation doesn’t mean returning to an impossible past – as Viollet-le-Duc (1814-1879) proposed through a “stylistic restoration”, with the redesign of the potential original state of the building, even if it was just conceived and never realized, restoring a building is not conserving it, repairing it or replacing it, rather it means returning the monument to a primigenial condition, “in uno stato che non può essere mai esistito in un dato tempo”¹ – but preserving the object for the future generations, avoiding loss of identity and irreversible falsifications, guaranteeing respect and maintenance of materials, eliminating or reducing the causes of deterioration so that it can be enjoyed and used² (Fig. 1).

This important conclusion had been reached over approximately 150 years of “history of conservation”, where “history” means common heritage, indispensable culture and ethical reference, made by censures


and approvals by the greatest European Masters, as Victor Hugo, John Ruskin, William Morris, Camillo Boito, Alois Riegl, and others.

In 1849 in his Seven lamps of architecture John Ruskin (1819-1900) (Fig. 2) contended that the so-called ‘restoration’ was the worst form of destruction. “la parola restauro [...] significa la più totale distruzione [...], una distruzione accompagnata dalla falsa descrizione della cosa che abbiamo distrutto”\(^4\). In the act of restoration something gets irreparably lost. Restoring depletes, taking away its varied complexity, the very richness of the treated object, be it a single building or a group of ancient formation, destroying both marks of what it once was and what time and man had done to it. His theories are considered a European breaking point into the conformism of conservation capable of stimulating the birth of the “Society for the Protection of Ancient Buildings (SPAB)”, with the active involvement of William Morris (1834-1896), Philip Webb (1831-1915) and others engaged in countless campaigns against restoration (Anti-Srape or Anti-Restoration Movement) and against the destruction of architectural heritage, which belongs to all humanity. When Ruskin talks about the “preziosa eredità architettonica da conservare”\(^5\) insists on the importance of simple houses, that is the diffused network of historical buildings, which has the great task to absorb and transmit the passage of time, a temporality that marks not only major events, as suggested in the monumental architecture, but also a more real, continuous and daily time. The diffused network of historical buildings constitutes the foundation of the city, a city that has the value of collective documents, main witness of the men’s life, their customs and their traditions\(^5\). The city is considered as a complex object, a continuous connection between the elements that reinforce the architecture. Ruskin performs highly accurate and detailed descriptions, as in The Stones of Venice, - elements, such as balconies, windows, chimneys or roofs - often meeting examples that he considers the most interesting not necessarily in the “monuments”, but frequently in small residence houses, the diffused network of historical buildings\(^7\).

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\(^4\) Ruskin J., Le sette lampade dell'architettura, Jaca Book, Milano, 1997, p. 226. Trad. “the word restoration [...] means the total destruction [...] a destruction accompanied by the false description of the thing that we have destroyed”.

\(^5\) See the aphorism 27 in Ruskin J., Le sette lampade dell'architettura, cit., p. 211. Trad. “precious architectural heritage to be preserved”.

\(^6\) This passage is underlined into the Roberto Di Stefano’s presentation to one of the last editions of the volume Le sette lampade dell’architettura: “L’ambiente urbano che ne consegue acquista, così, un valore corale di grande interesse, in quanto testimonianza della dignità, della saggezza e dell’equilibrio di un popolo, il quale trae anche da ciò le proprie capacità intellettuali e, particolarmente, quella di creare la ‘grande architettura’”. Trad. “The consequent urban environment, in that way, purchase a value of great interest, because witness of dignity, wisdom and balance of a community, which also elicits their intellectual capability and, especially, to create the ‘great architecture’”. Ruskin J., Le sette lampade dell’architettura, op. cit., p. 18.

\(^7\) Ruskin J., Le pietre di Venezia, Mondadori, Jaca Book, Milano, 1982, p. 202. “L’esempio più alto è un bel gruppo di finestre di una casetta che non ha alcuna pretesa dimensionale; abitata oggi da poveri, si trova nel Campiello della Strope”. Trad. “The best example is a nice group of windows in a little house without demanding particularly dimensions; inhabited today by poors, is located in Campiello della Strope”.

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**Fig. 2 – John Ruskin and his The seven lamps of architecture. Image from: Caivano, 2006.**
The restoration is considered the highest form of destruction; then the material, also the degraded one, becomes the element that enhances the architecture: “E’ in quella dorata patina del tempo che dobbiamo cercare la vera luce, il vero colore, e la vera preziosità dell’architettura”69. Furthermore Ruskin absolute defends the material truth of historic architecture: “Tutt’intera la rifinitura superficiale dell’opera stava proprio in questo mezzo pollice che se n’è andato; se provate a restaurare quella rifinitura, non potete farlo altro che arbitrariamente; se copiate quel che è rimasto, assicurando il massimo possibile di fedeltà (e quale attenzione, o meticolosità, o spesa, è in grado di garantirla?), come può la nuova opera essere migliore di quella vecchia?”69.

In The seven lamps of architecture Ruskin dedicates indeed an aphorism to the thematic of colour; the aphorism 14 “The colours of Architecture are those of natural stone” expresses the close relationship, between colour and material, which in that period was inseparable10: the true colours of nature are those of natural stone and every variety of hue are available. The use of the polychromy obtained from nature is the unique way to create a true and coherent building. A day will come when aids, as the work of the painters, will be lost and the building will be judge in his nudity, with only natural materials and colours11.

The debate continues in Italy over the late nineteenth century with the essential contribution of Camillo Boito (1836-1914), who elaborates the lessons of Ruskin and Morris. Boito asserts the preferability to conserve, instead of restoring, which means taking every type of “addition”, that an old structure may have, into a new planning territory: “Far io devo così che ognun discerna / essere l’aggiunta un’opera moderna”12. Boito clearly expressed the idea that the monument should be treated and respected like a document, that restoration interventions must be limited to the correct conservation of the existing and additions must follow the rules of contemporary planning. Just like Hugo, Boito reaffirms that the monument is a book, a stone witness, a handwritten document and can therefore welcome more pages.

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6 Ruskin J., Le sette lampade dell’architettura, op. cit., p. 220. Trad. “In the golden patina of time we must search the true light, true color, and true preciousness of architecture”.

9 Ruskin J., Le sette lampade dell’architettura, op. cit., p. 227. Trad. “The whole finish of the work was in the half inch that is gone; if you attempt to restore that finish, you do it conjecturally; if you copy what is left, granting fidelity to be possible, (and what care, or watchfulness, or cost can secure it), how is the new work better than the old?”.

10 See PART ONE – chapter 2. Colour Plan: the Italian situation - paragraph 2.1 The need for colour planning: the modern caesura between colour and material.


“I veri colori della natura sono quelli della pietra naturale, e vorrei proprio vederli valorizzati al massimo grado. Ogni varietà di tonalità, dal giallo pallido al color porpora, passando per l’arancio, il rosso e il bruno, è interamente a nostra disposizione; quasi ogni genere di verde e di grigio è disponibile anch’esso; e con questi e il bianco puro quali armonie non potremmo ottenere? Di pietre colorate e variegate ve n’è una quantità illimitata e delle più svariate qualità. Dove ci vogliono colori più brillanti si usi il vetro, e l’oro rivestito di vetro, a mosaico […], e l’opera del pittore sia riservata alla loggia immersa nell’ombra e agli ambienti interni. Questo è il vero e coerente modo di costruire; dove non è possibile attuarlo, il procedimento della colorazione esterna può, in verità, essere impiegato senza che risulti sconveniente; ma ciò deve avvenire con una cauta riflessione sul fatto che arriverà il giorno in cui questi ausili verranno meno e in cui l’edificio sarà giudicato nella sua nudità” Trad. “The true colours of nature are those of natural stone, and I’d really like to see them appreciated to the maximum degree. Each variety of hue, from pale yellow to purple, through orange, red and brown, is entirely at our disposal; almost every kind of green and gray is also available; and with these and the pure white, which harmonies we could not get? There is an unlimited quantity of coloured and variegated stones, and of the most diverse quality. Where are necessary brighter colours then use glass, and gold-coated glass, in mosaic […], and the work of the painter will be reserved to the lodge in the shadow and to the interior. This is the true and coherent way to build; where it is not possible to implement it, the process of external coloring may, indeed, be used without it being inconvenient; but this must be done with a careful reflection on the fact that the day will come when these aids will be less and in which the building will be judged in his nudity.”

12 Boito C., I restauri in architettura, in Boito C., Questioni pratiche di belle arti, Hoepli, Milano, 1893, pp. 3-48. Trad. “I must do so that everyone understands it is a modern addition”. 
into its chronological palimpsest (quality additions of contemporary planning), the writings of new generations of architects.

Camillo Boito’s thought is fundamental for the writing of the first Italian Conservation Charter (1883): “devono venire piuttosto consolidati che riparati, piuttosto riparati che restaurati”\(^\text{13}\). If “additions” and “renovation works” must be carried out, they must show out from and not hide into the old facies; he introduces the concept of distinguishability between old and new, against complete stylistic restorations. “Bisogna che i compimenti, se sono indispensabili, e le aggiunte, se non si possono scansare, mostrino, di essere opera d’oggi”\(^\text{14}\). The document reveals the auspice of using "different materials" in the restoration to highlight the difference between old and new: “Nel compiere parti distrutte o non ultime […] converrà […] che i conci aggiunti o rinnovati, pure assumendo la forma primitiva, siano di materiale evidentemente diverso, o portino un segno inciso […] sicchè neanche in ciò possa l’attento osservatore venir tratto in inganno”\(^\text{15}\). In the following paragraphs the attention is focused on the difference in style and materials between old and new, with the removal - integration - of profiles and ornaments, working only with "indispensable" consolidations respecting the "artistry" of the object: “le parti di compimento indispensabili alla solidità ed alla conservazione dovrebbero essere lasciate coi soli piani semplici e coi soli solidi geometrici dell’abbozzo, anche quando non appaiano altro che la continuazione od il sicuro riscontro delle altre parti antiche sagomate ed ornate”\(^\text{16}\).

Conservation is not inaction: it is necessary to contrast the causes that threaten the survival of the heritage, whether they are due to natural phenomena or to improper uses, present or past.

Another issue is that a building is significant solely in its original state, in the moment immediately after its creation. It’s easy to demonstrate the opposite: the essence of a building is within the original state, but also into all the events and stratifications that occurred during times, from its origins to the present day. Whatever type of interference the humankind has left, it will be actually interesting because potentially rich in meanings that can be found through an aesthetic or scientific experience.

At the beginning of the new century, the aims and the limits of a correct conservation intervention were elaborated starting from the theoretical contributions of Alois Riegl (1858-1905). He points out that the approach to conservation is an eternal conflict between opposing demands. If the objective is “historical value”, consequently the building leads the restorer to return to the ‘original’ architectural style. If the aim is the “value of age” of a building, therefore the age value will lead the architect to a ‘non-intervention’, working against the very demands of conservation. The value of age refers to the weathering, the “patina” and the eventual changes caused to it since the first construction and “its incompleteness, its lack of wholeness, its tendency to dissolve form and colour set the contrast between the value of age and the characteristics of new and modern artifacts”\(^\text{17}\). Of the two values, historical and age, the latter is the most comprehensive, covering even ruins or fragments that would not necessarily have any specific “historical” value. On the other hand, intentional monuments were a small part of the larger group of historical monuments.

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\(^\text{13}\) Trad. “consolidate rather than repair, repair rather than restore”.

\(^\text{14}\) Boito C., I restauri in architettura, in Boito C., Questioni pratiche di belle arti, Hoepli, Milano, 1893, pp. 3-48. Trad. “Completions, if they are indispensable, and additions, if they cannot be avoided, must not look like old work, but clearly show that they are the work of today”.

\(^\text{15}\) Trad. “Executing destroyed or not completed parts […] will be useful […] that blocks added or renewed, even assuming the primitive shape, are in a clearly different material, or bring a sign engraved […] so that even in this, the careful observer may be misled”.

\(^\text{16}\) Trad. “parts of completion essential to the solidity and conservation should be left with just simple plans and geometric solids of the sketch, even when they show themselves other than the continuation or the safe response of the other antique decorated pieces”.

\(^\text{17}\) Riegl A., Moderne denkmalkultur: sein wesen und seine entstehung, W. Braumüller, Wien, 1903.
Riegl considers the “value of the new” as the enemy of the good restorer. It represent the prejudice that wouldn’t consider successful an intervention on a decayed context, if it did not eliminate every embarrassing sign of dilapidation, and deterioration, in the name of systematic ‘renovation’ or replacement of structural and material components. Finally, Riegl recognizes and assigns importance to the “value of use” to guarantee the survival of the building itself thanks to its consistent use.\(^{18}\)

1.2 INTERNATIONAL CONSERVATION ChARTERS: FROM THE MONUMENT TO THE HISTORICAL CENTER

In support of good practices in the field of restoration are the ‘International Conservation Charters’\(^{19}\). The first document known as the ‘Athens Charter’\(^{20}\), produced in 1931 by participants in the International Conference of Experts for the Protection and Conservation of Monuments, Art and History, confirmed the validity of the dictates of the first ‘Italian Conservation Charter’ edited by Camillo Boito in 1883. The Athens Charter banns restorations and stylistic reconstructions, and considers the maintenance as physical and chemical techniques for reinforcing and conserving the materials, to be implemented only after careful examination of degradation and instability. The “Athens Charter” of 1931 corresponds to the moment when the debate about the architectural restoration/conservation was extended to an international level: the need to preserve the monuments context and the “picturesque perspectives” was made explicit, declaring respect for the character and the appearance of the city closeness to the monuments, that should not be altered by inappropriate modifications.\(^{21}\) Giovannoni, who collaborates in the writing of the Athens Charter, extends the concept of “monument” from a single building to the diffused network of historical “minor buildings” in which the monument is inserted. In some cases, actually the urban context and the “extrinsic condition” allow the perception of a building as a “monument”. The limit of this conception is the consideration exclusively of some areas of the city, the closest to the monuments, in a consideration of the entire urban structure that becomes fundamental just as “picturesque frame” for the monument.\(^ {22}\) The Athens Charter exhorts to the employment of modern materials paying attention to both material and chromatic dissonance, according to the concept of “distinctness” of restoration materials suggested by Boito.


\(^{21}\) “La Conferenza raccomanda di rispettare nella costruzione degli edifici il carattere e la fisionomia della città, specialmente nella prossimità dei monumenti antichi, il cui ambiente deve essere oggetto di cure particolari. Uguale rispetto deve aversi per talune prospettive particolarmente pittoresche [...] Essa raccomanda soprattutto la soppressione di ogni pubblicità, di ogni sovrapposizione abusiva di pali e fili telegrafici, di ogni industria rumorosa e invadente, in prossimità dei monumenti d’arte e di storia”. Trad. “The Conference recommends to observe in the construction of buildings the character and appearance of the city, especially near the ancient monuments, whose environment must be object of special care. Equal respect must occur for certain perspectives particularly picturesque [...]. It recommends in particular the suppression of all commercial advertising, any abusive overlapped of piles and telegraph wires, each noisy and intrusive industry in proximity of the artistic and historical monuments “. International Conference for the protection and conservation of artistic and historical monuments, point VII, 1931, in Casagrande S., Recalcati R. (eds.), Il restauro è nudo, Lampi di Stampa, Milano, 2010.


Both the Athens Charter and the Italian Restoration Charter of 1883 are in favor of minimum intervention. Gustavo Giovannoni asserts “non considerare il restauro [...] come occasione per sviluppare un’attività architettonica e decorativa [ma] per seguire la legge del minimo lavoro e della minima aggiunta”24.

The international debate continues after the war with the ‘Gubbio Conference’ in 1960 and after few years with the ‘Venice Charter’25 in 1964 written by Roberto Pane (1897-1987) and Piero Gazzola (1908-1979) on the occasion of the second international exhibition of monumental conservation in Venice. The Charter clearly sets the working methods considered incorrect and therefore the working methods to be avoided: - stylistic or analogical completion; - removals or demolitions that erase the changing of the monument during times; - the move, reconstruction or relocation to a place other than the original; - the alteration or removal of the “patina” from the historical monuments; - the alteration of the environmental conditions with which it came to us.

The last sentence represents a step forward the widening to the range of conservation: it moves from the single monument to its context, the whole historical center. Conservation changes scale; it becomes a functioning instrument in a more general plan of conservation and development at an urban and regional scale. The problem to conserve the characteristics of a built area is considered, particularly the word “colour” appears for the first time in the debate about the typology of operations allowed to deal with the needs for conservation of traditional historical contexts26.

Considering the experience of restorations done until then, more attention is paid to materials and techniques. In particular the efficiency of modern instruments for the conservation should be demonstrated by scientific data and guaranteed by the experience.

Article 12 also introduces the concept of “harmony” in the "distinctness": “Gli elementi destinati a sostituire le parti mancanti devono integrarsi armoniosamente nell’insieme, distinguendosi tuttavia dalle parti originali, affinché il restauro non falsifichi il monumento e risulti rispettata sia l’istanza estetica che quella storica”27.

In the same period the Associazione Nazionale Centri Storico-Artistici (ANCSA) was founded and the members sanctioned the refusal of demolitions-substitutions, static and hygienic renewal, new intangibility and buildable limits, need for a cataloguing and a knowledge base28.

Since the Seventies the typological model for evaluating the built process, elaborated by Saverio Muratori, has begun to circulate. This conception considers the restoration project like a method to split the architectural system into a sum of autonomous parts from which the parts extraneous from the building type will be subtracted with high destructive interventions. “Il metodo piace ai nuovi architetti e consulenti del recupero urbano (Benevolà, Cervellati) e prende facilmente piede in Italia [...]. Le amministrazioni delle grandi città iniziarono a fare a gara per assicurarsi, in nome della supremazia e oggettiva ragione del ‘tipo

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24 Giovannoni G., Questioni di architettura nella storia e nella vita. Edilizia – Estetica architettonica – Restauri – Ambiente dei monumenti, Società Editrice d’Arte Illustrata, Roma, 1925, p. 112. Trad. “to not consider the restoration [...] as an opportunity to develop an architectural and decorative activity [but] to follow the law of minimum intervention and minimal addition”.


26 1964 – Carta di Venezia, Art. 6. La conservazione di un monumento implica quella delle sue condizioni ambientali. Quando sussista un ambiente tradizionale, questo sarà conservato; verrà inoltre messa al bando qualsiasi nuova costruzione, distruzione ed utilizzazione che possa alterare i rapporti di volumi e colori”. Trad. “The conservation of a monument implies that of its environmental conditions. When there is a traditional context, this will be conserved; any new construction, destruction and use that could alter the balance of volumes and colours will ban”.

27 Trad. “The elements intended to replace the missing parts must integrate harmoniously with the whole, however distinguishing themselfs from the original parts, so that restoration does not falsify the monument and both the aesthetic and the historical significance are satisfied”.

edilizio di base", un nuovo e coerente volto, specchio delle nuove certezze ‘scoperte’ ed esibite dai nuovi feticisti del ‘recupero tipologico’: a Bologna, Brescia, Gubbio e così via. The simplification of reality for the purposes of study is made applicative and irreversible, sustained by the conviction that the urban transformations are attributable to typological invariants, then organizable through a methodology coded in advance. Anyway the typological plans are instruments used to deal with the need to be immediately operative contrasting the lack of regulations, as technical standards for implementation (Norme Tecniche di Attuazione) into the local strategic plans (Piani Regolatori): “La pianificazione urbanistica, a sua volta, deve favorire questo incontro articolando le sue norme in accordo con la struttura seriale dell’edilizia antica, distinguendo cioè negli strumenti urbanistici e nelle norme di attuazione i singoli tipi edilizi antichi. Le migliorie esperienze […] dimostrano che occorre introdurre la destinazione tra i tipi edilizi del Piano Regolatore Generale; così per ogni tipo le norme acquistano un carattere concreto, ed enumerano -in relazione ad un organismo edilizio definito- le parti da conservare e le parti da trasformare”. The ANCSA conferences in Gubbio and Bergamo (1970 and 1971) introduced the concept of historical center as economic asset. Gabrielli in the introductory document to the Congress of 1970 considers what happened in the previous decade barely relevant on the reality, because “è mancata una visione globale del problema, contestuale alla nostra società, alla dinamica dello sviluppo, alla utilizzazione delle risorse economiche e finanziarie. E’ mancata ciò non tanto l’ottica del sociologo o dell’economista, o dell’esperto finanziario, o del giurista, bensì la capacità di pensare in termini globali a tutto il problema nelle sue varie articolazioni. E’ mancata in sostanza l’ottica del pianificatore a grande scala, capace di individuare nel problema dei centri storici un problema di scelta della società civile”.

In 1972, eight years after the “Venice Charter”, the “Italian Charter of Restoration” was elaborated. It constitutes the basis for the formulation of mandatory instructions and a guidance for the heritage safeguarding. Among the significant changes introduced should be noted the focus on the concept of reversibility: “Ogni intervento sull’opera o anche in contiguità con l’opera […] deve essere eseguito in modo tale e con tali tecniche e materie da poter dare affidamento che nel futuro non renderà impossibile un

29 Dezzi Bardeschi M., Il restauro tipologico: nascita (e tramonto) di una categoria rassicurante, in “ÌNÀΓKH”, 9 (1995), pp. 60-63 e riedito in Dezzi Bardeschi M., Restauro: due punti e da capo, Gioenì (ed.), Franco Angeli, Milano, 2004. Trad. “The method is appreciated by the new architects and consultants of urban renewal (Benevolo, Cervellati) and easily takes hold in Italy […]. The administrations of the big cities began to compete to assure themself, in the name of the supremacy and objective reason of the ‘base building type’, a new and coherent aspect, mirror on the new certainties ‘discovered’ and exhibited by the new fetishists of the ‘typological restauration’: Bologna, Brescia, Gubbio and so on”.

30 Benevolo L., Le ricorrenze dell’edilizia antica come presupposto dell’intervento moderno con i sistemi ricorrenti, in Benevolo L. (ed.), Umbria. Una proposta per i centri storici, Officina Edizioni, Roma, 1986, p. 13. Trad. “The urban planning, in turn, should facilitate this meeting articulating its regulations according to the serial structure of ancient built, distinguishing the individual ancient building types in urban instruments and standards for implementation. The best experiences […] show that the function should be introduced in the building types of the Piano Regolatore Generale; so for each type the regulations acquire a concrete nature, and enumerate - in relation to a defined building - the parts to conserve and other to transform”.

31 Giambruno M., Verso la dimensione urbana della conservazione, op. cit.

32 Gabrielli B., Il recupero della città esistente. Saggi 1968-1992, Etas, Milano 1993, p.15. Trad. “a global view of the problem, contextual to our society, to the dynamics of development, to the use of economic and financial resources went missing. Not only the viewpoint of sociologist, economist, financial expert or lawyer, but also the ability to think in global terms to the entire problem in its various forms, went missing. In substance the viewpoint of the large-scale planner, able to recognize into the problem of the historical centers, the problem of choice of civil society, went missing”. The social issues and the fundamental role of architectural heritage conservation as priority aim for the planning, will be recovered in the “Amsterdam Charter” (1975): international document that constitutes the Final Declaration of “Congress of European architectural heritage”.
nuovo intervento di salvaguardia o di restauro”\textsuperscript{33}. In addition, article 9 defines that “L’uso di nuovi procedimenti di restauro e di nuove materie, rispetto ai procedimenti e alle materie il cui uso è vigente o comunque ammesso, dovrà essere autorizzato dal ministero della Pubblica Istruzione su conferme e motivato parere dell’Istituto Centrale del Restauro”\textsuperscript{34}; the I.C.R. will examine the materials and methods “antiquati, nocivi e comunque non collaudati, suggerire nuovi metodi e l’uso di nuove materie”\textsuperscript{35}.

In addition, the urban colours, considered until then a peripheral thematic to the safeguarding of the existing city, enter strongly in the question of the historical centers. The attention to colour arises, therefore, in conjunction with the resumption of attentions towards the conservation of the historical city, although initially just as “più esteriore manifestazione del restauro tipologico”\textsuperscript{36}. Pursuant to the critical reading of Ventimiglia the interventions following the precepts of the typological restoration are always aimed at deleting everything that’s not considered “serial” and substituting them with new materials. But the thematic of colour in cities is a corollary that “solo a forza può essere isolato ed enucleato da una più generale questione del restauro. Si corre il rischio [...] d’una sorta di riduzionismo culturale che sempre finisce col rendere miope la visione del problema ed infine col distorcerla”\textsuperscript{37}.

On that occasion Gianfranco Spagnesi, who opens the works and coordinates the roundtable, asserts: “Il problema del colore considerato autonomamente è un falso problema, il vero problema è quello della città”\textsuperscript{38}. The subsequent extension of the speculative field of restoration to historical city is an issue that has increased for the development of the existing asset with respect to new buildings, and also for the cultural, linguistic, formal and even chromatic connection that links the building to the city. For that reason it is not possible to restore a single element without considering the totality of the parts composing the urban organism of which it is part. After realizing the fundamental value of colour into a urban planning, in the last thirty years a debate has arisen, for the comparison between different schools of thought. These discussions led to specific studies towards, not just individual buildings, but also entire historic centers of cities. Hence the birth of the first “piani del colore” to reflect the importance of the colour, no more considered only as a decorative element. In fact, it begins to be “importante discutere e progettare il colore come elemento significativo dell’ambiente per restituire alla città qualche cosa di cui spesso è stata espropriata per timore delle difficoltà, per incuria o per mancanza di pensiero”\textsuperscript{39} – using Longo’s words.

In 1975 – the year of European architectural heritage – the ‘Amsterdam Charter’\textsuperscript{40} attested that conservation must not be considered as a minor problem, but as the main aim for urban and regional

\textsuperscript{33} 1972 – Carta Italiana del Restauro, Art. 8. Trad. “Any intervention on the building or in his proximity [...] must be performed in such a way and with such techniques and materials that can be trusted that in the future do not make impossible a new protective or restorative intervention”.

\textsuperscript{34} Trad. “the use of new methods for restoration and new materials, compared to procedures and materials, the use of which is in force or otherwise permitted, must be approved by the Ministry of Public Instruction on confirmations and reasoned opinion by the Central Institute of Restoration”.

\textsuperscript{35} Trad. “antiquated, harmful and not tested, suggest new methods and the use of new materials.”


\textsuperscript{37} Carbonara G., Avvicinamento al restauro. Teoria, storia, monumenti, Liguori, Napoli, 1997. Trad. “only strikingly can be isolated and enucleated from a more general question of restoration. There is the risk [...] of a kind of cultural reductionism that always ends with making short-sighted the vision of the problem and finally distorting it”.

\textsuperscript{38} Trad. “The problem of colour considered autonomously is a false problem, the real problem is that referred to the city”.

\textsuperscript{39} Longo A., Il passaggio dall’affettività all’architettura nei piani del colore, in Ministero per i Beni e le Attività Culturali (ed.), 1 colori in architettura, Ikon Editrice, Milano, 2006. Trad. “important to discuss and planning the colour as a significant element of the environment to give back to the city something which has often been expropriated for fear of difficulties, carelessness or lack of thought”.

\textsuperscript{40} 1975 - Declaration of Amsterdam.
planning. The new term ‘integrated conservation’ was coined: a new type of conservation integrated into
the planning on diverse scales, related with technical and economic management strategies. The concept of
‘monument’ was enormously enriched: from the themes of material culture and anthropological research,
to gradually including new types of cultural assets and the entire territory inhabited. These new topics
imply the fact that, on the small as well as large scale, the amount of conservation interventions over
historical heritage has been greatly increased.

Article 6 also specifies the importance of following multidisciplinary programs and in the field of
conservation “Le tecniche specializzate messe a punto in occasione del restauro degli insiemi Storici
importanti dovrebbero ormai essere impiegate per l’ampia gamma di edifici ed insiemi di minore interesse
artistico. Occorre controllare che i materiali di costruzione tradizionali rimangano disponibili e che le arti e le
tecniche tradizionali continuino ad essere applicate”41.

1.3 THE SEVENTIES AND EIGHTIES DEBATE: PLASTER AS HERITAGE OR “SACRIFICE SURFACE”

The Seventies and Eighties attend a debate created primarily from different conceptions about the concept
of finishing material of historical buildings. The issue of respect for the value and the historicity of the
finishes was a recurring question. This was the reason why among academics and experts the debate
between the two opposed philosophies remains always alive42: on one hand there are the advocates of
“non-intervention” or at most of “minimal intervention”, who admitted only the conservative treatment in
accordance with the respect for the image of the city as it had historically been received and considered the
finishes as integral parts of a historic building; on the other hand there are the proponents of the
restoration with a philological setting, who founded the correctness of their interventions on the existence
of archival documents and considered the plasters and coatings as “sacrifice surfaces”43.

Starting from his theories of 1963 based on the axiom that expresses the restoration only for the material
of the artwork, Cesare Brandi affirms the conservation of the patina that is “quel particolare affuscamiento
che la novità della materia riceve attraverso il tempo [...], testimonianza del tempo trascorso, non solo
ammissibile, ma tassativamente necessaria”44. If during an intervention a page of history is canceled (with
all the information that coloured surfaces can provide), actually the knowledge, which is sometimes crucial
to the history and understanding of the entire building, is erased.45 He has the certainty that, particularly
on historical buildings, an intervention that requires the least possible subtraction of material shall be
admissible. Material bearer of signs and meanings of documentary, technological and symbolic value, losing
which the intrinsic qualities of an object are missing; ignoring the material the possibility of obtaining
essential information for the understanding of human phenomena loses the intrinsic qualities. Cesare
Brandi, in this regard, claims that “il problema degli intonaci, del colore e delle ricoloriture, nell’edilizia
storica è non meno importante di quello della patina e della vernice nel restauro dei dipinti”46.

41 Trad. “The specialized techniques developed during the restoration of the historic important sets should now be used
for the wide range of buildings and sets with less artistic interest. It’s necessary to check that the traditional building
materials remain available and that the arts and the traditional techniques continue to be applied”.
44 Brandi C., Teoria del restauro, Einaudi, Torino, 1977. Trad. “the particular obfuscation that the newness of the
material receives through time [...], testimony of elapsed time, not only permissible, but absolutely necessary”.
problem of plasters, colourings, and the treatment of the "skin" of the historical buildings, it is no less important than
that of the patina and the varnish for a painting restoration”.

Colours and materials in the history of conservation
Marco Dezzi Bardeschi agrees in principle with Brandi and he supports the conservation of current plasters although deteriorated, in the name of the “effettiva conservazione in situ della cultura materiale depositata sul manufatto [per] non tradire la fabbrica, non ingannare chi a essa si avvicina, non alterare il monumento–documento nel nome del ‘restauro’ o della ‘manutenzione’ [...] non screditare l’obiettivo corretto della permanenza, ossia della effettiva conservazione del contesto fisico arrivato fino a noi”\(^{47}\).

On this same position Gianfranco Spagnesi takes place, who argues that the reinstatement, especially if aimed to the original colour, not only is an impossible operation, but also it is too influenced by subjective interpretations of documentary sources (archival or iconographic)\(^ {48}\).

The conservation of the authenticity of the material is supported also by Amedeo Bellini, who argues that, in a remake intervention, the replacement of original parts of the building is “la forma più rapida di distruzione, e ogni ricorso ad essa è la registrazione di una sconfitta”\(^ {49}\). The document assumes the value of an authentic source of information that can be interrogated in an ever new and different way. Therefore, if the restorer doesn’t want that this potential danger could be canceled, must transform himself into a conservator.

On the other hand Paolo Marconi arises in support of certain types of reinstatement intervention, criticizing “l’intangibilità feticista dell’oggetto documento”\(^ {50}\). He extends to the category of plasters, stuccos, patinas and paintings the concept of sacrifice surfaces. The sacrifice surfaces are tasked to protect the degrading building to be periodically renewed with maintenance or replacement interventions\(^ {51}\). The plaster removal is supported by the belief that at the historic construction site this practice represented a normal maintenance and that the colors were periodically renewed.

The hypothesis, long since invalidated on a theoretical level\(^ {52}\), has been recently undermined to its operational implications by some studies seeming to show how the concept of “sacrifice surface” was rather irrelevant to the construction site of the

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47 Bardeschi M., Conservare, no manomettere l’esistente: l’insostenibile “sacrificio” di Paolo Marconi, in “Recupere”, 24 (1986). Trad. “effective onsite conservation of material culture deposited on the building to not betray the building, deceive those approach it, not alter the monument/document in the name of ‘restoration’ or ‘maintaining’ […] not discredit the correct target of the permanence, that is the effective conservation of the physical context come until us”.


49 Bellini A., Teorie del restauro e finalità della ricerca sperimentale, in Biscontin G. (ed.), L’intonaco: storia, cultura e tecnologia, Libreria Progetto Editore, Padova, 1985, pp. 1-10. Trad. “the most rapid destruction, and any recourse to it is a record of a defeat”.


52 In relation to the reasons supporting the conservation of areas, the proceedings of the conference held in Bressanone in 1990 on the topic “Surfaces of architecture: finishes” are of particular interest. Numerous are the editions of the Bressanone Congress interested on finishing materials: 1985-L’intonaco: storia, cultura e tecnologia; 1990-Superfici dell’architettura: le finiture; 1995-La pulitura delle superfici dell’architettura; 2012-La conservazione del patrimonio architettonico all’aperto.
Marconi argues that this surface protection “aggiunta e deperibile [sia] sostituibile, anche con altri materiali ed espedienti tecnici rispetto a quelli originari, ogni qual volta questa desse segni di deperimento, con operazioni di manutenzione programmate”\(^{45}\). According to Marconi the superficial crusts are integral part of the patina “lontano dal poter essere considerate come un protettivo per le superfici, consistono invece in un accumulo di sostanze nocive continuamente messe in circolazione, a livelli sempre più profondi, dall’acqua meteorica o dall’acqua di condensa\(^{45}\).

These strong contrasts between the protagonists of the Italian debate can be compared with attempts to soften the positions or understand them within a wider or more articulated discourse. An example is the analysis of Valerio Di Battista, who asserts: “l’incoscienilità di queste posizioni che evidenziano obiettivi e sistemi di osservazione differenti dovrebbe però potersi superare attraverso la considerazione che si tratta di finalità e criteri entrambi legittimi […] questi due diversi modi di approccio al medesimo problema, come sensibilità scientifica al documento e come sensibilità alla qualità, entrano in conflitto quando riducono l’oggetto alla sezione di un’unica categoria di informazione, ed uno solo dei due approcci diviene possibile, ma diventano entrambi praticabili acquistando valenze diverse quando fossero applicati, entrambi, ad un sistema complesso […] qual è evidentemente la città storica, nella quale questi due obiettivi non sono più incompatibili, ma anzi sono indispensabili a realtà diversificate [per cui diventa fondamentale la] gestione pragmatica e sapiente di un accurato dosaggio tra conservazione e trasformazione\(^{56}\), and as he observes elsewhere “per le più complesse relazioni ambientali e le continuità temporali che caratterizzano il progetto dell’esistente, questi non potrà mai essere un progetto di sole modificazioni o trasformazioni, e neppure potrà mai essere un progetto di sola conservazione. Esso dovrà invece gestire proprio la continua necessaria compresenza di modificazione e conservazione; la loro inevitabile e complessa dialettica, la difficile ma indispensabile scelta di elementi e sistemi che in parte permangono e in parte mutano”\(^{57}\).

\(^{53}\) Torraca introduced the problem of belonging or not to the historic construction site of the periodical renewal of surfaces during the Bressanone conference in 1990: “Concerning the historical truth of this periodic renewal may be suggested, however, doubts; the bills of seventh and eighth century plasterers and the examination of the facades of Rome actually tell a different story, made of patches and repaintings, so that the “slam everything down” practice seems quite recent, probably related to the traumatic change that in the twentieth century occurs in the traditional trades related to construction”.

\(^{54}\) Marconi P., La questione delle superfici di sacrificio, 1987, op. cit. Trad. “added and perishable [is] replaceable with other materials and technical devices compared to the original, whenever this gave signs of degradation, with planned maintenance interventions”.

\(^{55}\) Marconi P., La questione delle superfici di sacrificio, 1987, op. cit. Trad. “far from being considered as a protective for the surfaces, they consist of an accumulation of harmful substances continuously put in circulation, to deeper and deeper levels, from rainwater or condensation water”.

\(^{56}\) De Battista V., Introduzione a Bocchi M., Duc M. (eds.), L’immagine della città storica: intonaci colori finiture, Electa, Milano, 1989. Trad. “the incompatibility of these positions showing different objectives and observation systems should however be able to pass through the consideration that the purposes and criteria are both legitimate […] these two different ways of approach to the same problem, as scientific sensitivity to the document and as sensitivity to the quality, are in conflict when they reduce the object to the section of a single category of information, and only one of the two approaches becomes possible, but both become practicable by purchasing different values when they are applied, both to a complex system […] what is evidently the historic city, in which these two objectives are no longer incompatible, but rather are essential to different realities [which is fundamental to the] wise and pragmatic management of an accurate dose of conservation and transformation”.

\(^{57}\) De Battista V., Progettare la diagnosi, in Buti A., Torre S., Ugolini P., Recupero e riqualificazione dei centri storici in Europa. Diagnosi e interventi, Regione Liguria, Genova, 1993. Trad. “for the most complex environmental relations and temporal continuity that characterizes the project, these will never be a project of the just changes or transformations, even can never be just a conservative project. It should instead manage the continuous and necessary presence of modification and conservation; their inevitable and complex dialectic, the difficult but necessary choice of elements and systems which in part remain and some change”.
From the comparison of the two positions emerges the absolute necessity of action with a deeper sensitivity and increased attention to knowledge aimed at conservation, considering the importance of the effects that arise when carrying out dissonant or incompatible interventions also in the smallest and modest building that belongs to a relevant context as the historical center of a city. Furthermore the signs of degradation can not be conserved and at the same time removed, also because the degradation is not only an event, but is often a process that keeps active the phenomenon. The conflict exists, but what “distingue il conservare i beni architettonici sta appunto nel riconoscere che gli stessi segni dell’invecchiamento, dell’usura e della degradazione sono parte integrante del bene, e anzi partecipano in modo insostituibile a definirne la nozione. […] L’affermazione brandiana, che lo stato di conservazione – cioè lo stato di degradazione – è segno testimoniale dell’opera e delle sue vicende, andrebbe esteso, dunque, alle stesse ragioni e cause del degrado”⁵⁸.

For many years the debate was limited to scientific or academic fields without any impact in the planning and operational phases. Today, on the basis of the experiences gained through the piani del colore and Colour Plans realized in many Italian towns, the comparison between the different positions looks more systematic and conscious. Nevertheless epistemological, technical and operative issues continue to be numerous. First of all, the topic of the semantic content of the component plaster continues to be debated, that is the controversy about the legitimacy/opportunity to consider the plastered surface only as a sacrifice surface or rather confer it its own aesthetic and historic value.

1.4 THE VALUE OF THE FINISHES AND THE MATERIAL CULTURE

Currently, the conservative approach which starts from the content of the different Restoration Charters condemns any intervention which contemplate the removal of the old material and its substitution with modern materials. In a single fragment of plaster are indeed contained historical evidence that can provide useful information on the historical colouring, materials and manufacturing techniques of the different periods used. The colour of historical façades, as well as the traditional plasters which support it, is nowadays considered document/monument, material full of historic and cultural significance: “l’opera del passato come rappresentativa della cultura propria di un determinato luogo e di un determinato tempo diviene cioè ‘materiale di storia’, in grado di dare informazioni sul mondo che l’ha prodotta. Ne consegue che, il passato è inteso come valore storico permanente, si pone l’esigenza di conservare le opere che lo rappresentano”⁵⁹. It is therefore extremely important to properly recognize and preserve all these material and immaterial values because they are hardly reproducible. Just like Walter Benjamin authoritatively stated in 1935: even if every work can be reproduced in a highly refined way “manca un elemento, l’hic et nunc dell’opera d’arte – la sua esistenza unica e irripetibile nel luogo in cui si trova. […] In quest’ambito rientrano sia le modificazioni che essa ha subito nella sua struttura fisica nel corso del tempo, sia i mutevoli rapporti di proprietà in cui può essersi venuta a trovare. […] L’intero ambito dell’autenticità si sottrae alla riproducibilità tecnica – e naturalmente non di quella tecnica soltanto. […] L’autenticità di una cosa è la quintessenza di tutto ciò che, fin dall’origine di essa, può venir tramandato, dalla sua durata materiale alla sua virtù di testimonianza storica”⁶⁰.

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⁵⁸ Torsello P., La materia del restauro. Tecniche e teorie analitiche, Saggi Marsilio, Venezia, 1988, p. 87. Trad. “distinguishes the conservation of architectural heritage is the recognition that the same signs of aging, wear and degradation are integral part of the building, and they participate in an irreplaceable way to define the concept. […] As Cesare Brandi said, the state of conservation - that is, the state of degradation - is a testimonial sign of the building and his events, should be extended, therefore, to the same reasons and causes of degradation”.

⁵⁹ Sette P., Il restauro dell’architettura. Quadro storico, Utet, Roma, 2001, pp. 3-9. Trad. “the work of the past as representative of the culture of a particular place and particular time becomes ‘historical materials’ able to give information about the world that produced it. It follows that the past is intended as a permanent historical value needing to preserve the works that represent it”.

⁶⁰ Benjamin W., L’opera d’arte nell’epoca della sua riproducibilità tecnica. Arte e società di massa, Suhrkamp Verlag, Frankfurt am Main, 1955 (I edition), Einaudi, Torino, 1966. Trad. “an element is missing, the l’hui et nunc of the work of
Today the fact that the surfaces contain a heritage of technological information (elements of material culture) and history of the building (various phases of construction, changes of the decorative scheme, colours, etc..) is common knowledge. Indiscriminate subtractions or substitutions of material, therefore, lead to the reduction or denial of the documental value of the building. Consequently, the value of the facades emerges: undermining the material integrity means definitively losing the documents/monuments, the places, the historical memory.

"art - its unique and unrepeatable existence in the place where it is located. [...] All that implies both the changes it has over time undergone in its physical structure and the changing property relations that may have encountered. [...] The whole sphere of authenticity eludes the technical reproducibility - and of course not only that. [...] The authenticity of a thing is the quintessence of all that, from the beginning of it, can be conveyed, from its material duration to its virtue as historical evidence".
Colours and materials of historical centers: sustainable conservation and management
2. COLOUR PLAN:
THE ITALIAN SITUATION

2.1 THE NEED FOR COLOUR PLANNING: THE MODERN CAESURA BETWEEN COLOUR AND MATERIAL

It’s widely accepted that each place has specific and usually unique chromatic connotations, and colour is one of the most important elements to recognize the identity of inimitable and unrepeatable cities. Within historical contexts the peculiarity of a place is expressed by materials colour, such as the stones, the bricks, the wood and the pigments available on site. Moreover, the colour variations occurred over time are often the result of phenomena related to few parameters, like local building materials, close relationship with the climatic conditions and succession of architecture patterns. Cities and architectures transformed their image according to aesthetic and ideological currents produced by the live-in society. On the contrary materials used changed only slightly because the manufacturers found them in the same areas of their predecessors, thus limiting the transformations. Architecture and city, therefore, arise directly from the materials available in the neighborhood, forcing urban spaces into the colour ranges typical of the surrounding territories. In that way it’s possible to associate a city to its colours: “Le antiche città italiane, oltre che una speciale architettura, hanno spesso un colore loro proprio. Chi può dimenticare quello ferrigno di Gubbio o Volterra? Quello terso di Siena e di Verona? Quello argenteo di Venezia e di Firenze? Quello fosco-vermiglio di Piacenza e di Bologna? Questi e altri toni di colore fanno parte della fisionomia di molte nostre città ed è quindi un errore voler loro imporre certe note convenienti, ad esempio alle piccole città di Tunisi e Tripoli […] dove le tinte chiare sono destinate a respingere la veemenza dei raggi solari.”\(^61\) It’s clear how during innumerable generations the urban environment remained stable. This material continuity led to the logical consequence of a constructive continuity\(^62\). Traditionally, therefore, the compositional elements of the historic façades are characterized by the shades of natural materials or the artificial finishes purposely applied creating the deep link colour-material-architectural element (Fig. 3).

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\(^61\) Ricci C., *Il colore di Roma*, in “Cronaca delle Belle Arti”, supplemento al “Bollettino d’Arte”, anno III (1916), pp. 82-83. Trad. “The ancient Italian cities, as well as a special architecture, often have a their own colour. Who can forget the steely one of Gubbio or Volterra? The clear one of Siena and Verona? The silver one of Venice and Florence? The dull-vermilion of Piacenza and Bologna? These colour tones and others are part of the appearance of many our city and then it is a mistake to impose certain convenient notes, such as the small cities of Tunis and Tripoli […] where light colours are intended to reject the vehemence of solar rays”.

Within historical contexts, place’s peculiarities come from the colour belonging to the used materials and on-site available; on the contrary, in contemporary situations, there are more advanced technological possibilities leading to break the relation “colour-material”, because colour is now separated from the physical and compositional materials’ properties. The need for studying the concept of colour within cities planning and conservation stands following the introduction on the market, from the middle of the last century, of “globalized” polymer-based paints hardly compatible with historical supports and available in any desired hues, together with the now undifferentiated availability of materials. Until then, the colour did not required special guidelines cause the individual choices were limited to on-site available materials and hues were mostly in the range of earth colours. The import and trade of materials and pigments, with the consequent reduction in costs, opened this market also to the classes before excluded and allowed the man to leave the territorial limits for sourcing materials that were once necessarily imposed. The original harmony given by the coherence in the relation “colour-material-architectural element”, nowadays, due to the industrialized products use, very often runs out (Fig. 4). Similarly the architectural and territorial identity that characterized the living spaces over the centuries goes missing\(^\text{63}\).

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If it’s possible to speak about a kind of colour authenticity related to the physical material properties with specific technics, then the doubt about a new colour legitimacy no more generated from this context grows. The repercussions in the specific colour field are essentials because, when the connection between material, technique and place was lost, even the colour itself loses the authority of a presumed legitimacy and then the need for developing new statutes grows up. The current limitless choice and the technological innovations in the constructive techniques and finishing products production field showed the priority need to provide indications to both public administration and individual citizens in order to control and direct the expression of individual taste.

2.2 THE FORMER EXPERIENCES OF COLOUR ATTENTION

In Italy the so-called piani del colore represented a first response to the need for tools to regulate, discipline, control, plan, but also enhance the colour on an urban scale starting from the most homogeneous or representative areas of the city, mostly attributable to the historical center. The total absence of control and management by the municipal authorities and institutions responsible for protection, in fact, led to uncontrolled changes of fronts, not just the so-called monumental buildings, but also the diffused network of historical buildings, which, as time went by, relentlessly altered the morphology and the perception of the historical district.

2.2.1 Torino 1978: the first colour project

The city of Torino can boast the first Piano Regolatore del Colore in Europe, dating back to 1978, when Giovanni Brino addresses the problem of "maintenance" on an urban scale of the facades of the historic city (Fig. 5). The project was born thanks to the discovery of several documents kept in the archives of the town through which it was possible to recreate the design color applied between 1801 and 1863. With that started the piano del colore in 1978, aiming to restore the external surfaces through the replacement of existing finishes and the painting with colours suggested by chromatic palettes of the nineteenth century; also thanks to the administration that made it possible to establish an actual method of colours planning and definition. The colours of the tradition, then, are rediscovered through archival research and the discovery of their original recipes; while “degli edifici di cui non esistevano i documenti (la maggior parte) la tinta è stata ricostruita in base alle tracce di colorazione originaria o in analogia ad altri edifici di eguale struttura, epoca o ambiente la cui colorazione è stata accertata attraverso documenti”.

67 Brino G., Il restauro del colore nei centri storici. Il piano del colore di Torino, in Rotondi Terminiello G., Simonetti F. (eds.), Facciate dipinte. Conservazione e restauro, Sagep Editrice, Genova, 1984, p. 71. Trad. “those of buildings about which there were no documents (most of cases) have been reconstructed either on the basis of traces of original color or by analogy with other buildings of the same structure, age, or environment, whose coloring was ascertained through documents”.

And also “per consentire la massima pubblicazione della ‘Tavolozza dei colori’, limitata, per ragioni pratiche, alle tinte più ricorrenti, questa veniva inviata sistematicamente, sotto forma di campionario a tutti i produttori di vernici presenti nell’area torinese in base all’elenco pubblicato sulle Pagine Gialle della guida del telefono locale”. Trad. “to allow the maximum publication of the ‘Color Palette’, limited, for practical reasons, to the most common hues, this was sent systematically, in the form of set of samples to all the paint producers present in the Turin’s area according to the list published in the Yellow Pages of the local telephone”. The logic of the market comes strongly in the realization of the piani del colore.
Synthetic materials with poor results were, at first, privileged for the realization of the plaster ("giallo Torino", an acrylic colour, is one of the most popular colours in those years). Acrylic plasters were incompatible with the historical materials and, having a limited durability, they were a source of degradation for the support.

In a second phase it was decided to return to the use of lime colours but “purtroppo tutti questi tentativi fallivano miseramente: subito e drammaticamente, come nel caso di una facciata [...] precedentemente tinteggiata con colori acrilici e probabilmente non completamente asportati nell’operazione di raschiatura, che andava in crisi in pochi giorni a seguito del dilavamento causato dalla pioggia, manifestando efflorescenze su tutta la superficie, che sarebbero sparite solo molto tempo dopo”\(^6\). The use of lime paints proved unsuccessful because applied on synthetic material support.

So if initially there had been an incompatibility between historical lime and acrylic plasters, in a second time, with the opposed application of lime plasters over acrylic ones, the situation was the same.

The necessary research of products compatible with historic masonries, activated the participation of multinational producers of colourings in the process of new products and new colour palettes research and development. Companies developed so much specific knowledge to participate with the Administration technicians and architectural designers into the realization of piani del colore. The knowledge developed by companies led the exclusion of technicians and architects from making proposals, because of a too specialized sector. The collaboration between designers and companies, especially at the products proposal phase, become indispensable\(^6\).

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\(^6\) Brino G., Colore e città. I colori di Torino (1801-1863), op. cit. Trad. “unfortunately all these attempts failed miserably: immediately and dramatically, as in the case of a façade [...] previously painted with acrylic paints probably not completely removed in the operation of scraping, which got into crisis in a few days as a result of runoffs caused by rain, manifesting efflorescence on the whole surface, which only would be gone after a long time”. The case is referred to the use of lime paint on façades of Cernaia barracks in Torino.


2.2.2 The diffusion of the colour projects

The reasons that led municipalities to broadly adopt the piani del colore are ascribed to those tools capabilities in stemming the uncontrolled transformations of the urban image and providing pilot projects that could work as a spin up for the redevelopment of historic districts. In fact, they sought to "arginare al più presto gli effetti più disastrosi costituiti dalle tinteggiature selvagge [...], cercando di ricondurre, pragmaticamente e per gradi successivi, l’operazione di ritinteggiatura [...] nell’alveo di un restauro corretto". Moreover, the results expected from the adoption of the piani del colore were obtained with not so exorbitant prices for authorities themselves, which operated proposing/imposing citizens simplified procedures through manuals with "easy" schemes related to the main processing and colorimetric indicators to examine with no need to study the material qualities and contexts.

2.2.3 Main critical advices

The undeniable mistake concerning early piani del colore lies in the desire to historically establish the repainting of the façades with the support of archive’s work, because “chi ha avuto esperienze di ricerche storiche sa quanto è difficile trarre dai documenti d’archivio indicazioni ‘certe’ e oltretutto non in ‘bianco e nero’ ma a ‘colori’”. Moreover, by doing this, you level out the historical richness expressed by multiple layers and modifications added over time. Connecting buildings to their “original” colours is in any case a “palese imprecisione terminologica [poiché] per ‘stato originario’ si intende per lo più un momento intermedio della vita di un edificio [...] Nei casi presumibilmente rari, ove fosse possibile definire il vero ‘stato originario’ esso costituirebbe un elemento prezioso ai fini della conoscenza [...] non certo un’acquisizione da porre a guida di una nuova coloritura”.

The piani del colore are to be considered as rigidly fixed systems to “restore” the identity of places or their authenticity. It is just because they are referring to their management system that those plans are called "prince’s plans" according to their imposing process: there is an authoritarian form of government of the existing in which application criteria are established unequivocally and without exception (only later there

See CONCLUSIONS, paragraph 1. A multidisciplinary approach.
See APPENDIX II. Products on the market.


Giambruno M., Verso la dimensione urbana della conservazione, op. cit.

72 Feiffer C., La conservazione delle superfici intonacate. Il metodo e le tecniche, Skira, Milano, 1997, pp. 83-84. Trad. “those who have had experience of historical research knows how difficult it is to draw from archival documents ‘certain’ directions, on top of that, not ‘black and white’ but ‘colour’ printed”.

73 Miarelli Mariani G., La città storica: alcuni nodi del recupero, in Perego F., Anastilos, Laterza, Bari, 1986. Trad. “gross terminological inaccuracy [because] ‘original state’ is defined as an intermediate moment of the life of a building [...] Rare cases where it is possible to define the real ‘original state’ would be great assets for knowledge [...] certainly not an acquisition which could serve as a helping guide for a new colouring”.

will be “citizens’ plans” where a set of guidelines that acts as a guide for individual choices assuring subjective areas of selection by the user is produced.

Over time these plans also have proven unsuitable to the real needs and to the needs of the community and especially haven’t considered the plans and works related to the recognition and promotion of tangible and intangible assets of the buildings and places, outcome of a long duration evenemential history that characterized them. Therefore, a particular consideration of colour textural features, its transparency effects, texture, roughness or gloss, as well as the ability/sensitivity to understand the unique value of the color itself is missing. The redevelopment of the historic area is exclusively programmed through the re-coloring of the façades regardless of the state of conservation of such areas as well as the environmental context in which they are set. According to the editors of the *piani del colore*, the area of architecture, plaster or coloured finish, is only just a “sacrifice surface” protecting the wall surface below. The main purpose that characterizes these instruments of study and planning is to bring back "dignity" and "health" preserving, but sometimes also recreating from scratch, an urban identity with authentic *maquillage* of façades through their colourings.

The plaster removal and substitution is supported by the belief that at the historic construction site this practice represented a normal maintenance and that the colours were periodically renewed. The hypothesis, long since invalidated on a theoretical level, has been recently undermined to its operational implications by some studies seeming to show how the concept of “sacrifice surface” was rather irrelevant to the construction site of the past. Therefore also this reason given by the designers of the *piani del colore* to justify the indiscriminate replacement of the facades finishes fails.

### 2.2.4 The cultural debate and the elaboration of the Colour Plan

During subsequent evolutions, solutions culturally more well-grounded are proposed, taking into account the criticisms arose from the realization of the *piani del colore*. In these cases it is assumed that it is impossible to distinguish the "skin" from the building structure, which “sono e devono essere considerate in relazione, tanto è vero che protezione e durata nel tempo dell’una corrispondono a protezione e durata nel tempo dell’altra; forma architettonica e completamento estetico delle decorazioni, delle coloriture, degli

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[77] Miarelli Mariani G., *Coloriture urbane: omologazioni tra uniformità e dissonanze*, cit., pp. 10-23. In relation to the reasons supporting the conservation of areas, the proceedings of the conference held in Bressanone in 1990 on the topic “Surfaces of architecture: finishes”. In particular:


[78] Torraca G., *Problemi di conservazione delle superfici esterne*, in Biscontin G., Volpin S., *ivi*, pp. 13-26. Torraca introduced the problem of belonging or not to the historic construction site of the periodical renewal of surfaces during the Bressanone conference in 1990: “Sulla verità storica di questo rinnovo periodico si possono avanzare comunque dei dubbi; i conti degli imbiancati del ’600 e del ’700 e l’esame delle facciate di Roma raccontano in realtà una storia differente, fatta di rappezzature e riteneggiature, per cui sembrerebbe che la prassi dello “sbatto tutto giù” sia abbastanza recente, probabilmente connessa al cambiamento traumatico che si verifica nel XX secolo nei mestieri tradizionali legati all’edilizia”. Trad. “Concerning the historical truth of this periodic renewal may be suggested, however, doubts; the bills of seventh and eighth century plasterers and the examination of the facades of Rome actually tell a different story, made of patches and repaintings, so that the “slam everything down” practice seems quite recent, probably related to the traumatic change that in the twentieth century occurs in the traditional trades related to construction”.
altri elementi più minuti che compongono la facciata si arricchiscono e si esaltano a vicenda”79. In-depth examinations of the project were subsequently taken, a greater articulation for historical research was given and, as a result, the operational guidelines, structured according to the needs were more carefully made. There is now the consciousness that the first “condizione auspicabile, e oggi quasi sempre disattesa, […] [6] privilegiare, là dove sia possibile e in presenza di materiali di calce, la conservazione degli intonaci esistenti; eventuali parziali integrazioni andranno realizzate con materiali analoghi a quelli conservati”80.

From these early experiences a cultural debate has resulted - considering Restoration Charters, international conventions and recommendations – and led to the elaboration of progetti colore81 (Colour Plans) and guidelines for the conservation and the management of historical centers. The guidelines consist in knowledge phases, as historical and technical analysis starting from the current state and conducted building by building; knowledge aimed at prolonging and conserving the existence of authentic and layered material82.

It is about reconsidering the value of the thickness of architecture, its intrinsic materiality, and the relationship of these with the context in order to define conservation interventions and sustainable development strategies, that would lead to a proper practice for safeguarding and enhancement. It is in fact restrictive to only deal with chromatic aspects of the finishes façades: the choice of hue is closely related to support materials, application technique and specific manufacturing realized. The physical and chemical compatibility between materials and paintings and their technical features must be taken into account. Working over old buildings, factors such as the possible situation of degradation and improper conditions of use are also to be considered. Risky simplifications83 are harmful and counterproductive for both individual buildings and the image of the city.

Currently, Colour Plans adopted by the Administrations in historical centers are increasingly refining the methodological approach of the operational protocol84 and the process of material/pathological and chemical/physical analysis necessary to promote a project that will have as its ultimate goal the preparation of intervention indications on colours and materials chosen in a compatible and aware manner. That method can avoid the frequent errors due to incompatibility between the materials of contemporary and the ancient conception.

The interventions can’t only deal with material restoration intervention, but also consider the sustainable development strategies that would lead to a proper practice for protection and enhancement. Therefore Colour Plans aimed at developing knowledge and conservation about the existent materials, thanks to a specific diagnostic. Not only: the multidisciplinary85 opening of the Colour Plan leads to the necessary collaboration between conservators, chemists, economists, research centers, public Administrations, architects, restoration products companies, with the common purpose to realize a documentation for

79 Bocchi M., Il centro storico di Parma: dal recupero urbano al restauro delle facciate, in Bocchi M., Duc M. (eds.), Immagine della città storica, Electa, Venezia, 1989, p. 12. Trad. “are and must be considered as in connection with each other as to share protection and durability, as well as the architectural form and aesthetic completion of decorations, colorings, and other elements that form the façade, one another”.

80 Bocchi M., Il centro storico di Parma…, ivi, p. 15. Trad. “desirable condition, today almost always ignored, […] [is] favor, where possible, the conservation of existing plaster; any partial integrations will be made with materials similar to those conserved”.

81 From here on, the terminology used to translate “progetto colore” will be “Colour Plan”. Methodology guidelines fot the Colour Plans are debated in PART TWO.


83 The reference is to the “recovery manuals” or “codes of practice” which, ascertained the impossible reproduction of the existing, propose an oversimplified reading of reality. Thus the control over the quality of the project and the standardization of the outcomes is lacking.

Giambruno M., Verso la dimensione urbana della conservazione, op. cit.

84 Methodology guidelines fot the Colour Plans are debated in PART TWO.

85 See CONCLUSIONS, paragraph 1. A multidisciplinary approach.
public use, available for both private owners and technicians. The documentation will be used as guidance and proposal for intervention based on extensive scientific historical, diagnostic and colorimetric investigations. The main currently Italian Colour Plan are characterized by easy consultability, with the intent to create a plan that is immediately applicable and support to the population. Virtuous models of Colour Plans realized in recent years on the Italian territory, like Morbegno\textsuperscript{86}, Asti, Pavia, Prato, Reggio Calabria, Siena, Bergamo, Caserta, etc., are entirely online consultable on the web-sites of the referential Administration, with attached forms for the intervention.

2.3 A CRITICAL LECTURE OF THE CURRENT SITUATION

In the Eighties with the Galasso Law the conception of landscape as "aesthetic picture" joins the concept of environment as cultural heritage ecosystem including historical centers. Fact not obvious if the landscape definition had in the past – with L. n. 1497/39 – an aesthetic value of scenic beauty; the landscape was considered as the natural picture, perspective or viewpoint. The Decree Law n. 490/1999 "Testo unico delle disposizioni legislative in materia di beni culturali e ambientali"\textsuperscript{87} and the Decree Law n. 42/2004 "Codice dei beni culturali e del paesaggio"\textsuperscript{88}, called "Codice Urbani", make more attention to the diffused network of historical buildings, regulating the national interventions. According to the "Codice", landscape is considered as homogeneous territorial part, which characters derive from nature, human history and/or their mutual interrelations, then conceiving the new definition of "cultural landscape". It identifies areas with peculiar landscape and environmental features, including evidence of human presence in the territory expressed through signs of his complex and multiform historical events. The "Ministry of Heritage and Culture" exerts directly and in a unified way the tutelage and enhancement functions towards landscape and can confer the management to Regions through agreement and coordination forms. Regions submit the territory to specific regulation through landscape plans (urban-territorial plans). Regions monitor on the compliance with the dispositions contained in the code, with the coordination between Administrations. Finally, the new code requires all public Administrations to cooperate with each other for the definition of guidelines and criteria concerning the activities of tutelage, planning, conservation, rehabilitation and enhancement of the built landscape - at different scales - and the management of related interventions.

This paragraph presents the main laws in Italy supporting Colour Plans. More specifically, the two Regional Laws of Campania 26/2002 and Liguria 26/2003 have been written \textit{ad hoc} as methodological guidelines to be followed for the Colour Plans realization. They address issues from multiple points of view aimed at the historical contexts enhancement: research and investigation activities; information regarding the management and the internal organization of the territory between the different actors involved in the project; incentives and funding for municipalities that adopt a Colour Plan\textsuperscript{89}. The Lombardia Regional Law is cited as example for all the other regions (with the exception of Liguria and Campania) that haven’t regional funds to lean on, and also shows the lack of technical information on the subject.

Finally is reported an example of a special law applied to the city of Siena, which allows to obtain national funding against obvious needs to safeguarding the high quality historical center through a Colour Plan for its development and maintenance.

\textsuperscript{87} Trad. "Unique text of legislative disposition for cultural and environmental heritage".
\textsuperscript{88} Trad. "Code of cultural and environmental heritage".
\textsuperscript{89} See CONCLUSIONS – Territorial management: planning the conservation.
2.3.1 Campania Regional Law 26/2002, Liguria Regional Law 26/2003

A methodological planning of the problem of colour in historic centers in the aspects of knowledge, protection and enhancement, as well as conservation and restoration has been suggested in particular by the Regional Laws of Campania and Liguria, respectively, with the Campania Regional Law 26/2002 “Norme e incentivi per la valorizzazione dei centri storici della Campania e per la catalogazione dei beni ambientali di qualità paesistica” and the Liguria Regional Law 26/2003 “Città a colori” (the definition of the Colour Plan by the municipal administrations and the related regulations will prevail if, in contrast, with those of the municipal building code). They have spread, making it operational, but also governing it methodologically, the thematic/problem of the colour in historical centers in the aspects of knowledge, enhancement and conservation.

The ideas expressed by the two laws are very similar to each other and provide guidance for the preparation of “guidelines”, focused on the study of materials and techniques of intervention, aimed at the preparation of “Monitoring and planned maintenance plans” and “Colour plans” together, partly in historical architecture and the restart built-up area. Such “linee guida perseguono l’obiettivo del mantenimento delle caratteristiche dei valori costitutivi e delle morfologie nonché delle previsioni di linee di sviluppo compatibili con i diversi livelli di valori riconosciuti e, infine, della riqualificazione delle parti compromesse o degradate, per il recupero dei valori preesistenti o per la creazione di nuovi valori paesistici coerenti ed integrati”. In addition, they act through interventions aimed at both the safeguarding of the historical-artistic monuments and the tutelage of “minor architecture”, namely the set of all those building elements that form diffused network of historical buildings of the historical centers and determine their own image.

90 Trad. “Rules and incentives for the development of the historical centers of Campania and classification of landscape quality environments”.

In depth analysis of the Campania Regional Law 26/2002:
Main objectives of the Law are:

a) conserve and enhance the heritage and urban and landscape contexts in which they are placed;
b) regulate the controls and interventions on cultural heritage and, in particular, restoration, decoration and colouring, both the external surfaces of civil buildings with historical, artistic and environmental, value, and also the urban curtains in the historical centers, in order to reduce the degradation of the buildings having more than 50 years.

In particular, the Color Plans must be written according to the guidelines expressed in the Regulation (Article 12):

a) intervention techniques and materials to be used with constant reference to the Restoration Charters;
b) the preparation by the municipalities of Colour Plan for the historic building, separated from the Colour Plan for the entire conurbation;
c) the preparation by the municipalities of planned maintenance, based on the analysis of materials and techniques, which includes streets, squares, stairs, staircases, balustrades, original stone textures, original green, assessed into the urban context.

91 Trad. “Colored city”.

In depth analysis of the Liguria Regional Law 26/2003:
Its field of application is extended not only to the historical centers, but also to other areas of the city, including those outside the city where often environmental degradation serve to exacerbate the social one.

Its field can also be found in those areas characterized by the widespread presence of buildings belonging to certain architectural styles such as Art Nouveau and rationalist architecture of the 20’s and 30’s.

The buildings and those other products object of maintenance must be either facing public spaces and constituting their physical boundaries or be visible in the whole or in a meaningful part by the same.


93 Campania Regional Law 26/2002 “Norme e incentivi per la valorizzazione dei centri storici della Campania e per la catalogazione dei beni ambientali di qualità paesistica”. Trad. “guidelines pursuing the aim of maintaining the characteristics of the founding values and morphologies as well as the lines of development compatible with the different quality levels and, finally, the redevelopment of degraded or compromised parties, for the recovery of pre-existing values or the creation of new consistent and integrated landscape values”.

Colour Plan: the Italian situation
From both Regions are also provided incentives for “il restauro, il deco re e l’attintatura delle facciate di edifici civili di interesse storico, artistico ed ambientale e delle cortine dei centri storici”⁹⁴ (art. 1) and contributions “a favore delle amministrazioni comunali che provvederanno alla redazione di un “Progetto Colore”. Il progetto deve individuare sia i materiali, le tinte e le tecniche pittoriche che fanno parte della tradizione storico‐architettonica locale, sia i colori più adatti all’impatto visivo […] La legge stabilisce inoltre finanziamenti a favore di soggetti pubblici e privati che provvedano a rifare le facciate degli edifici di loro proprietà”⁹⁵.

These laws consider fundamental values of the community, not only the "dignity" of the buildings, but also the "health" of public spaces that interrelate the buildings themselves. The buildings’ owners are forced to proper and continuous maintenance of their facades, since all parties facing public spaces are considered property of primary common interest.

Focal point of innovation is the unification of the “Monitoring and planned maintenance plan” and “Color Plan” with what the RL Campania defined as an “Integrated program of urban, building and environmental enhanced”. This widens the scope of interest from the mere restoration to a wide range redevelopment: the territory is perceived through in-depth historical, urban, architectural, environmental and social-economic analysis.

It is noted, finally, that the Liguria Region, to facilitate the bureaucratic and project procedure, established in the municipal office in Genoa and in many other towns special “Offices of Town Aesthetics” dedicated to the realization of Color Plan even on “minor buildings”, where they provide guidance to public structures and private individuals.

The Colour Plan for Finale Ligure city of can be considered a virtuous example. Funds predisposed by Liguria Region (LR 26/2003 “Coloured city”) as a result of participation in the announcement of 2004, are for this purpose. These funds are intended to encourage the municipalities (if considered appropriate) to submit projects, aimed at obtaining, by enhancing colour, the construction and environmental development of public spaces with specific reference to the fronts of buildings. This study, committed to architects and coordinated by the Liguria Region, is aimed at developing an experimental research about the appropriate methods for the intervention project on the colour in the historical centers. The identified methodology for the intervention is then promptly acquired by the Liguria Region, reprocessing it ad hoc in the form of improvement of the Regional Law.

Another emblematic example of interdisciplinary collaboration is the Colour Plan commissioned by the Authority of the “National Park Cinque Terre” and entirely funded by the Liguria Region. The project was divided into specialized working team coordinated by the appointed architect⁹⁶. The Authority of the Park established also an agreement with a company of finishing products, which has provided its own Research & Development Laboratory for the production of colour palettes realized with materials compatible with the performance requirements expressed in the techniques rules of the Color Plan.

These Colour Plans, as well as providing an example for the management of financings and funds, are also an inspiring model of research relapse in operational purposes.

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⁹⁴ Campania Regional Law 26/2002 “Norme e incentivi per la valorizzazione dei centri storici della Campania e per la catalogazione dei beni ambientali di qualità paesistica”. Trad. “restoration, decoration and painting of the civil buildings facades of historical, artistic and environmental and of the curtains of historic centers”.

⁹⁵ Liguria Regional Law 26/2003 “Città a colori”. Trad. "in favor of government authorities who will edit a “Color plan”. The project must identify both the materials, colors and painting techniques that are part of the local architectural and historical tradition, and the most suitable colors […] The law also provides fundings public and private entities who work to rebuild the facades of the buildings they own”.

⁹⁶ The process of "analysis and survey for the colour plan" was committed to the D.S.A. Università degli Studi di Genova; the phase of “Colour and material analysis, diagnostics and colour project, technical standards and applications" to DI.RES. Università degli Studi di Firenze; the "Study of palettes and reproducibility of the material models" and "Advice on infrastructure products" were committed to external consultants of specialized technicians.
In addition to these examples, there are several Colour Plans\textsuperscript{97} characterized by the close collaboration especially between municipalities, architects, companies and universities or research centers (Fig. 6) (among all Ischia or Bergamo). As pointed out by Olga Bottaro “la vera evoluzione/rivoluzione di questo grande laboratorio è rappresentata da una nuova filosofia di approccio ai progetti di riqualificazione urbana, realizzati grazie alla preziosa collaborazione delle diverse competenze istituzionali, accademiche, professionali e tecniche”\textsuperscript{98}.

![Image of Via del Campo, Genova. Via del Campo valorization project realized through the conservative intervention on painted façades. Examples of how the aesthetic development can activates renovation urban processes and improves the quality of life.]

**2.3.2 Lombardia Regional Law 12/2005**

The Lombardia Regional Law 12/2005, is here mentioned as an example of the lack of specifications regarding this kind of projects. In Italy, in fact, today there are only two regions (Campania and Liguria) having \textit{ad hoc} laws. If the methodology can still be applied and used even in the absence of specific regulations, the real problems, however, arise in the absence of incentives and facilitations\textsuperscript{99}.

Referring to the Lombardia Regional Law 12/2005, plans for redevelopment of historical centers can be connected to the plan of government of territory (PGT- \textit{piano di governo del territorio}) or to the building code (RE – \textit{regolamento edilizio}), of which, concerning those generally defined “A” zones, they are an attached document. This methodology became operative thanks to the rules plan (\textit{piano delle regole}) which, in addition to identify the centers of ancient formation and the environmental and historical-artistic monuments, identifies “le caratteristiche fisico-morfologiche che connotano l’esistente, da rispettare in caso di eventuali interventi integrativi o sostitutivi, nonché le modalità di intervento, anche mediante

\begin{itemize}
  \item Mor G., Galliani G.V., \textit{Manuale del recupero di Genova Antica}, Dei – tipografia del genio civile, Roma, 2006.
\end{itemize}

\textsuperscript{97} \textsuperscript{98} Bottato O., \textit{Laboratorio “Genova”}, in “Recupero e Conservazione”, 62 (2005). Olga Bottaro is currently Director of Research and Development at Boero Group. Trad. “the true evolution / revolution of this great laboratory is represented by a new type of approach towards urban enhance projects, realized thanks to the collaboration between the different institutional, academic, professional and technical competences.”

\textsuperscript{99} See CONCLUSIONS - Paragraph 3. Incentives and financings.
pianificazione attuativa o permesso di costruire convenzionato, nel rispetto dell’impianto urbano esistente, ed i criteri di valorizzazione degli immobili vincolati”100 (art. 10).

The Administration may use the tools at its disposal to address private interventions in redeveloping. The work consists in detailed requirements for the identification of intervention criteria that mainly relate to the image of the historical center: materials and colours of the façades, dimensions and characteristics of openings and overhangs, roofs and chimneys, gardens, street furniture and signage. The image recovery of public spaces should be the guide for private projects and at the same time, it can be an incentive to improve the consistency of buildings to make a confront of the conservative state with a new situation of higher overall quality.

The study for the rehabilitation of a historical center assumes the role of “master plan”, which is a valuable instrument available to the public administration and the private owners.

2.3.3 Siena Special Law 3/1963 - 75/1976

There are examples in Italy of Special Laws in the absence of specific laws for historical centers, such as those of Campania and Liguria regions. A meaningful example is the Special Law for Siena 3/1963 “Provvedimenti per la tutela del carattere storico, monumentale e artistico della città di Siena e per opere di risanamento urbano”101 together with a second Special Law 75/1976 “Legge volta alla tutela del carattere monumentale e artistico della città di Siena”102. On the basis of the measures already approved in favour of Venice and Assisi, this legislative initiative recourses to extraordinary public intervention, justified by the fact that “salvare il patrimonio artistico e lo splendore dei monumenti che Siena costituisce è un fondamentale dovere della comunità nazionale”103. The special law for Siena allowed, without a doubt, new possibilities for the restoration and safeguarding of the historical center, engaging the various institutional and social partners to work together on an issue of vital importance not only for the city itself, but undoubtedly nationally and internationally importance. Objective is the success of interventions, aimed to avoid degradation or brutal modification that afflict some of the historical centers in Italy. Thanks to these initiatives, the historical center of Siena has been included, in 1995, in UNESCO’s sites as “heritage of humanity”.

The law has also been one of the first evidence of the ability of the Parliament and of the State to support local policies of sustainable development of historical centers.

All these measures would not have been possible without the help of additional public resources that allowed the prosecution of interventions and decisions aimed at the conservation of the historical, artistic and architectural heritage, the protection of which couldn’t be supported by the local authority or private residents alone104.

Thanks to the Special Law the city of Siena was able to program many interventions that allowed to restore and rehabilitate public monuments, private property of the districts and part of quarters. The unique historical, cultural, artistic and architectural heritage of Siena therefore requires considerable resources to conserve and make accessible the existing wealth. With these conditions and these motivations, the city is one of those centers that can take advantage of the special fund for cultural heritage (Fig. 7).

100 Lombardia Regional Law 12/2005 (art. 10). Trad. “the physical and morphological features that characterize the existing buildings to be followed in the event of any replacement or supplementary operation, as well as the methods of intervention, in accordance with the existing urban system, and the measurement criteria of tied buildings”.

101 Published in Gazzetta Ufficiale 24 gennaio 1963, n. 21. Trad. “Provisions for the protection of historical, architectural and artistic characters of the city of Siena and for interventions of urban renewal”.

102 Trad. “Law to protect the monumental and artistic heritage of the city of Siena”.

103 Law proposal presented on 9 June 1960. Trad. “saving the heritage and splendor of the monuments that Siena represents is a fundamental duty of the national community”.

Fig. 7 – P.zza del Campo, Siena. Historical photography of Siena in 1890 (left); view of buildings overlooking Piazza del Campo after restoration (right). Images from: Bulian, 2010.
Colours and materials of historical centers: sustainable conservation and management.


Feiffer C., Il supermercato dei prodotti per il restauro, in “Recupero e conservazione”, 75 (2007), pp. 22-23.

Feiffer C., La conservazione delle superfici intonate. Il metodo e le tecniche, Skira Edizioni, Milano, 1997.


Longo A., Il passaggio dall’affettività all’architettura nei piani del colore, in Ministero per i Beni e le Attività Culturali (ed.), *I colori in architettura*, Ikon Editrice, Milano, 2006.


Ministero per i Beni e le Attività Culturali (ed.), *I colori in architettura*, Ikon Editrice, Milano, 2006.


Scarocchia S., Bergamo alta di Luigi Angelini, parte seconda, in “Restauro & città”, 5-6 (1986).


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A method for the conservation project of finishing materials of historical buildings, in this second part, is defined. The procedure will take into account the connection between material, architecture (the support), and context. The attention is therefore directed to the elaboration of a material conservation and chromatic project, in line with the fundamental principles and ethic codes of conservation, such as:
- **reversibility**, any element or material applied during the intervention must be easily removed without causing any damage to the original material;
- **compatibility**, the materials used in the restorative intervention must be chosen compatibly with the original material on which they will be applied;
- **recognizability**, any intervention should be recognizable, differing from the original material to avoid the falsification, without disturbing the overall view;
- **minimum intervention**, the restorative intervention must be closely related to the needs of each situation, conserving the original material as much as possible and intervening with the minor invasivity;
- **durability**, is the material ability to last in time resisting the aggressive actions from the environment and maintaining the essential properties, that is the adequate safety levels, throughout all the life of the material.

A Colour Plan, starting from the conservative method for the Architectural restoration\(^1\), consists on research and investigation activities, that in part are known, in part specific for its definition. Precisely a Colour Plan makes suggestions for a specific site, an historical center or an organic estate of buildings, thanks to a methodology of restoration and maintenance and a color palette for the finishes on the façades (plasters, decorative elements, windows and doors' shutters, iron elements, etc..)\(^2\). This set of activities can be summarized as follows\(^2\):

\(^1\) **Conservative project:**
1. Historical and documental researches about the intervention area and the interested buildings.
2. Geometric survey and orthophotos elaboration.
3. Stratigraphic lecture and building constructive phases individuation.
4. Material and alteration/degredation visual survey, according to the norma UNI Beni Culturali 11182:2006 or ICOMOS-ISCS Glossary.
5. On-site diagnostic analyses in order to evaluate the building state of conservation.
6. Conservative and consolidation intervention on buildings.

\(^2\) An exhaustive outline of the methodological Italian situation is proposed in Falzone P. (ed.), *Colore architettura ambienti*, Edizioni Kappa, Roma, 2008. Three Colour Plan realized by the Universidad Politecnica de Valencia are highlighted. They propose a methodology very similar to the Italian one and offer interesting and innovative operative issues in phase of colour data elaboration and preparation of the project proposal and the colour palette:
1. Historical and documentary researches on constructive and finishing materials, through documents found in public and private archives and bibliographic sources.

2. Geometric survey and orthophotos elaboration.

3. On-site stratigraphic investigations on the surface finishes and in particular on the plastered surfaces, in order to reconstruct the stratigraphic succession of materials and their colourings.

4. Material and alteration/degradation visual survey, according to the norma UNI Beni Culturali 11182:2006 or ICOMOS-ISCS Glossary.

5. Diagnostic investigations to characterize materials used in façade and to evaluate their state of conservation. These analyses consist on non-invasive on-site instrumental investigations and laboratory investigations on samples collected for this purpose.

6. Chromatic survey of the surface finishes of the different elements that constitute the façade, currently in view.

7. Elaboration of data obtained from historical researches, material and degradation surveys and chromatic analyses. Data are analyzed and processed divided according to the different buildings and the architectural elements of façades.

8. Creation of a digital colour palette and its corresponding in paper and gypsum in laboratory. It represents the catalog of surveyed colours currently in use in the historical center, elaborated with the Munsell notation system. It is informative and provides adequate suggestions for the planning of the chromatic project for restoration and maintenance activities.

9. Conservative intervention on finishing belonging to monumental buildings characterized by particular historic-artistic value.

10. Elaboration of guidelines for the choice of new materials and colours compatible with the support and the context, adequate for the restoration and maintenance of surfaces.

Historical (historical researches) and scientific (diagnostic analyses) knowledge is fundamental for the planning of an appropriate intervention.

The Plan doesn’t create intervention settings rigidly fixed, but its aim is to harmonize the conservation of the historic buildings: for each building, with particular attention to monumental one, is required a specific analysis and knowledge to propose appropriate and coherent methods of intervention. Then the knowledge of a building (its origins, transformations, constructive characters and techniques, materials, etc.), obtained thanks to specific researches and on-site and laboratory diagnostic, allows guidelines elaboration, considering also the urban context.
2.1 INDIRECT ANALYSES: HISTORICAL AND DOCUMENTAL SOURCES

Differently from the so called “direct analyses” characterized for the acquisition of knowledge directly from the structure, the “indirect analyses” allow to reach information from historical documentations. These documentations can be of different kinds and are located in specific archives, they can also be of local, regional or national interest. There are several type of documents which can be divided as follows:

- **bibliographic documentation**: consultation of monographies, book series, magazines, articles, degree thesis, Ph.D thesis. Written information about the study object are collect and analysed; a bibliography is elaborated (Fig. 1);
- **archivistic documentation**: consultation of all written information about the study object in main civic, local, public and parish archives;
- **iconographic documentation**: consultation of drawings, photographs, depictions in order to outline the evolution of the object’s history in the march of time. Thanks to documents it’s possible to verify the evolution of degradation during the time (study of the alteration and degradation evolution);
- **cartographic documentation**: identification of historical thresholds concerning the context and evolution of the building throughout the historical and actual cartographic analysis.\(^4\)

The historical research must give rise to the redaction of a report which includes the main data that characterize the historical knowledge of the building according its context and evolution phases. The restitution of the historical report is

<table>
<thead>
<tr>
<th>1.1 Documenti bibliografici</th>
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Riassunto testo: Il testo tratta della genesi del Santuario del Santo Crocifisso di Meda, le sue origini risalgono prima dell’anno 1800, secondo informazioni redatte da alcuni documenti inerenti.

Sino alla fine del 1700 la chiesa dipendeva dal monastero di San Vittore, e successivamente, con il decreto napoleonico, il monastero venne soppresso e la chiesa divenne da allora centro religioso e sociale di tutta la città.

Da quel momento fu abbellita e ristrutturata più volte nel corso del 1800 per poter accogliere la popolazione che di anno in anno aumentava sempre di più.

Al tempo era ricordata con il nome di Santa Maria e nell’anno 1996 fu consacrata con il nome di Santo Crocifisso in onore del profetismo Crocifisso collocato nella chiesa. Attualmente troviamo le pareti interne affrescate da Primo Busnelli e il Morgari.

Fig. 1 – Example of bibliographic document form. "Meda Sanctuary", Dipartimento di Progettazione dell’Architettura, Politecnico di Milano.

\(^4\) Beltramo S., Stratigrafia dell’architettura e ricerca storica, Carrocci, Roma, 2009.
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an important instrument for the knowledge of the interested object, but it is also a preliminary and essential document for the project development.

In the report different information collected during the research are summarized and analyzed: the analysis and evolution of the context in which the building or set of buildings are placed into, a chronologic document summary of the construction and modification acts on the building; the identification of methodology and original constructive materials and of following transformations; a collection of data concerning the restoration and consolidation interventions made during the time to identify the static, distribution and functional asset in the building’s history; the identification of decorative or artistic elements and their location; the knowledge of the end use of the building; the highlighting of eventual knowledge lacks found throughout the historical analysis. Here below the main synthesis and control reports about the data collected during the research from indirect sources are listed and described:

- **Historical report**
  - detailed description of the object (construction, transformations, restore) and context history.

- **Document summary**
  - compilation of a list of documents and historical events about the object.

- **Register**
  - elaboration and compilation of biographic forms and archive documents.

- **Elaboration of tables**
  - graphic elaborations which summarize the transformations occurred and documented by drawings, archive documents and bibliography: schedules and historical thresholds (Fig. 2).

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**Fig. 2 - Comparison of different uses of territory during centuries, by mean of the analysis of the cadastres - Archivio di Stato di Varese: Fondo per il Catasto Teresiano 1722, Fondo per il Catasto Lombardo-Veneto 1858, Fondo per il Catasto del 1954 (Castiglione Olona, VA).**
It’s important to gain an extensive knowledge related to the whole territory considering the transformations and connection with the main landmarks in the context; it would be useful make this type of analysis working at the same time with several layers, as infrastructures, built areas, properties, use destinations, construction periods, etc. (Fig. 3).

The investigation activities over the historic center will focus primarily the administrative aspects (properties, constraints, etc.) in order to identify the opportunities for public intervention and the eventual involvement of the private and the Entities responsible for environmental and cultural heritage conservation (Fig. 4).5

Historical documents can yield information about earlier finishes that have been covered since long time, and they can guide the architect during on-site investigation and sampling. Historic images often contain information about colour schemes and the location of decorative painting. They also offer a glimpse into the original design intent of the architect, information that can be useful when interpreting the results of a finishes analysis and making recommendations for a restoration paint scheme.

Fig. 3 – Road system and accesses (Castiglione Olona)

Fig. 4 – Property subdivision and monuments’ individuation in the studied area (Castiglione Olona, VA)

2.2 DIRECT ANALYSES: MATERIALS AND DEGRADATIONS SURVEY

The direct analysis of a work allows obtaining specific and in-depth information about its materials, transformations and the actual situation. The historical circuit is hardly ever homogeneous: transformations and alterations, not only morphologic but also about material and colour, add up with the passing of time, creating a particularly miscellaneous materials context.

Inside a Colour Plan, diagnostic activity examines in depth the knowledge about materials present on the façade. In the illustrated scheme in Tab. 1 we can see the general structure of diagnostic activity about materials. It is divided into two essential parts which are visual analysis and instrumental analysis. The aims of diagnostic activity are:

- the study of execution techniques, the study of the installation, manufacturing and finishing of materials techniques;
- the study of causes and mechanisms of alteration and degradation, that is the comprehension of changing underlined concerning materials used (physical, mechanical, chemical or biological causes);
- the choice and finalising of intervention techniques; that is the choice of proper and respectful methodologies to remove the main causes and pathologies of decay. The aim consists on choosing a general conservation strategy, throughout an extraordinary intervention on materials and a programmed and sustainable maintenance plan.

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Tab. 1 - The scheme illustrates the structure of a diagnostic project.
2.2.1 Visual identification of materials

The high number of transformation during the times, leaded buildings’ façades to be a mix of different materials with different aspects, especially in the areas around windows or doors, causing an image of “patchwork” in texture and colour. Not secondary are wood, wrought iron, copper and all the other materials used for windows, doors, railings, eaves, which, in a general perception of a front, can give the sense of an homogeneous and ordered structure.

This materials heterogeneity must be well documented starting from the visual survey which is the basis of the whole conservation project. Visual analysis of used and conservation state materials must be performed by specialized experts with a wide experience, and then graphically returned on geometric support in proper scale in order to obtain a general description of the situation.

A complete visual analysis must lead to the identification of construction materials and alteration/degradation forms macroscopically recognizable. In order to do this it is necessary to use a proper classification and nomenclature\(^6\) (Tab. 2). Ceramic materials can be divided into natural stones (Tab. 3) and artificial stones\(^7\) (Tab. 4), as established by the regulation UNI 11182: 2006\(^8\); metal materials can be divided into iron alloys and non-iron alloys (Tab. 5), for what concerns wood it’s necessary to visually recognise essences if possible, as established by the regulation UNI 11118: 2004\(^9\); for polymeric materials it is impossible to optically analyse and recognise them. The suggested classification scheme for natural stone materials and iron materials must be considered as a guide in the classification of materials, taking into account that optically recognise the different typologies of material is not always possible.

Visual recognising of materials degradation forms is an activity that must be yield at close quarters and examining closely the surface in detail; however, this procedure requires a big acquaintance and experience with different lexical items, because the variability of substrata and occurrences may easily lead to evaluation mistakes. Since the diagnostic plan and the intervention choices result from this research, it’s never underlined enough the fragility and importance of this phase.

![Classification of materials for architecture.](image)

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\(^9\) UNI 11118:2004 Beni Culturali – Manufatti lignei – Criteri per l’identificazione delle specie legnose.
Colours and materials of historical centers: sustainable conservation and management

Tab. 3 – Visual identification of natural stones.

Tab. 4 – Visual identification of artificial stones.
2.2.2 Visual identification of alterations and degradations

After the inspection and identification of materials, their state of conservation and, therefore, their types of degradation are analysed.

The material degradation is the material adaptation to the modification of environmental standards (microclimate, air quality, etc.) and to physical and mechanical stress. The unavoidable transformation linked to those processes appear in a more or less rapid and evident change of the characteristic and original properties of the material, and they finally lead to what is usually called alteration and/or degradation.

The difference between the meaning of the two terms “alteration” and “degradation” is basically important in order to recognise the conservation state, and are described as follows by the document ICOMOS-ISCS - Illustrated glossary on stone deterioration patterns\(^\text{10}\):

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- **Alteration**: modification of the material that does not necessary imply a worsening of its characteristics from the point of view of conservation. For instance, a reversible coating applied on a stone may be considered as an alteration.
- **Degradation**: any chemical or physical modification of the intrinsic stone properties leading to a loss of value or to the impairment of use.

In studies on stone deterioration and conservation, terminological confusion lead to major communication problems between scientists, conservators and practitioners. The ICOMOS glossary sets up a common language and constitutes an important tool for international scientific discussions on decay phenomena and processes. It is also an excellent basis for tutorials on stone deterioration. It is based on the careful examination of pre-existing glossaries of English terms. It does not aim at replacing these glossaries, often set up originally in a language other than English (French), and for most of them done to a high standard. If degradation patterns can be shown, named and described, then they can be recognized and compared with similar ones in a more accurate way in further investigations.

Tab. 6 suggests the ICOMOS glossary dividing degradations and alterations on the basis of main effects which characterize them:
- crack and deformation;
- detachment;
- features induced by material loss;
- discoloration and deposit;
- biological colonisation.

<table>
<thead>
<tr>
<th>CRACK AND DEFORMATION</th>
<th>DETACHMENT</th>
<th>FEATURES INDUCED BY MATERIAL LOSS</th>
<th>DISCOLORATION AND DEPOSIT</th>
<th>BIOLOGICAL COLONISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRACK (Fracture; Star crack; Hair crack; Crocchiatura; Splitting)</td>
<td>BUSTING</td>
<td>ALVEOLIZATION</td>
<td>CRUST (Black crust; Salt crust)</td>
<td>LICHEN PLANTS</td>
</tr>
<tr>
<td>DEFORMATION</td>
<td>BURSTING</td>
<td>EROSION</td>
<td>DEPOSIT</td>
<td>MOSS</td>
</tr>
<tr>
<td></td>
<td>DELAMINATION</td>
<td>(Differential erosion; Loss of components or of matrix; Rounding; Roughening)</td>
<td>DISCOLORATION (Coloration, Bleaching, Moist area; Staining)</td>
<td>MOULD</td>
</tr>
<tr>
<td></td>
<td>DISINTEGRATION</td>
<td>MECHANICAL DAMAGE</td>
<td>EFFLORESCENCE</td>
<td>PLANTS</td>
</tr>
<tr>
<td></td>
<td>(Crumbling; Gravel erosion; disintegration like powdering, Chalking, Sanding, Sugaring)</td>
<td>(Impact damage; Cut; Scratch; Abrasion; Keying)</td>
<td>ENCROUSTATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FRAGMENTATION</td>
<td>MICRORAST</td>
<td>FILM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Splitting; Chipping)</td>
<td>MISSING PART</td>
<td>GLOSSY ASPECT</td>
<td></td>
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<tr>
<td></td>
<td>PEELED</td>
<td>(Gap)</td>
<td>GRAFFITI</td>
<td></td>
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<tr>
<td></td>
<td>SCALING</td>
<td>PERFORATION</td>
<td>PATINA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Flaking; Contour scaling)</td>
<td>PITTIGN</td>
<td>SOILING</td>
<td></td>
</tr>
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</table>

**Tab. 6 – Survey of terms used for characterization of stone deterioration (according to ICOMOS-ISCS 2008).**

At the Italian national level, the official referential technical regulation is UNI 11182:2006 Beni Culturali\(^\text{11}\), even though it presents various lacks concerning the expository ICOMOS completeness, for example restricting to simple visual descriptions of degradations/alterations associated with photographic reports, without referring to possible causes and triggering events.

In Italy the Technical Commission Beni Culturali – UNI NorMal has also developed a series of technical rules to support professionals concerning conservation and restoration\(^\text{12}\).


\(^{12}\) Di seguito vengono citate alcune tra le norme tecniche legate al settore restauro e conservazione:
- UNI 10924:2001 Beni culturali - Malte per elementi costruttivi e decorativi - Classificazione e terminologia;
- UNI 11087:2003 Beni culturali - Materiali lapidei naturali ed artificiali - Determinazione del contenuto di sali solubili;
- UNI 11088:2003 Beni culturali - Malte storiche e da restauro - Caratterizzazione chimica di una malta - Determinazione del contenuto di aggregato siliceo e di alcune specie solubili;
- UNI 11089:2003 Beni culturali - Malte storiche e da restauro - Stima della composizione di alcune tipologie di malte;
Materials used for rendering or plastering of the facades, usually show the signs of time; disintegration, erosion, loss of material and deposits of extraneous substances can be observed on the surfaces. Other decays in outdoor are detachments between the new and the old plasters, due to the difference in their physicochemical characteristics, such as chemical composition and hydro-thermal behaviour. Additionally loss of smoothness, discolouration and loss of binding material are frequently detected. These degradation can be ascribed to natural weathering. Façade materials suffer by the aggressive polluted atmosphere, as well as, by the disruptive action of water, especially in areas where rain water is not successfully collected with sewage systems. This leads to surface washout, crusts formation and accumulation of bio-deterioration products

2.2.3 The abacus of degradation forms

A kind of abacus of decay forms is shown in Tab. 7, with the aim of providing a useful tool to identify the degradation pathologies. These tables want to be an example in support of the diagnostic activity on-site, but they are not exhaustive of all the phenomena that can be identified in real cases, in fact they report just the main ones that afflict the façades characterized by plastered façades with the presence of several frescos and decorations in sandstone. The ICOMOS-ISCS glossary does not provide an assessment of the extent of damages and the identification is only qualitative, even though other authors have carried out researches about the possibility of evaluation by naked eye of the level of degradation: if it is necessary to gain a thorough experience for the correct identification of the pathologies, it is very dependent on the experience of the person in establishing the extent or level of degradation.

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UNI 11139:2004 Beni culturali - Malte storiche - Determinazione del contenuto di calce libera e di magnesia libera;
UNI 11140:2004 Beni culturali - Malte storiche - Determinazione del contenuto di anidride carbonica;
UNI 11176:2006 Beni culturali - Descrizione petrografica di una malta;
UNI 11189:2006 Beni culturali - Malte storiche e da restauro - Metodi di prova per la caratterizzazione chimica di una malta - Analisi chimica;
(Disponibilità online della documentazione: www.webstore.unii.com a pagamento).

15 See APPENDIX – I. Case study of Castiglione Olona.
### DEGRADATIONS

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Example 2</th>
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<tbody>
<tr>
<td><img src="image1.jpg" alt="Image" /></td>
<td><img src="image2.jpg" alt="Image" /></td>
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<td><img src="image3.jpg" alt="Image" /></td>
<td><img src="image4.jpg" alt="Image" /></td>
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<td><img src="image7.jpg" alt="Image" /></td>
<td><img src="image8.jpg" alt="Image" /></td>
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</tbody>
</table>

#### POWDERING
Terms sometimes employed for describing granular disintegration of finely grained stones.

- **sandstone**
- **sandstone**

#### FRAGMENTATION
The complete or partial breaking up of a stone, into portions of variable dimensions that are irregular in form, thickness and volume.

- **plaster**
- **coloured plaster**

#### EROSION
Loss of original surface, leading to smoothed shapes.

- **fresco painted plaster**
- **coloured plaster**

#### MISSING PART
Empty space, obviously located in the place of some formerly existing stone part. Protruding and particularly exposed parts of sculptures (nose, fingers...) are typical locations for material loss resulting in missing parts.

- **granite**
- **plaster**

#### CRUST
Generally coherent accumulation of materials on the surface. A crust may include exogenic deposits in combination with materials derived from the stone. A crust is frequently dark coloured (black crust) but light colours can also be found. Crusts may have an homogeneous thickness, and thus replicate the stone surface, or have irregular thickness and disturb the reading of the stone surface details.

According to ICOMOS-ICBS 2008

**Photographs taken from the fronts of the historical center of Castiglione Olona**
## DEGRADATIONS

### DEPOSIT

Accumulation of exogenic material of variable thickness. Some examples of deposits: splashes of paint or mortar, sea salt aerosols, atmospheric particles such as soot or dust, remains of conservation materials such as cellulose poultices, blast materials etc...

<table>
<thead>
<tr>
<th>Sandstone</th>
<th>Plaster</th>
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</thead>
</table>

### DISCOLOURATION

Change of the stone colour in one to three of the colour parameters: hue, value and chroma.
- hue corresponds to the most prominent characteristic of a colour (blue, red, yellow, orange etc.).
- value corresponds to the darkness (low hues) or lightness (high hues) of a colour.
- chroma corresponds to the purity of a colour. High chroma colours look rich and full. Low chroma colours look dull and greyish. Sometimes chroma is called saturation.

<table>
<thead>
<tr>
<th>Sandstone</th>
<th>Coloured plaster</th>
</tr>
</thead>
</table>

### MOIST AREA

Corresponds to the darkening (lower hue) of a surface due to dampness. The denomination moist area is preferred to moist spot, moist zone or visible damp area.

<table>
<thead>
<tr>
<th>Plaster</th>
<th>Coloured plaster</th>
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</table>

### STAINING

Kind of discoloration of limited extent and generally of unattractive appearance.

<table>
<thead>
<tr>
<th>Porphyry</th>
<th>Plaster</th>
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</table>

### EFFLORESCENCE

Generally whitish, powdery or whisker-like crystals on the surface. Efflorescences are generally poorly cohesive and commonly made of soluble salt crystals.

| Plaster | Fresco painted plaster |

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According to ICOMOS-ISCS 2008

Photographs taken from the fronts of the historical center of Castiglione Olona
<table>
<thead>
<tr>
<th>DEGRADATIONS</th>
<th>EXAMPLE 1</th>
<th>EXAMPLE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPOSIT</td>
<td>Deposit caused by water preferential way of running.</td>
<td>plaster</td>
</tr>
<tr>
<td>GRAFFITI</td>
<td>Engraving, scratching, cutting or application of paint, ink or similar matter on the stone surface.</td>
<td>sandstone</td>
</tr>
<tr>
<td>PATINA</td>
<td>Chromatic modification of the material, generally resulting from natural or artificial ageing and not involving in most cases visible surface deterioration.</td>
<td>coloured plaster</td>
</tr>
<tr>
<td>PLANTS</td>
<td>Vegetal living being, having, when complete, root, stem, and leaves, though consisting sometimes only of a single leafy expansion (e.g. Tree, fern, herb).</td>
<td>plaster</td>
</tr>
<tr>
<td>BIOLOGICAL COLONISATION</td>
<td>Colonization of the stone by plants and micro-organisms such as bacteria, cyanobacteria, algae, fungi and lichen (symbioses of the latter three). Biological colonization also includes influences by other organisms such as animals nesting on and in stone.</td>
<td>plaster</td>
</tr>
</tbody>
</table>

According to ICOMOS-ISCS 2008
Photographs taken from the fronts of the historical center of Castiglione Olona
<table>
<thead>
<tr>
<th>DEGRADATIONS</th>
<th>EXAMPLE 1</th>
<th>EXAMPLE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRACK</td>
<td><img src="image" alt="sandstone example" /></td>
<td><img src="image" alt="plaster example" /></td>
</tr>
<tr>
<td><em>Individual fissure, clearly visible by the naked eye, resulting from separation of one part from another.</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLISTERING</td>
<td><img src="image" alt="plaster example" /></td>
<td><img src="image" alt="plaster example" /></td>
</tr>
<tr>
<td><em>Separated, air-filled, raised hemispherical elevations on the face of stone resulting from the detachment of an outer stone layer. This detachment is not related to the stone structure.</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DELAMINATION</td>
<td><img src="image" alt="sandstone example" /></td>
<td><img src="image" alt="sandstone example" /></td>
</tr>
<tr>
<td><em>Detachment process affecting laminated stones (most of sedimentary rocks, some metamorphic rocks...). It corresponds to a physical separation into one or several layers following the stone laminae. The thickness and the shape of the layers are variable. The layers may be oriented in any direction with regards to the stone surface.</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISINTEGRATION</td>
<td><img src="image" alt="plaster example" /></td>
<td><img src="image" alt="fresco painted plaster example" /></td>
</tr>
<tr>
<td><em>Detachment of single grains or aggregates of grains.</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to ICOMOS-ISCS 2008

Photographs taken from the fronts of the historical center of Castiglione Olona

Tab. 7 – Abacus of degradation/alteration forms to identify the main pathologies present in the historical center of Castiglione Olona, according ICOMOS-ISCS 2008.
2.2.4 Mapping of the state of conservation

All the data observed and acquired in situ should be reported into a geometrical survey to produce an easily consulting mapping regarding the materials at work and the conservative situation\(^{17}\) (Fig. 5). Actually, the prerequisite for mapping building external façades is the availability of a geometrical or a photogrammetric survey\(^{18}\), which exactly depicts the size and form of the building.

The following goals can be attained within the scope of a damage analysis:

- **Recording the different type of materials.** Using the existing protocols\(^{19}\) together with an high level of experience, it’s possible to obtain a precise mapping of the different materials.
- **Recording the present state of degradation.** This may be valuable for scientific purposes as well as documenting the starting point for conservation or restoration measures.
- **Acquiring information about the distribution of degradation on the object and localization of the most degraded areas.** The results may give an indication of the causes and mechanisms of degradation. For example, degradation forms and salt efflorescence mainly concentrated at the bottom of a building might be caused by rising dampness. This hypothesis should be verified by selective sampling for moisture and salt investigation in the affected area.
- **Extent and intensity of deterioration recorded by systematic mapping** are the basis for detailed planning of restoration measures and assessment of costs.

The obtained materials and degradation surveys provide the starting point for further investigations, sampling location and the set up of the most suitable diagnostic procedure.

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**Fig. 5. - Materials and degradations surveys (Palazzo Branda Castiglioni, internal court - Castiglione Olona, VA)**

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\(^{18}\) UNI 11150-3:2005. Edilizia - Qualificazione e controllo del progetto edilizio per gli interventi sul costruito - Parte 3: Attività analitiche ai fini degli interventi sul costruito: survey activities “comprendono le operazioni finalizzate alla conoscenza dei dati dimensionali e delle configurazioni geometriche, alla descrizione dei materiali e delle tecniche costruttive dei beni edilizi”. Trad. “include operations aimed at acquiring knowledge about dimensional data and geometric configurations, the description of materials and construction techniques of the buildings”.

The surveys are generally documented in 1:50 scale, except in cases where it is necessary to work at scale 1:20.

\(^{19}\) See chapter 2. Knowledge and critical investigation, chapter 2.2 Direct analyses: material and degradation survey.
2.3 DIAGNOSTIC METHODS

Historical investigations and direct surveys alone do not provide information enough about the actual state of conservation of materials and moreover about the different layers of materials that have been applied and used during the centuries on historical buildings. In that case the general state of “health” of the walls must be investigated examining the building techniques (often heterogeneous) and the stratigraphic relationships between the various parts of the building, through the use of diagnostic methods. Material investigations should basically be performed on surfaces that are typical for the entire object or specific areas on the object, which are representative for the material variety and the damage condition. These actions and localization can be determined from the mapping and be defined according to the technical and financial possibilities for the specific architectural object.

A thorough understanding of materials must include:

- **chemical characterization**: allow to identify the chemical composition (elemental and molecular) of the used material (substrate), materials of neo-formation, materials intentionally added on surfaces.

- **physical characterization**: allows to study the microstructure of the material (crystalline structure, porosity, density, water behavior, etc…).

- **mineralogical-petrographic characterization**: allows the identification of mineralogical phases present such as original materials and degradation products, microstructure and texture of the minerals.

- **morphological characterization**: allows to observe and describe the morphological characteristics of the microstructure of the material through the microscopic observation of the surface or cross sections.

- **mechanical characterization**: allows to study the mechanical properties of materials, such as the elastic modulus, the tensile, compression and bending strength, and their variations as a function of the material degradation.

A separate discussion must be reserved to study the “biodeterioration”, a particular form of degradation, which is the product of the colonization of surfaces and structures by microorganisms and plants.

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24 In this field there are numerous regulations UNI to which refer for the definition of the forms of degradation, the identification of microorganisms and weed species, and methods of intervention; the most important are: UNI 10923: 2001 Beni culturali - Materiali lapidei naturali ed artificiali - Allestimento di preparati biologici per l’osservazione al microscopio ottico;
The diagnostic analyses of Colour Plans, moreover, are used as control before and during the interventions, and to prove their effectiveness and duration in the course of time. A wide range of diagnostic analytical methods on-site and in laboratory are available, oriented to defining strategies for the conservation and maintenance. The analysis of the stratigraphy of a plaster sample can reveal valuable information about the building construction chronology by comparing the samples collected from different parts of the building. Fig. 6 shows how the diagnostic methods that can be used for “Colour Plan” can be useful to gather information about the existing masonries, providing to designers the comprehension of the current conditions and the potential causes of any distress. This knowledge and confidence is typically lead to better planning an appropriate conservation program to the historic structure, using materials and methods for the intervention compatible with the existing situation.

![Fig. 6 – Brief scheme of the knowledge process in a conservative intervention.](image)

Different types of investigation will be carefully assessed, planned in advance and selected bearing in mind the aims, the effectiveness, the limitations and the economy of the techniques. The most appropriate methods depend on many factors and should be identified case-by-case. Furthermore investigations should be planned carefully to include appropriate methods with minimal damage to the façades. It’s essential to divide the methods of investigation according to their destructive feature, so preferably using those which can be defined non-destructive or micro-destructive. Non-destructive and micro-destructive methods are important for the analysis of buildings, because comparative investigations can easily be performed in many different points on the object. In addition, these methods can be applied to the same surface areas before and after a treatment, and can be used for the long-term study of conservation measures.

The analytical methods mentioned and described below, are an indication about the currently most effective and versatile techniques for the characterization of the façade materials, for the evaluation of their state of conservation and for the measurement of their colorimetric parameters. The descriptions below concern just a limited number of instruments, the more adequate and traditional to be used but in case of particular needs, many other methods could be used.

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UNI 10813:1999 Beni culturali - Materiali lapidei naturali ed artificiali - Verifica della presenza di microrganismi fotosintetici su materiali lapidei mediante determinazione spettrofotometrica UV/Vis delle clorofille a, b e c.


26 The analytical diagnostic techniques most used in cultural heritage conservation are: hygrometer, infrared thermography, ultrasonic wave measurements, endoscope, pachometer, Schmidt hammer, karsten tube, weight method and calcium carbide method, stratigraphic essay, optical microscopy, ultraviolet-visible spectroscopy, raman spectroscopy, X-ray diffraction, X-ray fluorescence, infrared spectroscopy, scanning electron microscopy, acid dissolution, chromatography.
Many of these techniques, whilst extremely effective if used alone, become even more powerful when used in combination. Typically, an investigation involves the use of multiple complementary evaluation techniques. The instrumental analyses can be carried out on-site through non-destructive techniques or in laboratory through the analysis of samples taken from the building.

### 2.3.1 On-site investigations

#### Hygrometer

The hygrometer uses the difference in the dielectrical constant between the water and the dry building material. In these measurements exact numerical values using a non-calibrated scale are depicted on the measuring apparatus, which measures a “high” or “low” moisture content in the material. Only the surface area is measured, whose moisture content is strongly dependent on the surrounding climate, and the field of measurement only reaches a maximum depth of a few centimetres (Fig. 7).

![Fig. 7 - Data capture concerning damp and temperature by means of protimeter surveymaster (Cappella del “Palazz”, Campodolcino, SO).](image)

#### Infrared thermography

The infrared thermography can be used to gather information about wall construction, measuring with considerable accuracy the constant emissivity in the infrared region and how it can vary in consequence of thermal excitations. A photographic image of the temperature distribution of the surface of the building under analysis was obtained (thermogramme). The different absorption of IR radiation by the materials that constitute the building is represented with different colours (Fig. 8). However, infrared thermography is very sensitive to weather conditions: rain or bright sun on a wall to be investigated may prevent any successful assessment, and the temperature gradient required sometimes means that more information on heated buildings can be obtained in winter, and unheated ones may be better surveyed at night when the day’s solar gain provides sufficient gradation.

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Colours and materials of historical centers: sustainable conservation and management

Ultrasonic wave measurements
The ultrasonic wave technique\(^\text{29}\) relies on acoustic measures and analyses the propagation of elastic waves generated in the materials by percussion. The wave propagation is comprehended between a few tens (sonic investigations) and a few hundred (ultrasonic investigations) of kHz. The variation into the propagation velocity of these waves is detected by means of accelerometers which allow to acquiring and recording the several waveforms according to the morphology of the wall structure and its state of degradation. The measurements are performed with a non-destructive assessment, they don’t leave mark and they can be used on fragile surfaces.

The ultrasonic wave technique provided additional information about the quality of the examined materials. In particular, it’s possible to identify degraded areas and discontinuities, to define the degree of homogeneity and compactness of the walls and to classify the mortars according to their elastic modulus. If masonry presents low values of ultrasound velocity means that contains a lot of voids and discontinuities (Fig. 9).


Fig. 8 - The thermogram on the left reveals that the infiltration in correspondence of the damp patch is now passive. The diagram on the right shows the temperature distribution along the profile n.2 and the histogram the temperature percentage inside the affected area (Chiesa di San Francesco, CN).

Fig. 9 - Phases of ultrasonic survey: identification of the test area and distribution of elastic waves on the grid (loggia della Torre Quadrata del Circo Romano, MI).
**Endoscope**

Endoscopy\(^{30}\) is an extension of the essential visual survey into areas inaccessible to the naked eye. While certain aspects of historic masonry construction are visible at the surface, other problems may be hidden from view and it's necessary to make probe openings or observations through small holes using an endoscope. The equipment ranges from relatively simple endoscopes consisting of a light source, a small diameter tube with built-in optics and an eye-piece, up to complex controllable systems with numerous specialized attachments. By drilling a hole (normally less than 12mm) and inserting the tube, the inside situation of the wall can be inspected. Systems are available down to 6mm diameter, and more specialized system down to less than 2mm. Photographic or video cameras can be attached to the eye-piece to record the findings (Fig. 10-11).

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**Fig. 10 - Phases of investigation by means of endoscope (loggia della Torre Quadrata del Circo Romano, MI)**

<table>
<thead>
<tr>
<th>Pilastro sinistro (2° livello)</th>
<th>C3/V 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Note: Le video-endoscopie del terzo caruggio indicano una disomogeneità e irregolarità nella tessitura, una malta disgregata e presenza di piccoli vuoti.

**Fig. 11 - Example of form realized in case of endoscope survey (loggia della Torre Quadrata del Circo Romano, MI)**

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**Pachometer**
The pachometer\(^{31}\) is a digital device based on the principle of magnetic induction. It detects in a non-destructive way the presence, the direction and the diameter of metal bars in the walls. Typically, metallic items are distinguishable only within 10 to 20 cm of the masonry surface. Somewhat more sensitive metal detectors can be useful in locating discrete anchors or ties, but these devices do not provide reliable information about size or depth of the metal (Fig. 12).

![Fig. 12 - Phases of investigation by means of pachometer (loggia della Torre Quadrata del Circo Romano, MI).](image)

**Rebound hammer**
The rebound (or Schmidt) hammer\(^{32}\) is a non-destructive test easily applicable on-site for estimating the rock strength. The advantage of using the Schmidt hammer is its cost-effectiveness and easy handling, and therefore it seems to be a promising tool at first sight for testing also weathered surfaces. The operative mechanism of the instrument is rather simple. When a Schmidt hammer is pressed onto the stone surface a spring-loaded mass is released against a plunger. The plunger impacts the surface and the mass recoils. The rebound distance travelled by the piston after it rebounds is called the rebound value (Fig. 13).

![Fig. 13 - Phases of investigation using rebound hammer. The table shows the reference values for measuring the hardness of the materials–TNO Institute, Delft (loggia della Torre Quadrata del Circo Romano, MI).](image)

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\(^{32}\) Schmidt E., *A non-destructive concrete tester*, in “Concrete”, 59 (1951), p. 34.


**Stratigraphic essay**

This intervention is typical for the investigation of plaster sequences applied to a masonry. It implies the progressive removal of material starting from the most superficial layer till the innermost layer adherent to the substrate, that is the masonry (brick or stone masonries). The process should be carried out by a certified restorer using various instruments based on the type of material to be treated: surgical scalpel in the case of finishes and paintings, or scalpel, chisel and hammer for the most resistant materials.

Facade stratigraphic analysis correlates single surface layers to well-defined construction phases; it focuses on chronological indicators inside a building or related to other buildings, and helps to reconstruct the finishing evolution (Fig. 14).

One of the major problems encountered in carrying out the plaster stratigraphy is the distinction between the stratigraphic units and the alteration/degradation. The bad state of conservation of the plaster may determine, actually, an overlapping of stratigraphic units and degradation. Therefore, the first analysis of the plasters should be the identification of the degradation items so as not to confuse it with different compositions or manufacturing of the plaster. In these cases the removal of stratigraphic samples chosen in representative zones can help to determine the correct sequence of the layers and the same samples can serve also for laboratory analysis on the composition, porosity, state of conservation and degradation causes.

*Fig. 14 - Stratigraphic essays realized over the façades of the main important buildings in the historical center of Castiglione Olona, VA (in this case Palazzo Branda Castiglioni and Pio Albergo dei Poveri di Cristo).*
2.3.2 Laboratory investigations

Sampling
Reliability and usefulness of the materials results characterization, in a critical way, depends on sampling activity\textsuperscript{33}; already in 1980 the Normal Commission has published a Recommendation\textsuperscript{34} concerning the stone material sampling, underlining the importance of such an operation.

The choice of the type and number of samples must be done after visually analysing the whole studied object and identifying the different type of material used and the present forms of alteration and/or degradation. It is also necessary to have information about previous restore interventions. Samples must represent all problems to be solve; in fact, their analysis must lead to the most complete and exhaustive knowledge of the studied object.

The sample should be representative of the material that is under investigation, should not damage the architectural element and the size of sample should be adequate for the selected analyses to be carried out.

Before collecting samples the goals must be clearly defined, concerning the required information and the analytical techniques to be use. In fact, samples must be representative of the monument or a part of it, must be adequate for the analytical techniques which must be used. For this reason the presence of an expert is peremptory to decide how many samples and in which quantity, keeping in mind the object problems and materials importance (Fig. 15).

In general the below criteria must be followed as strictly as possible:

- samples for identification and characterization of materials;
- samples to study of the deterioration phenomena, new formation compounds (such as efflorescences or deposit, etc.)
- samples to study of the causes and mechanism of degradation.

According to the need, sample collecting can be done from inside the wall or from the surface with different methodologies:

- Superficial sampling: made with brushes, scalpels or chisels to collect samples of superficial material or of its forms of alteration/degradation.
- In depth sampling: thanks to a probing tool of adequate dimension, possibly in position very near to the surface samplings.

The collected sample must be conserved in containers for inert material labeled with number or letter correspondent to the sampling.

The sampling operations must be accurately documented with photographs of the whole action, macro-photographs of phenomena to be investigated and macro-photographs of the areas the sample location.

Before the analysis the samples must be described through stereomicroscope observation and must be photographed underlining details and eventual particular aspects.

Fig. 15 – Sampling phases: a. stone sampling (Scolastica, Castiglione Olona, VA); b.c. plaster sampling (Palazzo Branda Castiglioni, Castiglione Olona, VA).


**Optical microscopy**

Optical (or light) microscope (Fig. 16-17) uses visible light and a system of lenses to magnify small samples and provide information about the structure and characteristics. Optical microscopy (OM)\(^\text{35}\) involves the interaction of light with a sample and magnification from x2 to x200 is achievable. Samples may be examined with transmitted light, reflected light and via stereomicroscopy where a three dimensional image is obtained. There are also different imaging modes that may be used. Bright field is the normal mode of operation in OM. With transmitted light, the contrast is based on variations of colour and optical density in the material. With reflected light, if the bright field mode does not provide adequate contrast, then the dark field mode may be employed.

Polarized light microscopy (PLM)\(^\text{36}\) involves the study of samples using polarized light. Such materials demonstrate a range of refractive indices depending on the propagation direction of light through the material. Polarising microscopy exploits the interference of the split light rays as they are reunited along the same optical path to extract information about anisotropic materials.

There is a range of sampling techniques available in OM:
- small samples observed without any preparation;
- powders observed by dispersion on a microscope slide;
- small samples embedded in a suitable material such as acrylic or epoxy resin examined in thin cross-sections.

The observation of the cross-sections in UV light permits to identify the organic compounds characterized with a fluorescence glow. Therefore these analyses are specific to indicate substances of different nature (crystalline or amorphous) or to recognize particular pigments and binders (Fig. 18).

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Fig. 17 - Stereomicroscope observation of samples from the historical buildings in Castiglione Olona (VA): a. calcite fog and support, magnification 1,6x; b. micro-fracture on fog, magn.8x; c. product of a precedent restoration, magn.6,3x (a.b.c. Palazzo Branda Castiglioni); d. finishing and support, magn.0,78x (Pio Albergo dei Poveri di Cristo); e. mortar (Casa Scurati); f. finishing (Scolastica); g. polished cross-section under reflected visible light showing the finishing mortar and the superficial white calcite fog (Palazzo Branda Castiglioni); h. polished cross-section under reflected visible light showing the finishing mortar and the superficial ocre paint (Corte del Doro).

Fig. 18 - a. polished cross-section under reflected visible light showing the finishing mortar (Layer1), the yellow-orange ground layer (L2) and the superficial finishing layers in gold foil and brass (L3-4); b. polished cross-section under UV light showing the presence of an organic-based layer (L1c) with a pink fluorescence located between the finishing mortar and the ground layer (cappella della Vergine del Carmelo, chiesa di San Rocco, Lomello, PV)38

X-ray diffraction

X-ray diffraction (XRD)\textsuperscript{39} is a technique used to determine the arrangement of atoms in a solid, with particular regard to the crystalline state. Therefore the mineralogical phases of material can be detected and identified. In the diffraction technique a monochromatic X-ray beam is directed at a powdered sample spread on a support. The intensities of the diffracted beams are recorded by a detector in function of the diffraction angles. The pattern obtained is characteristic of the material under study and comparison with a database of XRD patterns allows the material to be identified. The raw data consist of the X-ray intensities at all angles in the diffractometer. Fourier analysis is used to analyse the measurements and convert them into the locations of the atoms in the materials (Fig. 19).

\textbf{Fig. 19} - XRD spectrum of mortar sample (same sample of Fig. 20). X-ray diffraction: the spectrum shows the presence of calcite, quartz, muscovite, albite, kyanite (Palazzo Branda Castiglioni, Castiglione Olona, VA).

Infrared spectroscopy

Fourier transform infrared (FTIR) spectroscopy\textsuperscript{40} is a technique based on the vibrations of the atoms of a molecule. An infrared spectrum is commonly obtained by passing infrared radiation through a sample and determining what fraction of the incident radiation is absorbed at a particular energy. The energy at which any peak in an absorption spectrum appears, corresponds to the frequency of a vibration of a part of a sample molecule.

The FT-IR analysis may be executed in two different methods. The first is making KBr pellets in which the finely grinded material to be analysed is dispersed; the second is by means of diamond cell that allows to


analyse very small part of micro-samples, which are specifically separated from the rest of the sample by mechanical or chemical method (for example acid dissolution). In the diamond cell method the sample is highly compressed and a film of the micro-sample is obtained and can be analysed. The Fourier transformed infrared spectroscopy allows a chemical molecular characterisation of the materials, both for inorganic and organic compounds. The interpretation of the spectrum allows to identify with high accuracy and sensitivity the examined materials: for example, mineral pigments into finishes, binders and additives into mortars, treatments and protective products (Fig. 20).

**Fig. 20 - FT-IR spectrum of mortar sample (same sample of Fig. 19).** FT-IR transmission: the spectrum shows the presence of calcite, quartz, nitrate, silicate, magnesium carbonate (Palazzo Branda Castiglioni, Castiglione Olona, VA).

**Scanning electron microscopy**

In scanning electron microscopy (SEM) the image of an object is created using a beam of electrons rather than traditional visible light (Fig. 21-22). A scanning electron microscope can magnify objects of the order of 100,000 times and detailed three dimensional images can be produced. Such a technique is clearly of use when examining punctual region of samples.

Scanning electron microscopy may also be combined with X-ray spectrometry (EDS or WDS) in order to carry out elemental analysis of very small samples.

A scanning electron microscope operates by producing a beam of electron in a vacuum. The interaction of the electrons with the sample causes electrons to be dislodged from the atoms within the sample. The electron generated are detected and amplified.

The SEM analysis may be conducted on untreated samples to observe their superficial morphology, or on polished cross sections for deeper study about the stratigraphy.

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Fig. 21 - a. False colour SEM image of the polished cross section of the border region between the “body” mortar (on the left) and the finishing mortar (on the right). The blue colour is related to the presence of calcium, while purple stands for magnesium and green for silicon; b. EDX maps of the same areas for calcium, magnesium and silicon (cappella della Vergine del Carmelo, chiesa di San Rocco, Lomello, PV).

Fig. 22 - a. SEM image of the polished cross section with indication of the EDX analyses location (points b and c); b. EDX analysis of the overall composition of the ground layer; c. EDX spot analysis of pigment grain of the ground layer (Cappella della Vergine del Carmelo, chiesa di San Rocco, Lomello, PV).
**Determination of the aggregate fraction in a mortar**

The acid dissolution of a mortar sample is used to determine the content of siliceous or silicate aggregates. The procedure is described in the protocol UNI 11088:2003\(^{42}\). The sample under examination is subjected to a chemical attack with a dilute solution of hydrochloric acid, for a specified time and at a given temperature. This attack leads in solution the binding matrix and any calcareous aggregate, while the siliceous and/or silicate aggregates remain undissolved, including any pozzolanic material that had not reacted with lime.

The method aims at separating the aggregates from the binder fraction and then calculate the Binder/Aggregate ratio by weight. The method is a very simple chemical procedure followed by an algorithms in which a precise series of steps are followed and an answer is generated automatically without any informed judgment on the part of the analyst (Fig. 23).

Other diagnostic analyses can be made on the residue obtained from the treatment.

![Table realization for the acid dissolution of a mortar sample in order to determine the content of siliceous aggregate](image)

**Diagnostic masterfile**

A “masterfile” containing all the collected and analysed samples, divided for buildings, can be created at the aim of recording data and collect in a unique file the synthetic results (Fig. 24). This file (generally created by Microsoft Excel software) allows one to record the sample location, the characteristics, the notations about sampling, the sequence of layers, the on-site and in lab analyses.

Sequences of different layers of materials (like a multi-layer plaster) must be recorded through photography and written notes about the morphology of the samples, allowing for comparison of samples to establish general layering sequences and differences in individual or localized stratigraphies. Digital photomicrography has made the task of recording sampling much easier and more effective, because it permits a sure and fast direct comparison of samples coming from different places or layers.

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\(^{42}\) Beni Culturali – NorMal, Norma tecnica UNI 11088:2003 Beni Culturali – Malte storiche e da restauro – Caratterizzazione chimica di una malta – Determinazione del contenuto di aggregato siliceo e di alcune specie solubili.
**Fig. 24 - Diagnostic masterfile of Palazzo Branda Castiglioni (Castiglione Olona, VA): it permits a direct comparison between samples and facilitates the subdivision of the samples into groups according to their similarities.**
2.4 CHROMATIC SURVEY

The assessment of the surface colour of the different elements that constitute a single building, can be carried out using different measurement methods and expressing the results using different chromatic notations or coordinate systems\textsuperscript{43}.

A simple and immediate representation of the colour general state is of great importance for the architect who is in charge of the conservation work; this simple chromatic survey is very important to gather an accurate description of the current chromatic state, recording the changes occurred by atmospheric exposure, rainwater erosion, general ageing of materials, etc. Besides subjective visual impressions and interpretations, quantitative evaluation of colours can be carried out for almost homogeneous areas or architectural elements. From now on this kind of colour survey will be called “colour palette”.

A careful measurement session should be planned as far as meteorological conditions can influence the colour (for instance, moisture presence in the plaster layers or in the stones can deeply affect the colour measurement\textsuperscript{44}).

Nowadays the measurements of colour is easily performed using a \textit{reflectance spectrophotometer}, that is a simple and common portable instrument which allows determining the reflectance spectrum of an opaque surface in the VIS light range. The details of the application of this technique are reported in the next paragraph.

2.4.1 Spectrophotometer, Colorimeter

Spectrophotometers measure the reflection (or transmission) characteristics of a specimen at different wavelengths of the visible spectrum. Reflectance is the ratio of the amount of light reflected by a specimen relative to the amount of light illuminating the specimen. Reflectance factor is the ratio of the amount of light reflected by a specimen relative to the amount of light that would be reflected from a perfect reflecting diffuser under the same geometric and spectral conditions of measurement. The amount of light reflected is converted directly into tristimulus values or colour coordinates such as \( L^*, a^* \) and \( b^* \) (according to the colour system used).

Colorimeters are generally not as accurate as spectrophotometers because of the difficulties in matching the light source and filters to the combination of CIE illuminant spectral power distributions and colour-matching functions.

The portable devices existing for practical applications can be employed for measurements directly on the objects surface within a circumference up to several square centimeters (8 mm diameter), independently from the external lights or shadows and from weather conditions\textsuperscript{45}. (Fig. 25)

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\textsuperscript{43} The most used colour systems are: XYZ, Yxy, CIE \( L^*a^*b^* \), CIE \( L^*CH^* \), Hunter.Lab and Munsell.


2.4.2 Colour scale systems: CIE L*a*b* and Munsell Color

The colour of the exposed elements in a façade can be matched both visually and instrumentally. During the survey by means of the spectrophotometer and during the data elaboration phase, the CIE L*a*b* colour system is generally used. This colour space is currently recommended by the Commission Internationale de l’Éclairage (CIE) (International Commission on Illumination) and is widely accepted by both the scientific and industrial community.

The 1976 CIE L*a*b* sphere describes every possible colour in terms of geometric coordinates within its three-dimensional colour space. The vertical axis L* corresponds to colour brightness: L* values are always positives, symbolizing with 0 the ideal black and with 100 the ideal white. If the sphere is bisected along its equator, the two-dimensional horizontal cross-section is described by two perpendicular axis: a, the red-green axis and b, the yellow-blue axis. Red tones have positive a* and green negative a* values. In the same way yellow tones present positive b* and blue negative b* values. Colours become grayer at points closer to the center and more saturated at points closer to the edge. The colour sphere of the CIE L*a*b* system is reported in Fig. 26.

The successive phase of elaboration of the colour palette and chromatic project requires the translation of the CIE L*a*b* scale into the Munsell Color System, aiming at physically reproducing in a standard mode, both the colour palette and project; especially the chromatic project needs to prepare color samples to be evaluated in a more perceptive way, maybe on-site and with different lights.

Munsell Color System is the most internationally corroborate and accepted system, includes a wide “earth range” colours, diffused before the introduction of synthetic pigments, that make it especially recommended for the survey on archaeological sites, historical buildings or for restoration interventions. The problem with this system is that it still relies on human observers to compare colours to a particular Munsell standard system, and the number of Munsell standards with which colours can be compared is limited: the most extensive sets of Munsell standards typically provide no more than 1550 colours47. So,

Fig. 25 – Portable spectrophotometer used on-site for measuring the plastered façade in the historical center of Castiglione Olona, according with the CIE L*a*b* colour scale.

Fig. 26 - CIE L*a*b* 3D colour scheme.


this method is strictly dependent on the skill and experience of the observer and therefore can result in a subjective assessment.

The Munsell Color System\textsuperscript{48}, developed in 1915\textsuperscript{49} and still in use today, was an early attempt to catalogue colours in an objective and quantitative manner by creating a series of fixed colour standards. The colours of the spectrum are divided into ten colour groups or hues, and organized around a vertical axis called value, which runs from light at the top to dark at the bottom (brightness). Chroma, or how pure the colours appear (saturation), runs from grayer at the center to purer at the outer perimeter. The Munsell classification consists in an alphanumeric system where each colour is so ordered that the chromatic difference between two adjacent colours (in the three space dimensions) is always constant (Fig. 27).

\textbf{Fig. 27 - Munsell color system.}

\textsuperscript{48} De Grandis L., Teoria e uso del colore, Mondadori Electa, Milano, 2000.

2.4.3 Survey procedure

The measurements by means of the reflectance spectrophotometer are carried out in a round area of 8 mm diameter and aren’t affected by the environmental conditions and solar irradiation, although sometimes the roughness and texture of the plaster may alter the results. In addition, the usual inhomogeneity of an architectural surface, due to differences in the surface morphology, treatment and aging conditions, and to the general large dimensions, suggests to select a precise and limited representative area and to perform a high number of measurements. The final chromatic coordinates will be obtained from a statistical media of the surveyed data (Fig. 28).

The procedure for the chromatic survey of a single building consists in the measurements of all the important different elements and features which characterize the building external facades (Fig. 29). The main architectural elements that constitute a façade in an historical context are the following:
- **ground** (the wider surface area that characterizes the façade, with finishing or uncovered masonries. It can be made of different materials, like rendering and plaster with painting layers, brick or natural stone masonries with bedding mortars, wood or painted wood, etc.);
- **decorative elements** (like windows and door frames, string-courses, columns, pilasters, etc.);
- **basement** (the lower part of the building directly in contact with the ground);
- **main entrance, doors, shutters** (generally made by wood or metal alloys);
- **handrail, grating, etc.** (metallic elements).

**Fig. 28** - Chromatic data obtained from the on-site survey of Palazza Branda Castiglioni in the historical center of Castiglione Olona; final chromatic coordinate obtained from a statistical media of the surveyed data. According to CIE L*a*b* colour system.

**Fig. 29** - Chromatic on-site survey by means of reflectance spectrophotometer in the historical center of Castiglione Olona.
2.4.4 Data elaboration

The chromatic data, obtained by spectrophotometric measurements, are elaborated usually by means of a dedicated software, directly connected with the instrument. The software can arrange colour data in a database, work at the same time in different colour scale, calculate differences in colour coordinates, elaborate data with statistical procedures and express results in meaningful graphical modes.

The software can elaborate the data in several modalities with very different type of graphs reproduction, this is the reason why the aims of the research need to be clear at the beginning of the work.

Several elaborative methods are here suggested. Figure 30 shows the database containing the colour coordinates in the two different measuring geometries: with specular component included (SCI) or excluded (SCE). The specular component is the reflected light from the surface such that the angle of reflection equals the angle of incidence. SCE settings are recommended for general purpose. Also, the SCE setting is favored for comparison with laboratory data based only on diffuse light.

Another data interpretation is provided by the colour space Yxz. The diagram is based on tristimulus values, where the colours come from the mixing between the three primary colours: red, green and blue.

The colours are located in a three-dimensional space, but it’s possible to consider the colour space Yxz lying on a plane with two dimensions; each points in the graphs are identified with three (xyz) or two (xy) chromatic coordinates (Fig. 31).

The diagram in Fig. 32 shows in details which part of the colour space is occupied by the data. Usually the ground surveyed in historical context have coordinates a and b (according to the CIE L*a*b* system) located in the “earth range”. L values are reported in a separate graph; this data may be furthermore elaborated singularly into a comparative diagram, like in Fig. 33. This kind of elaboration permits to easily understand the differences in brightness between contiguous buildings.

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51 Cuppo F.L.S., Garcia-Valenzuela A., Olivares A., Influence of surface roughness on the diffuse to near-normal viewing reflectance factor of coatings and its consequence on color measurements, in “Color Research and Application”, ...

52 American Society of Testing and Materials (1987). Standard practice for identification of instrumental methods of color or color-difference measurement of material (reapproved in 1987) ASTM E805-81, Philadelphia. There are standards and recommendations that include the measurement geometries defined with diffuse illumination (SCE) or with total illumination that included diffuse and the specular component (SCI).

53 In-depth analysis are shown in the APPENDIX, applied to the case study of the historical center of Castiglione Olona (VA).
Fig. 31 - Castiglione Olona - Chromatic data of the plasters of via Roma — elaborated by means of the software Spectra Magic. The main graph provides the representation of the colours in the three-dimensional space Yxz, where Z corresponds to L*, and x and y to a* and b*, according to the CIE L*a*b* system. On the left: the colour are represented in the two-dimensional graphic (norm color system) where the red components are tallied along the x axis of the coordinate plane and the green components along the y axis. Colours on the left tend toward gray, which means that their spectral purity is decreased. What is not taken into consideration in this graph is brightness (the z axis).

Fig. 32 - Castiglione Olona - Chromatic data of the plasters of via Roma - elaborated by means of the software Spectra Magic. On the right: the graph locates in detail the data into the two-dimensional colour space, where a* corresponds with x axis and b* to y axis. Colours on the left tends toward gray, which means that their saturation decreases. On the left: the graph identifies the brightness of the data (L).
Fig. 33 - Castiglione Olona - Chromatic data of the plasters of the south side of via Roma, elaborated by means of the software Spectra Magic. On the x axis are sorted, as currently disposed, the building belonging to the south side of via Roma, starting from east (left on the graph) up to west at the end of the street (right on the graph). Y axis shows the L* value for each building. The graph permits a direct comparison between the brightness of adjacent buildings and a general evaluation on the whole street. It’s possible to create the same comparison also considering chroma and value data.
3. COLOUR PLAN: PROCEDURAL GUIDELINES

3.1 THE COLOUR PALETTE

As already mentioned, the colours palette is the most concise and meaningful rendition of all the colours on the exterior façades of a building or set of buildings, that will be the benchmark for any future colour choice. It will be submitted to the competent municipal office together with the chromatic project and made available to the operators and private citizens in the intervention phase.

Given the heterogeneity of a historical context, clear and specific criteria, according to the features of the set of buildings analyzed, must be defined to get the colour palette. Since the colour palette is an instrument that faithfully reflects the territory from which it comes, there isn’t a unique method for its preparation, therefore, it must necessarily be specifically created for each situation.

In case the historical stratigraphy of buildings is the key element of the project area, a “table of historical periods” will be compiled according to the construction period of the buildings. As many colours palettes as the identified historical periods will therefore be compiled. Mainly those hues obtained from bibliographical historical sources compared with the results of diagnostic investigations performed on original colouring and pigments will be considered.

However, considering both the many interventions that followed one another over time and the state of deterioration of the façades in historical centers, neither clear bibliographical evidences are always available nor the specific hue to associate with a given historical period is always possible to be identified through diagnostic tests. In that case the intervention area is divided into “sub-units” that is a sort of zoning internal to the project and based on the morphological features of the site as well as the typological features of the buildings. Each and every “sub-unit” will have its own colour palette whose hues are those currently in use and surveyed on-site.

3.1.1 Colour palette reproduction

The hues in the colours palette should consider all the architectural elements which form the façade - basements, grounds, decorative elements, doors, shutters, handrails, gratings, etc. – found in archival documents or surveyed on-site. As already mentioned, the colour palettes are conventionally expressed with the Munsell notation system.

Existing problems in the accurate reproduction of hues using digital copy printing should be considered: digital softwares mostly use RGB scale colour, different from those used for the architectural survey and also the support is obviously different (Fig. 34). To create a colour palette as similar as possible to the real


55 The majority of Italian cities divided the project area into different zones, like “comparto unitario” in Reggio Calabria, “circoscrizione” in Pavia, “unità minime di decoro” in Prato, etc.
wall supports, but nevertheless easy to handle and comfortable to use, “colour samples” are created in laboratory using natural pigments and usually gypsum on a paperboard support. Each paint should be controlled and evaluate by means of the spectrophotometer, and corrected until reaching the wanted colour expressed in Munsell Scale.

Fig. 34 – Comparison between the digital Colour Palette on the left and the Colour Palette reproduced in laboratory on the right. The Colour Palette in Munsell scale shows the main family surveyed from the plasters of via Roma – Castiglione Olona. For the digital reproduction the RGB scale was used, while the photographs of the colour samples are taken with natural light, to simulate the lighting of an external surface, with the digital camera Canon EOS 550 D optic 67, 18-135 mm.
3.2 PROJECT CRITERIA

The redevelopment and enhancement of the façades as provided in the execution phase of the chromatic project should be carefully evaluated according to the context. The proposal for the appropriate intervention to perform is given by the single study of each building, assigned to specific catalogues, and the evaluation of façade materials’ state of conservation. Given the many possibilities of intervention, since each building is a special case, it’s possible to set general criteria applicable to all the historical centers. The model depicted in Tab. 8 summarizes the procedural course that, starting from survey, reaches the project proposal, and it is an explanation of the method underlying the pursuit of the redevelopment of a historical center using Colour Plans. Summing up what has already been expressed in the previous chapter\textsuperscript{57}, the survey phase includes the dual focus on characterization of materials and cataloging of colours. Both materials and colour can be inspected and surveyed directly on-site or in laboratory through diagnostic investigations. On-site colour survey, combined with historical/bibliographical researches and diagnostic analyses, makes it possible to process and produce the colour palette, essential tool and guide for future chromatic projects.

Given the heterogeneity of the urban historical context, the first and substantial consideration to make before proposing any intervention on the façades is the distinction into two main categories of buildings, with different working procedures:

- **monumental buildings**: they are part of the architectural heritage and generally are listed buildings. The façades, the materials they are made of and the original colours, with all the stratifications and the changes undergone over time, have a strong historical value that must be preserved. The proposed intervention should preserve what exists by using only materially and chromatically compatible restoration materials; replacements or total reconstructions of architectural elements are generally not proposed. Even the plaster, though fragmentary, becomes a characterizing element and worthy of careful conservation.

- **diffused network of historical buildings**: referring to those historical buildings structuring the urban area, and acting as a context to monumental buildings. Although the value and historical importance can not be compared to monumental buildings, the diffused network of historical buildings is equally important and strongly characterize the image of the historical center. Their conservation and careful maintaining is therefore also essential. There are, in this case, different intervention criteria, because, in case of extreme degradation, the complete replacement of deteriorated architectural elements, such as plaster, by using materially and chromatically compatible restoration materials, is allowed and recommended.

\textsuperscript{57} See PART TWO Chapter 2. Knowledge and critical investigation.
COLOUR PLAN PROCEDURE

HISTORICAL RESEARCH
- on project area
- bibliographic documentation
- archival documentation
- iconographic documentation
- cartographic documentation
- on individual building

CRITICAL INVESTIGATIONS
- material characterisation
- in laboratory
- on-site
- chromatic survey
- in laboratory
- on-site

PROJECT CRITERIA
- monumental buildings
- conservative intervention
- compatibility
- material depending on diagnostic investigations
- colours depending on Colour Palette
- diffused network of historical buildings
- protection of uncovered masonry / plaster replacement
- monitoring and planned maintenance

GUIDE LINES FOR THE COLOUR CHOICE
- guidance in choice of HUE
- possible variations
- VALUE
  - hue:
    - ground
    - decorative elements
    - basement
    - doors, windows, shutters
    - handrails, gratings
  - chroma:
    - depending on:
      - location of the building and illumination of the facade
      - connections between an historical building and its context
      - identity and belonging to a community
      - colour as phenomenal experience
3.2.1 Intervention criteria for monumental buildings

Each conservative intervention on monumental buildings should involve two very important concepts: respect and compatibility. First of all respect for the historical value of the building, knowledge of the fundamental architectural characters, respect and conservation of the materials; in this context compatibility means the use and employment of compatible materials and techniques for restoration; moreover, it means also chromatic compatibility within the surrounding buildings and the historical context.

The colour palette is a crucial instrument to pursue the chromatic compatibility, while the diagnostic results about the material characterization are the starting point for a conscious conservative intervention. As already explained thoroughly, the role of the diagnostic investigations is of fundamental importance and necessary in order to identify the type of support and the causes of degradation.

Table 9 shows some commonly found combinations of materials and products for restoration. In historical context the following materials, among others, need to be conserved:
- traditional masonry (mixture of several construction materials connected by a mortar);
- natural stone elements;
- ceramic materials;
- renderings and plasters.

For the conservation of these materials the following products for restoration can be pointed out as of potential interest:
- mortars for rendering and plaster;
- consolidants;
- protectives (water repellents treatments).

<table>
<thead>
<tr>
<th>Historical materials</th>
<th>Products for restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mortars</td>
</tr>
<tr>
<td>Traditional masonry</td>
<td>X</td>
</tr>
<tr>
<td>Stones</td>
<td>X</td>
</tr>
<tr>
<td>Ceramics</td>
<td>X</td>
</tr>
<tr>
<td>Plasters and mortars</td>
<td>X</td>
</tr>
</tbody>
</table>

Tab. 9 – Common combinations of historical materials and products for restoration on historical buildings.

The performance of a given mortar will depend simultaneously on the type and properties of the substrate and of the restoration mortar. To identify in a systematic and exhaustive manner all the parameters potentially involved, a very in-depth essay should be done\(^{58}\), anyway the main parameters can be summarized as follows:

- Relevant parameters of the substrate:
  - chemical and biological parameters composition (lime mortar, lime and pozzolane mortar,
    type of bricks, salt content, presence of biogrowth, etc.);
  - physico-mechanical parameters (porosity, bulk and dry density, strength and deformability,
    capillarity, texture, etc.).

- Relevant parameters of the restoration mortar:
  - type of binder, additives and additions;

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- granulometry and colour of aggregates;
- physico-mechanical parameters (porosity, capillarity, water vapour permeability, strength and deformability, drying behavior, cracking resistance adherence to the support);
- durability (resistance to salt crystallization, etc.);
- workability;
- hardening behavior in wet and dry conditions;
- available working time;
- salt content.

The other products for restoration, as consolidants and protectives, have specific and well established requirements to be applied on high value historical architecture, and properties like chemical composition, viscosity, contact angle, gas permeability and impregnation capacity in the concerned substrate, should be assessed.

The conservative intervention consists in a series of operations which can be briefly summarize as follows:

**Preliminary operations:** mechanical removal of the integration mortars, mechanical removal of spontaneous vegetation, maintenance of windows, maintenance of wrought iron grilles, maintenance of rainwater drains, etc.

**Interventions of preconsolidation:** preconsolidation of plasters and natural stones.

**Interventions of cleaning:** removal of crusts, deposits, efflorescences and also protective products and the paintings considered harmful for the conservation. During this phase, the consistency of the plaster and its specific state of degradation must be carefully assessed.

**Operations of integration:** integration of gaps in plaster, filling of cracks. The integrations on the surface must be performed with products most similar to the existing ones, respecting the composition, the hues, the number of layers, the thickness and the grain size of the aggregates, thus trying to get the same values of behavior and aesthetic.

**Interventions of consolidation:** plaster consolidation and re-adhesion of blistering and detached of plaster.

**Interventions of protection:** application of protective products (water repellent treatment).

Furthermore the overall performance of any given conservation action depends on the intrinsic parameters of the concerned building and on the conditions of the environment where the building is located and, therefore, the compatibility/incompatibility of the concerned action cannot be assessed without taking the environment constraints into consideration.

### 3.2.2 Intervention criteria for the diffused network of historical buildings

Complete substitution of the plaster should be considered when there are technical conditions that make impossible to maintain it adherent to the substrate thus compromising the conservation of the support.

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The mortars used for the replacement should be compatible with the materials that constitute the support and with the colours currently applied to the facades and to context, as reported into the colours palette. When a general condition of decay of the plastered surfaces is established (generally the 35-40% of detachment and fragmentation), it’s appropriate to proceed with the complete substitution of the existing plaster, because the mechanical properties of the degraded mortar can no longer guarantee a safe condition\textsuperscript{62}. Furthermore the availability of materials affects decisions on whether to repair or replace existing façade components. Some original materials – for examples stones from a particular quarry – may simply be unavailable.

Taking decisions concerning replacements is not always so clear. Many factors must be considered, among them: the original materials, possible replacement materials, possibility to attach a repair, cost of repair, cost of replacement, projected life of repair, projected life of replacement, availability of materials, availability of labor, time required for production of replacement parts, location of the building\textsuperscript{63}.

### 3.2.3 Monitoring and planned maintenance

The overall objective of monitoring and planned maintenance\textsuperscript{64} assets is to control, maintain or restore the balance between the operating status of a building and its quality level. Monitoring and planned maintenance assets should also anticipate the possible failures in the interventions performed and define a set of adequate procedures for either their prevention or correction. Purpose of monitoring and planned maintenance assets is to define for the whole period they refer to (for example three-year, five-year or ten-year plans):

- inspections and interventions to carry out over time depending on the different maintenance strategies;
- the frequency of conducting those activities (such frequency depends on a number of factors: aspects emerged from diagnostic tests; regulatory requirements; over time building components behaviour emerged from studies, observations or experimentations);
- intervention criteria and reference procedures (such as operating, organizational and security procedures);
- necessary resources (men, materials, tools);
- measurement activities and monitoring criteria;
- satisfaction levels to reach and the measurement and monitoring criteria of such levels;
- estimated costs.

Italian law provides a whole series of UNI regulations referring to maintenance and management of the architectural heritage\textsuperscript{65}.

\textsuperscript{62} Carria F., La conservazione delle facciate. Materiali e tecniche per il recupero, Tecniche Nuove, Settimo Milanese, 2004.


\textsuperscript{65} Della Torre S., La conservazione programmata del patrimonio storico architettonico. Linee guida per il piano di manutenzione e consuntivo scientifico, Edizioni Guerini e Associati, Milano, 2003.


\textsuperscript{65} The main Italian regulations about the monitoring and planned maintenance are: UNI 10147:1993, Manutenzione. Terminologia


3.3 GUIDELINES FOR THE COLOUR CHOICE

Today one of the main problems within historical context is the loss of the original balance. In the past such balance was mainly given by the uniformity of materials and natural pigments found on-site and used for construction, transcending even the style dissonances of buildings erected in different historical periods with different architectural and decorative systems. The colours and material, then, were the common denominator giving the city its identity and perception of a coherent and homogeneous urban area, largely due to the local finding of raw materials.

The many changes made to historical buildings over time using materials and colours barely compatible with the support, the deterioration due to poor maintenance and care because of the increasing depopulation of historical centers and the lack of a common plan for interventions are some of the factors that affected changes in the image of historical centers.

The municipalities can use the colour plans like a tool aimed at helping public and private owners and professionals for the choice: the public offices need concrete intervention proposals to provide useful information to operators and private citizens helping them selecting the adequate products and colours for historical buildings.

3.3.1 Architectural units

Visual disorders and contradictions into a historical center are also caused by the subdivision of a facade following the private real estates without considering the original uniform composition created through the architectural elements. These facades aren’t supported by a real coordinated design activity planned at an urban scale, but are only characterized by the owner’s/operator’s decisions.

The colour plan doesn’t consider the current real estates of the buildings, but the original structure, namely the “architectural unit”\(^{66}\). Those architectural units are identified by several factors, first of all the architectural elements on the façade, as the eaves, the shingle, the shape and the rhythm of the windows, the decorative elements and the compositional structure of the building.

3.3.2 Guidance in the choice of the chromatic coordinates

The chromatic plan affects all of the architectural elements making up the façade which have been surveyed and recorded in the colour palette. The chromatic proposal will then take place specifically evaluating each element of the architectural unit. In most cases the choices have to be made on a case by case basis considering both the specific features of the buildings and the typical characteristics of the context. In any case it is here possible to describe some of the typical cases easily found in historical buildings.

The guidelines provide instructions to follow lessening the possible chromatic choices according to certain parameters evaluated on the basis of external factors that will be studied in the next section (such as illumination, environmental conditions, location, state of conservation, perception). This limitation of choices, is not an imposition, and leaves the opportunity for owners to express their aesthetic taste.

As the starting point of the new chromatic proposal is the colours palette, also the guidelines will be expressed according to the Munsell Color System\(^{67}\).

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\(^{67}\) See PART TWO Chapter 2.4 Chromatic survey – Colour scale systems: CIE L*a*b* and Munsell Color.
Ground

The impression of a chaotic surrounding, at operative level, is in most cases expressed in a color palette that reflects a current situation where the range of ground hues present in the investigated area is particularly wide (with the exception of those historical centers that make the polychromy their distinctive feature).

The first intention is to create a new coherence and uniformity for the grounds, coherence lost during centuries of transformations. It can be done for future interventions limiting the hues reported on the colours palette just to a few ones. The hues selected for the project correspond to the most present and surveyed hues in the interested area (Fig. 35). The project suggestion can’t be too far from the current situation avoiding to create disorientation and weaken the sense of belonging to the community.

![Munsell Hue Circle](image)

*Fig. 35 – Ground hues surveyed the historical center of Lomello (PV). On the left current chromatic state with expressed how much buildings belong to each hue. On the right the hue proposal which choice is based on the most used hues.*

The guidelines based on just few hues may look too restricted, with the risk to turn the area into a too much homogeneous and flat curtain deprived of vitality. However, it’s necessary to know that the perception of the same colour, considering for instance the different daily and seasonal illumination, the chromatic variations of the plasters upon aging, or the different period of intervention, changes a lot. The criteria adopted for the choice concern the decrease or the increase (within range established in the project) of values expressing the value (brightness) and chroma (saturation) parameters, preserving the main current hue (Fig. 36).
Colours and materials of historical centers: sustainable conservation and management

Fig. 36 – Chromatic project proposal for the ground of via Roma in Castiglione Olona. On the left are reported the chromatic coordinates considered the most adequate for the context; on the right the correspondent chromatic coordinates in Munsell representation.

Decorative elements
The perception of an uniform and homogeneous facade without visual contrasts, should be reached using the same hue for both ground and decorations. The necessary difference between the grounds and the decorative elements will originate from the different choice of value and chroma. Usually the decorations (such as ledge, pilaster, windows and door’s cornice, bas-reliefs, decorate balcony, arches, decorative ornaments, paints, etc.) are characterized by chromatic coordinates brighter than the ground. Therefore the proposal for the intervention should be an increasing of the value (brightness), maintaining the hue of the ground (Fig. 37).
Closing elements: doors, windows, shutters / handrails, gratings

The iron and wooden elements of the facades need for a particular attention during the planning phase because with their materials and colours influenced a lot the perception not only of the building to which they belong but also of the adjoining ones. Many of the minor interventions (replacement of shutters, window frames, new eaves, etc.) can significantly alter the overall appearance of an architectural unit and, when added to other processes of change, also the context in which it is inserted.

The splitting of the same architectural units between many owners is mostly revealed by the different maintenance interventions made on the elements for the door and window’s closings. Without any rules imposing homogeneity and coherence to the facade, the risk is to find several elements different from each other (Fig. 38). Into the project proposal for the facade it will be specified that there should be a single typology of shutters and doors for each architectural unit with the same material and same colour.

If the elements of the front are in good condition, the intervention will consist in a general consolidation and a superficial new paint; otherwise the substitution of the deteriorated elements is suggested. Hence each architectural unit will be singularly analysed, making particular attention to individuate not only of the colours but also to the materials employed. The hue chosen for the project should be one among the chromatic values of the elements that are already present in the front and reported on the colours palette (Fig. 39).
3.3.3 Criteria behind the choices

As already mentioned, the choice, within the proposed range, of the chromatic coordinates most adequate for any architectural element present in the facade is connected to several factors and variables. In addition to the instrumental objectivity beforehand expressed and used to identify a colour, also the important influence of the visual perception should be taken into account. Visually, in fact, the color is always perceived in a different way because of external factors of the context and factors specific to the person perceiving it. Therefore the objectivity of colour is supported by the subjectivity of perception: basic concept to take into account in phase of choosing the most adequate chromatic coordinates. This type of approach aimed at reading colours by considering and analyzing an increasing number of environmental variables that determine their perception.

The difficulty of the choice is to bring the extraordinary richness of the real phenomena into a unique, scientifically objective, chromatic coordinate.
Building location and façade illumination

It’s important to consider both the subjective aspects of visual perception, and the objective characteristics of the illumination source. The action of light, even only at different daily hours, makes the visual perception of the colours neither constant nor precisely determinable over time (Fig. 40).

![Fig. 40 - Distinct chromatic perception during different seasons (Palazzo Branda-Castiglioni, Castiglione Olona -VA-).](image)

Furthermore, the knowledge about the orientation of a building and its daily illumination is fundamental for an adequate chromatic choice. For instance, the more one street is positioned in shadows or in very tight street, the better is an intervention proposal that, among the coordinates indicated, prefers the more bright colours for the ground (Fig. 41). Similarly, the northward facades should be brighter than the southward ones because during the day they receive less solar illumination.

![Valencia](image)  
![Castiglione Olona](image)

*Fig. 41 – Historical buildings located into tight streets: the façades are usually in the shades and maybe just for few period in a day are illuminated by solar light.*
Karlin Friedell Anter⁶⁸ made an interesting research about the colour of the façades, focusing on the impact over the perceived colour caused by three factors: the daylight conditions, the point of view distance and the surrounding colours into the visual field. The colour determinations showed that all three factors individually investigated may actually cause variations in the façade colour perception, but these variations, because of light entity, can be considered negligible. In fact the major differences of perception are perceived comparing directly a façade’s surface with a sample reproducing the same tonality. The experiment allow to underline that the perception of a colour depends not only on the pigments used, by also on the texture and the roughness, that create shadows and movements on the surface. Then the application of a material is fundamental because may alter a lot its perception.

Colour samples were realized in Laboratorio Color, Departamento de Expresión Gráfica Arquitectónica de la Universidad Politécnica de Valencia, in according with the chromatic coordinates surveyd in the historical center of Castiglione Olona⁶⁹. The samples were made by gypsum and pigments applied over a cardboard. Figure 42 represents the comparison between the same chromatic coordinates applied to different supports: the plastered wall and the lab-created chromatic sample used for the colours palette. Although the instrumental measurement identifies the same chromatic coordinates, the human eye perceives the two colours in a different way.

![Fig. 42 – Castiglione Olona, via Roma. Comparison between the perception of same chromatic coordinate - 10YR 6/4 in Munsell Scale - applied over different supports: the plastered wall and the lab-created chromatic sample made by gypsum and pigments applied over a cardboard.](image)

Connections between an historical building and its context
The chromatic perception of the urban scene is not only given by the façades hues but also from an increasing complex set of elements whose resultant isn’t attributable to the sum of its parts. Every front can be considered as an unicum; its perception, however, will always be strictly linked to the context in which it is inserted. The colour can’t just be considered as a project for singular buildings, but must be related to the context, becoming a whole composed of single parts. The reference is to Josef Albers⁷⁰.

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⁶⁹ Chromatic samples realized in Laboratorio Color, Departamento de Expresión Gráfica Arquitectónica de la Universidad Politécnica de Valencia.

See PART TWO - Chapter 3 Colour Plan: procedural guidelines - Paragraph 3.1 Colour palette - 3.1.1 Colour palette reproduction.


"quasi mai (cioè, senza particolari accorgimenti) possiamo vedere un colore solo, isolato e non in relazione con altri colori. I colori si presentano in un flusso continuo, costantemente in rapporto con vicini che variano e in condizioni
according to which a colour is almost never seen isolated from its context but always in relation to other colours. So it’s impossible perceive an isolated colour, because is always in relationship with the near ones, and both in variable external conditions.

The only punctual analysis of colours, therefore, is not enough to read and give back the chromatic complexity of the urban image with its visual and perceptive hierarchies that are the result of a simultaneity of relations and reactions. The colour of an area into the visual field depends on surrounding stimulations determining local interactions so that the appearance of the colour could change according to the intensity of the near colours.

Figure 43 visually expresses how the perception of the same chromatic samples, contextualized with different colours around, changes. Although the photographs have been done with the same illumination and at the same day time, the two samples are visually perceived in a completely different way if the context conditions change.

**Fig. 43 – Castiglione Olona, via Roma. Differences of perception the same chromatic coordinates of the samples, changing just the context and maintaining same atmospheric conditions and same illumination. The chromatic coordinates of the samples are 10Y8,5/1 and 10Y7/1, while the support on the left is 10Y8,5/1 and on the right 10YR7/2, according to Munsell Scale.**

Trad. “hardly ever (i.e., without particular precautions) we can see just one colour, isolated and unrelated with other colours. The colours show up in a continuous flow, constantly in relationship with near ones that vary and in variable conditions”.
Itten\textsuperscript{71}, in his theory of colours, highlights the connection between colours, materials and the man: the surfaces of architecture are characterized by polychromy due to the natural colours of the different materials used. There are materials with peculiar chromatic characteristics, or man-made materials with a specific chromatic intent. In any case, the colour assumes meaning just when perceived by human senses (through retina and brain).

Moreover, in a historic urban context characterized by a very compact built area, the colour perception is never expresses singularly for each building, but, according to Itten's theory of perception of coloured shapes (in which shape and colour are never separated from the volume), a colour acquires different values depending on the adjoining colours and the overlapping ones.

**Colour as phenomenal experience**

Finally, the psychophysical aspects of colour is fundamental (the physical properties of the object and the phenomenal experience of the observer), because the man himself contributes with his way of looking, through his experience and also his mood, to the construction/interpretation of the chromatic values of the image. So the results is always filtered by the subjective component, which forms the basis of the perceptual process\textsuperscript{72}.

The colour is always seeped both through the atmosphere with particular weather conditions, humidity, effects of sunlight and also through human sensations, feelings and culture elaborating an image that has little to do with the chemical substances of the colour\textsuperscript{73}.


"da sempre, la policromia è una componente inscindibile dell'architettura e delle sue superfici, poiché il costruito si sostanza di materia e a questa materia è sempre connotato un valore cromatico, sia in relazione all'uso dei materiali naturali dotati di caratteristiche cromatiche peculiari, sia in relazione all'uso di materiali prodotti dall'uomo con questa specifica intenzionalità (una realtà cromatica) determinabile e analizzabile dal punto di vista fisico-chimico, che assume il suo contenuto e significato umano mediante la percezione attraverso la retina e il cervello". Trad. "all along the polychromy is an inseparable component of the architecture and its surfaces, because the built is embodied of material and this material and a chromatic value is inborn in this material, in relation to the use of both natural materials with peculiar chromatic characteristics, and man-made materials with this specific intent (a chromatic feature) physic-chemical determinable and analyzable, that assumes its human content and meaning through the perception by means of retina and brain".

\textsuperscript{72} Falzone P. (ed.), *Colore architettura ambiente*, Edizioni Kappa, Roma, 2008.

\textsuperscript{73} Palmas Devoti C., *Problemi di ambiente e restauro delle facciate genovesi*, in *Il colore nell'edilizia storica. Riflessioni e ricerche sugli intonaci e le coloriture*, supplemento al ”Bollettino d’Arte”, n. 6 (1984), pp. 41-46.

"Il colore delle case non è ciò che è ma ciò che noi vediamo attraverso l’atmosfera e in particolari condizioni di ambiente, umidità, incidenze di raggi solari; qualche volta è ciò che noi vogliamo che sia, un’immagine sintesi di sensazioni umane, di sentimenti e di cultura, un’immagine dunque che poco ha a che vedere con la sua sostanza chimica". Trad. “the houses’ colour isn’t what it is but what we see through the atmosphere and in particular weather conditions, humidity, effects of sunlight; sometimes it is what we want it to be, an image synthesis of human sensations, feelings and culture, an image therefore that has little to do with its chemical substance".
References


References


References


Schmidt E., A non-destructive concrete tester, in “Concrete”, 59 (1951), p. 34.


CONCLUSIONS

TERRITORIAL MANAGEMENT: PLANNING THE CONSERVATION
Colours and materials of historical centers: sustainable conservation and management
CONCLUSIONS

TERRITORIAL MANAGEMENT: PLANNING THE CONSERVATION

The cultural heritage - specifically the historical façades - could be a real resource and, through appropriate integrated management, provide a significant contribution to the local economic development. The conservation of historical façades together with the enhancement of local economy, will be achieved by concerted actions in order to recover the lost identity of the historical center. Identity renewed thanks to a collaborative process established between all the participants - public and private – with an active role both in knowledge and investigative phases and in operative management of Colour Plan.

The Colour Plan is an operative instrument that can be adopted by a local public Administration and can be diffused and used by architects or technicians and private owners in support of the material and chromatic choices. Public Administration may adopt a Colour Plan, inviting or forcing residents to follow guidelines and rules of the plan; for this purpose the Administration can encourage the use of the Plan through economic facilitating or tax relief. Instead of restricting or prohibiting any action or choice of intervention, it could be better to invite citizens to follow guidelines for the implementation of projects with scientific and technical basis providing significant benefits: economy, durability, improvement and increase in the value of building, better living conditions of the context.

The implementation of this plan facilitates and simplifies the technician’s work, providing them a sufficient knowledge about the object or guidelines for carrying out investigations, and assuring the assistance by municipal technicians and the access to all the specific documentation available at the municipality.

The Colour Plan is intended as a tool for conservation and enhancement of formal and material values of the historical center, consisting also in the nature and colour of finishes, the characteristic of the site, the local tradition and the specific culture. They are presented in Italy as an important integration to the rules defined by the existing planning instruments and regulations (the NTA-technical standards for implementation attached to PGT-local strategic plan and RE-building regulations) and as a tool for planning the conservation and maintenance of the façades, linking the purely technical features to the historical-critical ones.

The long term objective is to enhance historical centers and sites, and promote the culture of conservation through a better dialogue between public authorities and private owners of the architectural heritage.

Proposals for the Colour Plan management on the territory are consecutively elaborated; these proposals don’t want to be exhaustive of the problems that plague the historical centers, but are, starting from the practice, the most pressing and necessary. The problems faced by the Colour Plans are indeed very complex and require a multi-disciplinary approach. A general management strategy aims to reduce the overall intervention duration and costs, so that a sustainable conservation planning can be achieved. In such way, the funds raising phase is a major issue that has to be properly considered. A wide and easy collaboration of all the participants involved (both professionals figures and private owners) is also a highly desirable result to be achieved in the Colour Plan realization.
1. **A multidisciplinary approach**

Since the interventions start from the territorial scale up to the materials diagnostic analysis, there is not any discipline which can autonomously deal with historical centers problems. The problems faced by the Colour Plans are indeed very complex and commonly require a multi-disciplinary strategy. Aware of the fact that cities are a multidimensional reality, any intervention on urban façades conservation and colouring is integral part of a re-qualification project of the pre-existing façades (the cheapest and fast impact solution) but it must be necessarily followed by other interventions which understand its complexity by recommending long range application techniques. In this case it will not be defined as “Colour Plan” but generally as a “Conservation, maintenance and enhancing interventions plan” to be achieved in historical centers. So, the dialogue among different disciplinary sectors is fundamental because they must be all involved in the planning process and interventions works. The more the preliminary analysis will be interdisciplinary, the more the project choices will be pertinent to real issues. As a matter of fact, a single discipline cannot solve all the questions arising from the study of the historical center, and architects, urban planners, chemists, engineers, economists, territorial associations, public and private institution and specialist companies are asked to work as a team. In particular, the essential roles are: the economist, who realizes the economic and management plan, territorial associations which intensify the vital synergies in order to contribute to the success of the project between public institutions and citizens, architects and professionals in the area and companies in this field.

2. **Methodological strategy and tools**

In order to produce a complete and reliable documentation, before, during and after the interventions, it is necessary not only to continuously renew the methodologies and instrumentation used, but also to verify the strategies and the approach, going towards a complete on-site analysis and investigation. In fact, the current biggest deficiencies are observed, not in the methods, but in the operative phase strategy.

**A dynamic survey by means of the Colour Plan Unit**

First of all, the creation of a team is preferred because it can adopt an interdisciplinary “unified analysis” methodology with an thorough “dynamic survey” on-site; in the meantime, it would be useful to create an reference “abacus” as a “catalogue” of the degradation forms and of the therapies applied and tested, made of individual intervention examples to be evaluated as a useful basis for similar cases. In addition to this there should be a “Colour plan unit” (a mobile laboratory). This lab would be provided with the most proper instruments for an ad hoc on-site non-invasive diagnostics tool for the Colour Plan in order to obtain the basic data to define reliable diagnostic frames in short time. This could be even used as a permanent laboratory for example in case of a monitoring campaign. The contribution of the “Colour plan unit” would not deal with the diagnostic method, but with the strategy to be adopted in different cases.

In this way a real interdisciplinary work would be realized, in which each professional afferent to different laboratories (diagnostics for historical architecture, chemistry, structural engineering and design) could autonomously operate inside a collective coordinated actions scenario (Fig. 1). Moreover, it becomes necessary to extend collaborations in order to obtain self-managing and self-supporting projects, so that the valorisation process activated could be pursued, preventing transforming it into an end to itself project.
Digital models for an easier interpretation

In order to make the intervention suggestions more clear and readable and make coherent critical evaluations on advanced project choices, it is preferred to realize a three-dimensional digital model, maybe with an annexed video maker about the study field\(^1\) (Fig. 2). The opportunity to read the chromatic complexity of the city in its linked simultaneity requires a reflection not only in terms of analysis but also in terms of visual return and, for this reason, the opportunity to use three-dimensional visualisation techniques revisited for this aim, appears extremely promising\(^2\). Apart from comparing the condition of things with expected results, it is also possible to evaluate the proposed actions through the visualization of a highly realistic 3D Model which enables more than one level of fruition. Visualizing different proposals for the fronts colour design it could be possible to define the best solution applicable as well as to evaluate the planned actions through still images or walking through videos. The use of the model for conservation or for new re-qualification projects may offer planners further means by which the impact is evaluated and how the projects might be supported in the decision-making process.

3D modelling techniques show land, material and pathological survey made on widespread building surfaces, and urban fabric planning information; the architectural surveys, subjected to appropriate verification, might actually provide an excellent source of useful information for the modelling process without having to resort to more expensive surveys in terms of time and resources, like photogrammetry and laser scanning. The 3D render will simultaneously show the re-configuration of public spaces and the re-qualification of the overlooking façades. Therefore, even chromatic choices and materials specification for the new asset can be evaluated in order to improve the urban environmental quality and the area’s usability.

Mixing up science and new technologies with the traditional conservation survey actions could be desirable for creating interpretative mathematical models for the considered decay, to represent the actual state of the façades and to simulate the design actions. The obtained digital model reconstructs with a high degree

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of realism the actual state of the center and it satisfies the prerogatives of the project, i.e. the achievement of a model which may support a multi-platform visualization to act as an urban planning support system. This could cause a more effective control of the analytical and designing activities as well as the refining of a future Master Plan to manage cultural heritage.

![Image of three-dimensional modeling of the Piazza Repubblica in Lomello (PV): comparison between the current state (left) and simulation of the proposed project for the redevelopment of the square and fronts (right). The Colour Plan reported here represents only one of the infinite possibilities of choice between different hues, each with its own saturation and brightness.](image)

**Fig. 2** – Example of three-dimensional modeling of the Piazza Repubblica in Lomello (PV): comparison between the current state (left) and simulation of the proposed project for the redevelopment of the square and fronts (right). The Colour Plan reported here represents only one of the infinite possibilities of choice between different hues, each with its own saturation and brightness.

**Georeferenced GIS data base**

The creation of a database for georeferenced cataloguing of information allows the management of all historical-archive information and technical-scientific data produced during analytical and diagnostic phases, implemented with different methods. It can also become the data basis for the executive planning of restoration interventions (conditions, times, costs) and for the collection, underway upgradable, of all information about monitoring and conservation operations. The data base compilation, with accurate information about materials and techniques, will be useful to monitor and manage the programmed maintenance activities and it will represent a technical support for next interventions. So a new operative methodology is suggested which considers the monitoring system as a method to know the recovery process.
3. Incentive and financing

Although nowadays administrative offices are autonomously looking for funding, even promoting researches and projects in this direction, there is a total lack of national ad hoc laws which can boost projects of recovery and value of cities historic fragments thanks to the façades requalification. As obvious, virtuous administrations are in those regions provided with laws and benefits expressly predisposed or which enjoy the favour of special laws\(^3\). For all those regions which even today cannot take advantage of proper laws and for municipal administrations which would like to promote esteem initiatives; however, there is a scenario of possible actions aimed to the reduction of timetables and intervention costs.

_ Financing through Leggi Regionali or Leggi Speciali_

Colour Plans completely granted by Regions\(^4\) are today virtuous models as for reference laws, as for the strict collaboration between municipal administrations, designers, companies and universities or research centers.

Funds at their disposal are assigned on participation to Call made by the Regions themselves. Those funds aim is to solicit municipal administrations presenting projects, supportable if congruous, aimed to obtain the building and environmental requalification of public spaces; through the chromatic appreciation, with specific reference to buildings façades.

Coordinated by regions, projects got the colour plan actors ready for conducting even experimental researches about the planning of the suitable process methodologies for the colour intervention plan in historical centers and in urban fabric.

Besides being models for the funding and funds management, those Italian “pilot project” represent even valid examples of collaboration with research authorities, universities, but also with leader companies which produce construction materials and the consequent return on the research in those fields. Furthermore those collaborations often make up for nowadays complications for local administrations to sustain and provide expensive expert advice from external professionals.

_ Co-financing through private foundation or banking facilities_

In case an administration wouldn’t be able to take ad hoc public funding, they can find other bank/foundations funding - agreeing with research centers (also universities) in order to initially plan cognitive actions (relief, diagnostics, planning “guide lines” preparatory for the historical facades conservation, etc.). Those funding would be given for the “return” of future loan/overdraft to private account holders in order to favour later fulfilsments. There is the possibility to obtain different forms of funding even through private foundations after participating to public Calls. In this case it is necessary that inside public administrations there are qualified professionals able to acknowledge and promote the opportunities suggested by sponsors. Presently, it is very difficult for city halls to reach this goal without the partnership with other Entities like universities or companies, because of the low specific competence of technical divisions, and the lack of proper economical opportunities. In any case, those actions are based on a one and devised efficiency. In fact, the main thing is the dialogue between the building owners and the actors involved in the planning/proj ecting and executive process.

_ A joint project instead of several single interventions_

Over financial facilities, other virtuous processes can be started. It is actually possible to plan other combined actions aimed to lower total costs, so that the Colour Plan can self-manage and self-support thanks to the collaboration net. Instead of realizing single separated interventions, as it happens in the

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\(^3\) Chapter 2 “Colour Plan”: the Italian situation, A critical lecture of the current situation.

\(^4\) The projects commissioned by the Authority of the National Park of the Cinque Terra, by the city of Finale Ligure, the city of Genova and the city of Ischia.
most part of cases, it’s important to consider that realizing a unique project involving city areas leads to a considerable bureaucratic time and execution costs reduction. In fact, the coordination between administrations can identify consistent areas of intervention and realize a masterplan of “building groups” inside historical centers in which are important to be provided:
- a single work direction;
- a single authorization procedure for different offices (Supervision, municipality, etc.);
- a single monitoring, use and disassembly plan for scaffolding to be in rotation provided in the project area;
- benefits on public land occupation taxes;
- the same contacts with banks to obtain loans;
- the same agreements with the field companies to obtain reliefs on products prices.

The virtuous chain can though include even the choice of the sector companies and firms. The latter can often be actors of the plans (together with administrations and research bodies), thanks to their experience in providing “colour palettes” aimed to orientate the public and the private customer in the product choice. So the actions agreed can include that companies and firms act important reliefs on prices, just because simultaneously suggested to more interlocutors⁵.

In reality, a lot of those here mentioned incentives have already been experimented in the field.

4. Divulgation and diffusion of the intents and the results

A remarkable step facing Colour plans is the diffusion of intents and results of the project, because the involvement of all levels is necessary to reach the goals fixed in advance. In particular, it is basic to inform citizens and operators about laws, rules, benefits, methods and techniques of intervention. Plans imposed, if not recognized and understood are an end to themselves, without having a follow up of future improvement. On the contrary, if from the beginning the importance of actions made is clear, the population itself will start projects of improvement copying single cases provided by the administration. This can happen thanks to the elaboration of an integrated plan of communication of the project: conferences, public meetings, seminars, workshops, publications, open websites.

This kind of meetings must be included in the plan and basically consists on a comparison with citizens in order to guarantee the vital transparency and a proper involvement aimed to the fulfillment of the plan.

**Involvement of citizens**

On the basis of intervention ways which can also be very different among them, sociologists, architects, but also technicians and artisans – or people more in contact with the daily city life – must collaborate together with citizens to improve social and housing conditions according to the effective specificity of the intervention context (i.e. from maintenance operations to real planned interventions through the organization of helpful initiatives or the promotion of professional education courses). Therefore, over the specific thought experiences and the consequent variety of interventions (for disposition, scale, theoretical premises, approach and people involved), the common strategy should consists on starting recovery processes (social, economical, architectural, etc.) beginning with a direct confrontation with the citizens’ opinion in order to make their participation as dynamic, efficient and concrete as possible for the transformation intervention: colour can be conceived as an integrant and natural factor in a general conservation-restoring plan of the historical building⁶.

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⁵ A significant example is given by the city of Portofino: in Piano del Colore di Portofino. A guide for citizens of the city of Portofino to access free and discounted supplies distributed by the city, warranted to be free five years of inorganic paints based on lime and silicates, glazes and accumulated primer preparation and all other coatings may be necessary in accordance with the culture and tradition of craftsmanship of Portofino.

Territorial management: planning the conservation
Colours and materials of historical centers: sustainable conservation and management.
DOCUMENTARY SOURCES

ARCHIVIO DI STATO DI MILANO
Fondo per il Catasto Teresiano
Fondo per il Catasto Lombardo-Veneto
Fondo per il Catasto del 1954
Fondo Araldica

ARCHIVIO DI STATO DI VARESE
Fondo per il Catasto Teresiano
Fondo per il Catasto Lombardo-Veneto
Fondo per il Catasto del 1954

ARCHIVIO STORICO CIVICO DI MILANO

ARCHIVIO DELLA CURIA ARCIVESCOVILE DI MILANO
Fondo delle Visite Pastorali

ARCHIVIO DELL’OSPEDALE MAGGIORE DI MILANO

ARCHIVIO BERTARELLI

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Biblioteca del Dipartimento di Chimica, Materiali e Ingegneria Chimica “Giulio Natta”
Servizio tesi e documentazione – TeDOC
Archivio Lavori Didattica e Tesi di Laurea. Laboratorio di diagnostica per la conservazione e il riuso del costruito. Dipartimento di Progettazione dell’Architettura

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Colours and materials of historical centers: sustainable conservation and management
Collegiata di Castiglione Olona, Baptistery frescoed by Masolino da Panicale
Colours and materials of historical centers: sustainable conservation and management
CASE STUDY: HISTORICAL CENTER OF CASTIGLIONE OLONA

CASTIGLIONE OLONA IN THE HISTORY

Studies and researches are currently carried out by the Politecnico di Milano\(^1\) together with the Administration of Castiglione Olona (VA) with the purpose to realize a real Colour Plan for the historical center of the city. The opportunity rises after the participation to the 2011-Fondazione Cariplo call named “Promote innovative methodologies for planned conservation” and the subsequent financing obtained for a two-years project “Castiglione Olona: laboratory of integrated methodologies for the valorisation” in partnership between local Administration and Politecnico di Milano.

Castiglione Olona offers suitable features for such research both for the remarkable architectural and artistic value, and for the heterogeneity of the diffused network of historical buildings and structures, despite the generally bad conservative conditions of the whole historical center. In addiction nowadays Castiglione Olona is territory of studies and cultural center because is one of the less examples existent of Lombard Renaissance well transmitted and conserved.

“…quella specie di mistica cittadella fiorentina edificata dal Cardinal Branda sul colle lombardo…”

Gabriele D’Annunzio

\(^1\) Dipartimento di Progettazione dell’Architettura and dipartimento di Chimica, Materiali e Ingegneria Chimica “G. Natta”, Politecnico di Milano.

\(^2\) Trad. “…that sort of Florentine mystic citadel built by Cardinal Branda on the Lombard hill…”.
The old town of Castiglione Olona consists in a core of historic buildings built between the eleventh and the fifteenth century: aristocratic palaces, places of worship, civil buildings all erected around a piazza according to the humanistic canons of architecture. Castiglione Olona was designed and completely reorganized in the early decades of the fifteenth century, exactly starting in the 1421, for expressed want of Cardinal Branda Castiglioni (1350-1443). He developed this town as landmark of cultural, religious and above all spiritual authority following the typical Tuscany Filippo Brunelleschi’s canons and, indeed, in advance of the times, the Leon Battista Alberti’s theories about the “cittadella ideale”3 that shows the city assimilated to a palace where “le vie sono i corridoi, le piazze le stanze”4. These ideologies are physically expressed in the organization of the town, where Palazzo Branda Castiglioni, the private Cardinal’s residence expanded over fourteenth-century pre-existences, is the core of the urban structure of Castiglione Olona. In addition to his palace the Cardinal Branda Castiglioni arranged to give an appropriate residence to his family, constructing appositely for them the building in front of his. It should be added that there were already many Castiglioni’s residences into the town and all of a very high standard. The arrangement of the town is very simple: it is hinged around three main streets; the oldest are those who are now called Via Mazzini and Via Roma, the first north-south oriented, the second orthogonal to this one. But the characteristic feature of the town is defined by the implantation of via Cardinal Branda from Via Mazzini, creating the small square in the center: the landmarks of this street are on one side the Cardinal’s palace and on the other side on the top of the hill the Collegiate Church, decorated with frescos and pictorial cycles realized by the famous Tuscan artists Masolino da Panicale and Vecchietta. Just between these two landmarks are inscribed the majority of the buildings erected by Cardinal Branda. Buildings that gave a new and definitive image of the town, even social value, such as the Grammar and Singing School into the so-called Scolastica and the Church of Villa in the principal square.

![Collegiata di Castiglione Olona, Baptistry. “Storie del Battista”, frescos, about 1435, Masolino da Panicale.](image)

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3 Trad. “ideal citadel”.

4 Leon Battista Alberti, De re edificatoria, 1452. Trad. “the streets are corridors, the squares are rooms”.
This old town, during the time, has not undergone particular transformations. In 1849, the foundation of the company of plastic materials “Mazzucchelli 1849” led to the first urban expansion beyond the old boundaries of the town, with the consequent residential area’s decentralization. The local economy changed from a predominantly rural to an artisanal and industrial setting.

The local strategic plans occurred over times, while on the one hand contributed to the building development management of Castiglione Olona, on the other hand produced regulations (NTA) not yet adequate to the enhancement, the conservation and the valorisation of the historical center and its context. Currently the façades are characterized by an advanced state of degradation and the private owners take care of them without a specific control plan.

Aim of the research is the proposal of guidelines for the historical center’s valorisation project, starting from the fronts’ conservation and taking into account the historical and material specificity of the constructions. On-site and laboratory preliminary studies have been carried out over the existent finishes with the purpose of survey the chromatic data, characterise the material composition as well as assess the conservative situation.

Castiglione Olona is situated in the homonym valley, which hosts the river Olona, and is nowadays considered as “latent opportunity area”. Furthermore the development of Castiglione Olona can be inserted into a wider valorisation idea, creating cultural and landscape interrelation between the historical and archaeological sites that are closely related to each other and are located in the Valle Olona, as Castelseprio (UNESCO site), Torba and Cairate. Castiglione Olona and the Seprio municipalities can, with good reason, be considered a cultural district and fulcrum of future economic development of the whole Medio Olona territory. Then in this area there are many characteristic places, located in a relatively short distance from each other, that can be connected in a wider network according to a strategy of requalification, reception and accommodation capacity. The unifying element of the Seprio administrations is the agricultural vocation of the Olona axis, the presence of rural historic buildings and mills, and successively numerous architectural artifacts of industrial archeology. In addition must be considered the important Valmorea railway line: one of the first examples of rail infrastructure in the emerging Unitary State extended from Castellanza to Mendrisio, for which there is the purpose about the reopening of the trade from Malnate to Castellanza with tourism aims.

**Case study: historical center of Castiglione Olona**

*Historical center of Castiglione Olona, Church of Villa, 1431.*

*Cultural and environmental heritage in Valle Olona. Torba monastery (on the left), Cairate monastery (in the middle) and pedestrian and cycle path adjacent to the disused Valmorea railway line (on the right).*
VALORISATION PROJECT FOR THE HISTORICAL CENTER OF CASTIGLIONE OLONA

Castiglione Olona is nowadays place of experimentation and ideal ground for comparison and meeting between theory and practice, between method and its practical application in a complex reality. On this basis, it is possible to plan a development system for the entire old town, including both public and private buildings. Since July 2011 (start date activity) the project has greatly expanded involving the main institutions and cultural associations in the area: thus, bases are led for a successful long-term collaboration. Principal actors of the project are municipal administration5, designers appointed for drafting the new PGT, representatives of Ente Parco Rile-Tenore-Olona, representatives of local associations and finally Politecnico di Milano6.

The project progress is examined during several technical meetings; they are very important both for the organizational setting-up (taking into account the different roles of the actors in the project) and for establishing schedules and deadlines, including open appointments with citizens in order to make public actions clear and transparent. In fact, the involvement of the community is essential for the achievement of final objectives. In particular the diffusion of project intents will take place through technical conferences, the opening of a website and also the publication of a final results report.

The methodology intervention presented in PART TWO finds a practical application in the case study of Castiglione Olona. The whole work can be divided into the three main phases which characterize a Colour Plan: historical research, materials characterization and colour analysis with a proposal for intervention. Historical research has been carried out over the entire old town and permitted to identify five public buildings of particular historical and artistic value: Palazzo Branda Castiglioni, Corte del Doro, Casa Scurati, Scolastica, Pio Albergo dei Poveri di Cristo. Some of these still retain their importance and are landmarks in the context; they will be considered such as monuments to be conserved just as they were handed down. Instead, other buildings in the course of time lost their value, and, because of their current use, they are now considered part of the diffused network of historical buildings, without any form of tutelage or care.

Diagnostic investigations and sampling were carried out over this five emblematic public buildings. These are considered as "pilot-sites" for the development of a methodological intervention proposal - in line with the real local problems - applicable both on the monuments and on the diffused network of historical buildings and structures. The hope is that the valorization of these five “representative” buildings could be a positive example and could start a real willingness to intervene even among private owners (preferably supported at local level by a common coordination and by benefits to the project).

The chromatic survey, instead, was carried out over the whole street façades belonging to the historic buildings of the old town. The result allows a very exhaustive statistical data elaborations with the possibility of extending the chromatic proposal to the entire center.

This appendix shows in detail two meaningful examples: the first one concerns the application of the whole procedure to the street-front of Corte del Doro building, the second concerns the colour survey and the intervention proposal realized for via Roma.

5 Mayor, Culture Assessor, Urban Planning Assessor, Culture Office personnel, Technical Office personnel, Finance Office personnel - municipality of Castiglione Olona (VA).

6 Dipartimento di Progettazione dell’Architettura and dipartimento di Chimica, Materiali e Ingegneria Chimica “G. Natta”, Politecnico di Milano; project managers: prof.ssa Lucia Toniolo, prof. Maurizio Boriani; collaborators: prof.ssa Susanna Bortolotto, arch. Margherita Bertoldi.
a. CORTE DEL DORO
Each architectural unit will have its own form and here is proposed the Corte del Doro case; historical researches, samplings, diagnostic analyses and colour studies were held over this building. The form incorporates all studies and investigations carried out over the building and the data elaborations, as well as historical researches, diagnostic and chromatic analysis, and the project proposal with some exempla of enhancement. The studies conducted over Corte del Doro can be outlined as follows:

1a. Historical and documental sources
   . cadastral lecture
   . construction phases
   . iconographic documentation
2a. Materials and degradation survey
   . mapping of materials and degradations
   . diagnostic investigations
   . results and discussion
3a. Chromatic survey
   . on-site survey in Munsell scale
   . elaboration data in CIE \( L^* a^* b^* \) scale and subdivision in architectural unit
4a. The colour palette
5a. Project criteria
   . intervention of plaster substitution
   . monitoring and planned maintenance
6a. Guidelines for the colour choice
   . hypothesis of intervention

b. VIA ROMA
Via Roma is an example for the methodological protocol application aimed at the proposal of intervention guidelines, based upon the chromatic survey of each element in the façades. It provides an operative model that could be applied to the entire historical center. The studies conducted over via Roma can be outlined as follows:

1b. Chromatic survey
   . on-site survey in Munsell scale
   . elaboration data in CIE \( L^* a^* b^* \) scale and subdivision in architectural unit
2b. The colour palette
   . for every architectural elements in façade
   . in-depth analyses for the ground hues
   . colour palette reproduction
3b. Guidelines for the colour choice
   . guidance in the choice of chromatic coordinates
   . criteria behind the choices
a. **CORTE DEL DORO**

1a. **HISTORICAL AND DOCUMENTAL SOURCES**

The courtyard has medieval origins. This is attested both by the floor plan with a close courtyard delimited by two architectonical units plumbed to the street, and by the building technology characterized by herringbone cobblestone walls. Cobblestone portions in the wall are clearly distinct from the brick ones: brick portions were placed afterwards on pre-existing structures. Such as the majority of fourteen century’s civil buildings in Castiglione Olona, the front is constituted by an arched main entrance on the courtyard.

The oriental unit of the courtyard was the rural stable, connected with the occidental one by an enclosure wall toward Monteruzzo hill. A nineteenth century’s paint of Arturo Ferrari\(^7\) shows the enclosure wall, a porch and a low construction with a stair and a small balcony for the access to the first floor. The cadastral plans show that the south part was destroyed in the last century.

On the other hand, the oriental unit maintained nearly his whole original aspect. The only variations were due to the different uses during the time: must be notified the several layer of mortar that were applied over the original external frescos. This frescos were recently discovered by architect Cazzola in the last century during a restoration intervention.

The façade of Corte del Doro is composed by two different parts of the palace: the rustic one, with the main access on the courtyard, and the noble one, where MAP museum is actually located.

The rustic part is characterized by several squared opening in the ground floor, leading to Castiglione Olona Pro Loco offices and to some stock rooms.

The noble part is higher that the rustic one. It is divided in two portions based upon the actual properties. This division entails two different styles in the same façade: ochre mortar for the part of MAP museum and cobblestone wall with paint decoration for the part that includes the main arched entrance to the noble courtyard.

The façade is in a generally state of deterioration with a lot of cement mortar restorations. The external ochre mortar is missing in extended areas permitting to see the support. Further elements that create disturbance in the general interpretation of the front are the several cable and electrical systems installed on the façade. The main problem is the lack of maintenance.

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Colours and materials of historical centers: sustainable conservation and management

CASTIGLIONE OLONA - HISTORICAL CENTER / USE DESTINATIONS
Case study: Historical center of Castiglione Olona

1722: CATASTO TERESIANO

1856: CESSATO CATASTO

CASTIGLIONE OLONA - HISTORICAL CENTER / PROPERTIES
_CONSTRUCTION PHASES_

Dating: XIII century
Property: private
Use: residence

Date of construction deducted by the herringbone cobblestone type of building technology. This particular technique was used in other thirteenth century’s buildings in the same area.

Dating: XV century
Property: private
Use: residence

A brick unit was set on the cobblestone structure: this two parts, cobblestone and brick, are independent. The palace entrance is situated into a contiguous courtyard, on the right of the structure. The confirmation comes from a stone armorial bearing on the main entrance from the actual via Roma. Instead, the entrance of the rural part is, in Corte del Doro.

Dating: before the middle of XIX century
Property: private, fam. Castiglioni di Monteruzzo;
1946: fam. Mazzucchelli;
1985: west unit public
Use: residence

As shown on the cadastral plans of the 1856 and 1904, revised in 1954, the courtyard is closed on the four sides. In the 1923 the exterior frescos weren’t covered by the mortar and the lancet arches at the ground floor of the palace weren’t closed yet. The windows at the first floor are the only elements that don’t underwent any transformation. In the 1946 the descendants of Teresa Castiglioni, members of Monteruzzo family, sell the palace and the courtyard to Mazzucchelli family.

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8 Castle of Vizzola Ticino (VA) and tower of the castel of Masnago (VA).
Case study: historical center of Castiglione Olona

Dating: from 1970 to 2004
Property: private, fam. Mazzucchelli
1985: west unit public
Use: residence
2004: offices of MAP, of Pro Loco, and of local associations

In the Seventies the south side of the courtyard was demolished. The property passed from private to public in the 1984. In the following year started the interventions of restoration lead by architect Cazzola. The intervention consisted in demolition of extraneous elements, structural consolidation, functional redistribution and construction of an access area for the superior rooms in place of the south corp. In 2004 MAP museum was inaugurated.

ICONOGRAPHIC SOURCES

Galletti, photograph, 1987
Arturo Ferrari, Cortile quattrocentesco a Castiglione Olona, 1895
Sant’Ambrogio, photograph, 1893
2a. MATERIALS AND DEGRADATIONS SURVEY

_ GEOMETRIC SURVEY

_ ORTHOPHOTO
MATERIALS MAPPING
Colours and materials of historical centers: sustainable conservation and management

_ALTERATIONS/DEGRADATIONS MAPPING_
DIAGNOSTIC INVESTIGATIONS

Sampling
The present study reports the results of a selection of samples from the north façade of the Corte del Doro, which faces the street. Three different areas were selected and are indicated in the following figure. Each sample was named with an identification code (e.g. RUST_A01, RUST_B, NOB_C) according to its sampling location and corresponds to a single layer of the stratigraphic structure. The sampling operations were carried out by means of a steel scalpel, chisel and hammer in order to collect fragments of plasters, mortars and superficial finishing. The collected samples were stored in polyethylene containers.

Analytical techniques
Analyses were carried out in the MaMeCH Lab (Dipartimento di Chimica, Materiali e Ingegneria Chimica “G. Natta”, Politecnico di Milano). The analytical techniques and instrumentation are reported below.

- **IR Thermography.** Therma Cam B2, Flir System.
- **Spectrophotometry.** Portable spectrophotometer in visible light reflectance KonicaMinolta CM-2500c with geometry 45/0°.
- **Stereomicroscopy.** Leica M205C stereomicroscope, equipped with a Leica DFC290 digital camera. Observation made on samples’ fragments and polished cross-sections.
- **XRD.** Philips PW1830 instrument with Bragg-Brentano and Thin Film geometry, using a Cu anticathode and Kα radiation (λ = 1,54058 Å). X-ray diffraction analysis performed on powder samples.
- **Fourier Transformed Infrared Spectroscopy.** Thermo Nicolet 6700 instrument coupled with a FTIR Continum microscope. Micro-particles were analysed in diamond compression cell with a MTC detector in the spectral field 4000-600 cm⁻¹, while fine grinded samples were analysed once dispersed in KBr pellets (KBr FTIR grade by Sigma-Aldrich) with a DTGS detector in the spectral field 4000-400 cm⁻¹.
138 Colours and materials of historical centers: sustainable conservation and management

MaMeCH Lab - Materiali e Metodi per il Patrimonio Culturale. The photograph shows the stereomicroscope and the FT-IR instruments.

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9 Laboratorio MaMeCH - Materiali e Metodi per il Patrimonio Culturale, Dipartimento di Chimica, Materiali e Ingegneria Chimica del Politecnico di Milano; http://midar.chem.polimi.it
Sample RUST_A01

SAMPLING

Sample’s location and description. North façade, left side of the entrance arch. About 4 m height. The sampled mortar has been used both as bedding material for the masonry and for the inner layer (01-rinzaffo) of the plaster.

STEREOMICROSCOPY

The overall aspect of the mortar is characterized by a light gray coloured binder, with several voids within the matrix. Large (up to 1 cm) white lumps can be observed. The mortar’s matrix appears heavily disaggregated. The aggregate fraction seems to be rather homogeneous for what concerning grain size and grains’ colour. The average dimension of the aggregates below 0,5 mm with a grey-ochre prevailing colour.
Colours and materials of historical centers: sustainable conservation and management

FT-IR

RUST_A01: FTIR spectra of mortar’s sample. Powdered sample in KBr pellet.

FTIR results show the presence of both magnesium carbonate, as hydromagnesite (peaks at 3649, 3447, 1480, 1425, 745 cm\(^{-1}\)) and calcite (1425, 874, 713 cm\(^{-1}\)). This indicates that a mixed magnesium and calcitic binder has most probably been used in the mortar’s preparation.

The broad absorption peak around 1085 cm\(^{-1}\) is mainly related to the Si-O, Si-O-Si bonds of quartz-siliceous aggregates. Crystalline quartz is detected at 795, 695 cm\(^{-1}\).

Peaks at 3512, 1619, 1145, 695 and 594 cm\(^{-1}\) indicate the presence of gypsum, whereas the sharp peak at 1385 cm\(^{-1}\) is related to nitrates.

A single white lump has been mechanically separated from the mortar’s matrix and analysed. The results are consistent with the use of calcitic lime in the mortar’s preparation as the lump is entirely made of calcite (peaks at 1429, 874, 713 cm\(^{-1}\)). Residual traces of hydromagnesite and siliceous compounds belong to the surrounding mortar can still be observed. The sharp peak at 1385 cm\(^{-1}\) confirms the presence of significant amount of nitrates within the binder.
XRD results show the presence of calcite and quartz as the main mineralogical phases. The calcite/quartz ratio can be estimated around 1. The aggregate fraction also includes albite, kyanite, muscovite and dolomite. A low amount of gypsum is present as well.
Sample RUST_A02

SAMPLING

Sample’s location and description. North façade, left side of the entrance arch. About 4 m height. The mortar has been used as intermediate layer (02-arriccia) between the coarse layer (01-rinzaffo) and the most superficial plaster layer (03-intonachino).

STEREOMICROSCOPY

The overall aspect of the layer (about 1 cm thickness) is characterized by a gray coloured binder, with several voids and micro-crack within the matrix. White lumps (about 0,5 cm) can be observed. The mortar’s matrix appears generally disaggregated. The aggregate fraction seems to be rather homogeneous for what concerning grain size and grains’ colour. The average dimension of the aggregates is below 0,5 mm with a grey-ochre prevailing colour.
FT-IR

FT-IR results show the presence of both magnesium carbonate, as hydromagnesite peaks at 3648, 3443, 1454, 1426, 745 cm$^{-1}$) and calcite (1465, 874, 713 cm$^{-1}$). This indicates that a mixed magnesium and calcitic binder has most probably been used in the mortar’s preparation.

The broad absorption peak around 1084 cm$^{-1}$ is mainly related to the Si-O, Si-O-Si bonds of quartz-siliceous aggregates. Crystalline quartz is detected at 797, 695 cm$^{-1}$.

Peaks at 3512, 1621, 1147, 695 and 598 cm$^{-1}$ indicate the presence of gypsum, whereas the sharp peak at 1385 cm$^{-1}$ is related to nitrates.

XRD

XRD results show the presence of calcite and quartz as the main mineralogical phases. The calcite/quartz ratio can be estimated around 1:1.5. The aggregate fraction also includes dolomite, with minor albite, kyanite and muscovite. A low amount of gypsum is present as well.
Sample RUST_A03

SAMPLING

Sample’s location and description. North façade, left side of the entrance arch. About 4 m height. The mortar is the most superficial plaster’s layer (03-intonachino) and it’s covered by the external finishing.

STEREOMICROSCOPY

Microphotographs of RUST_A03

POLISHED CROSS-SECTION

Microphotographs of the polished cross-section of RUST_A03 under reflected visible light
The microscopic observation of the polished cross-section shows a rather compact ochre binder’s matrix. The mortar has an average thickness of about 3 mm. No voids or micro-cracks can be observed, neither along the matrix, nor along the binder/aggregates interface. The mortar still preserves a good cohesion as no signs of disaggregation are visible. The aggregate fraction is quite heterogeneous in colour (varying from light brown to dark grey) and grain size (up to 2 mm). The aggregates are mostly angular in shape with few particularly elongated grains. The overlapped finishing layer (sample RUST-04) can be observed along the upper border of the section. Some residual traces of a further finishing layer are located between the mortar and the finishing layer, and appear as pink-coloured grains (indicated by a white arrow in the figure).

FT-IR

**FTIR spectra of mortar’s sample. Powdered sample in KBr pellet.**

FTIR results show the presence of both magnesium carbonate, as hydromagnesite peaks at 3648, 3443, 1454, 1426, 745 cm\(^{-1}\) and calcite (1426, 874, 713 cm\(^{-1}\)). This indicates that a mixed magnesium and calcitic binder has most probably been used in the mortar’s preparation. The broad absorption peak around 1084 cm\(^{-1}\) is mainly related to the Si-O, Si-O-Si bonds of quartz-siliceous aggregates. Crystalline quartz is detected at peaks 797, 695 cm\(^{-1}\). Peaks at 3512, 1621, 1147, 695 and 598 cm\(^{-1}\) indicate the presence of gypsum, whereas the sharp peak at 1385 cm\(^{-1}\) is related to nitrates.
XRD results show the presence of calcite and quartz as the main mineralogical phases. The calcite/quartz ratio can be estimated around 1. The aggregate fraction also includes albite, kyanite, muscovite and minor dolomite. A low amount of gypsum is present as well.
**Sample RUST_A04**

**SAMPLING**

*Sample’s location and description.* North façade, left side of the entrance arch. About 4 m height. Superficial finishing ochre in colour (04-ochre finishing)

**STEREOMICROSCOPY**

*Microphotographs of RUST_A04*

**POLISHED CROSS-SECTION**

*Microphotographs of the polished cross-section of RUST_A03 under reflected visible light*
The microscopic observation of the polished cross-section shows an ochre superficial finishing layer of about 200 µm thickness. The layer is completely detached from the substrate (RUST_A03) and the gap between the two layers is filled by powdered soot material. The underlying mortar layer (sample RUST-03) can be observed in the lower border of the section. Some residual traces of a further finishing layer are located between the mortar and the superficial finishing layer, and appear as pink-coloured grains (white arrow).

**FT-IR**

![FT-IR spectrum](image)

*RUST_A04: FTIR spectra of mortar’s sample. Powdered sample in KBr pellet.*

The spectrum of the finishing layer shows the presence of high amount of gypsum (characteristic doublets at 3546-3405, 1684-1621, 1144-1117, 670-602 cm⁻¹), with minor calcite (peaks at 1426, 875, 712 cm⁻¹) and nitrates (single sharp peak at 1385 cm⁻¹).

The peak at 1325 cm⁻¹ can be related to the presence of calcium oxalate, as weddellite.

Finally the peak at 1740 cm⁻¹ could be ascribed to the presence of an organic binder, most probably a polymeric resin (alkyd or acrylic resin).
Sample’s location and description. North façade, sample collected above the first window on the left, near a wide crack of the plaster. About 3 m height.

STEREOMICROSCOPY

Microphotographs of RUST_B

The overall stratigraphy includes an inner mortar layer (arriccio, white arrow), an overlapped superficial one (intonachino, yellow arrow), traces of a discontinuous blue and white painted layer and an external ochre finishing layer (RUST_A04). The inner mortar layer alone will be discussed. The prolonged exposition to the outdoor environment, together with the general lack of maintenance of the façade, have promoted the deposition of soot material and the growth of biological colonization over the surface (this can be particularly noticed after the observation of the inner surface of the sample - orange arrow).

The inner mortar layer (arriccio) is characterized by a gray coloured binder, with several voids. The aggregates are homogeneous in colour and grain size; the average dimension of the aggregates below 0,5 mm with a grey prevailing colour.
FT-IR

FTIR results show the presence of both magnesium carbonate, as hydromagnesite peaks at 3648, 3512, 3445, 1454, 1427, 747 cm⁻¹) and calcite (1427, 874, 713 cm⁻¹). This indicates that a mixed magnesium and calcitic binder has most probably been used in the mortar’s preparation.

The broad absorption peak around 1084 cm⁻¹ is mainly related to the Si-O, Si-O-Si bonds of quartz-siliceous aggregates. Crystalline quartz is detected at peaks 797,695 cm⁻¹. Neither gypsum, nor nitrates can be observed in this case.

XRD

XRD results show the presence of quartz as the main mineralogical phases, with minor calcite. The calcite/quartz ratio can be estimated around 1:2. The aggregate fraction also includes albite, kyanite, muscovite and dolomite. A low amount of gypsum is present as well.
Sample NOB_C

Sample’s location and description. North façade, sampled near the left balcony of the first floor. Plaster layer (intonachino) covered by the ochre finishing.

STEREOMICROSCOPY

The overall aspect of the plaster layer is characterized by a gray coloured binder, with several voids and micro-crack within the matrix. White lumps (about 0.5 cm) can be observed. The mortar’s matrix appears disaggregated. The aggregate fraction seems to be rather homogeneous for what concerning grain size and grains’ colour. The average dimension of the aggregates is below 0.5 mm with a grey-ochre prevailing colour. The plaster is covered by a ochre finishing layer and, as for RUST_A03, some residual traces of a further layer (pink-coloured grains) can be observed between it and the inner mortar.
FTIR results show the presence of both magnesium carbonate, as hydromagnesite peaks at 3649, 3516, 1486, 1429, 745 cm\(^{-1}\) and calcite (1429, 875, 713 cm\(^{-1}\)). This indicates that a mixed magnesium and calcitic binder has most probably been used in the mortar’s preparation.

The broad absorption peak around 1084 cm\(^{-1}\) is mainly related to the Si-O, Si-O-Si bonds of quartz-siliceous aggregates. Crystalline quartz is detected by the peaks at 796, 694 cm\(^{-1}\).
_RESULTS AND DISCUSSION_

The diagnostic investigation of the samples allows to define the general stratigraphy of the plasters (described from the internal to the external layer):
- an inner layer of mortar (rinzaffo, RUST_A01),
- an intermediate layer of mortar (arriccio, RUST_A02),
- a thin superficial layer of mortar (intonachino, RUST_A03 and NOB_C),
- a finishing layer (RUST_A04).

Sample RUST_B belong to a restoration intervention and it is therefore to be considered separately, being different from all the other samples.

- **Samples RUST_A01, RUST_A02, RUST_A03**

The aspect of three layers differ mainly in the binder colour: the sample RUST_A01’s binder is light gray coloured, the RUST_A02’s binder in gray coloured, while the RUST_A03’s binder is ochre/gray coloured. Microscopic observation of polished cross-section (sample RUST_A03) shows that the mortar still preserves a good cohesion and no sign of disaggregation are visible, even if FTIR and XRD analyses indicate the presence of gypsum and nitrates, typical neo-formation minerals after degradation of binder phase. FTIR results show the presence of both magnesium carbonate, as hydromagnesite, and calcite. This indicates that a mixed magnesium and calcitic binder has most probably been used in the mortars’ preparation. The binders are characterized by the presence of several voids, micro-crack within the matrix and white lumps of different dimensions (up to 1 cm). The aggregate fraction seems to be rather homogeneous for what concerning grain size and colour. The average dimension of the aggregates is below 0,5 mm with a prevailing grey-ochre colour. XRD results show that the aggregate fraction is composed by a large amount of quartz, also including albite, kyanite, muscovite and dolomite. A low amount of gypsum is present as well.

The differences between the three samples are the higher nitrate peak and the larger amount of silicate in the sample RUST_A01 (Fig. 1).

XRD results show the presence of quartz as the main mineralogical phases, with minor calcite, for all samples.

The analyses on samples RUST_A01 and RUST_A03 allow to estimate the calcite/quartz ratio around 1, while in the sample RUST_A02 the calcite/quartz ratio is around 1:1.5 (Table 1a).

Microscopic observations, FTIR and XRD analyses allow to understand that the chemical and mineralogical composition of the three layers (rinzaffo, arriccio and intonachino) are indeed very similar. The statement indicate that, most probably, they have been applied in the same period.

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*Fig. 1 - FT-IR spectra: comparison between the samples RUST_A01 (light blue), RUST_A02 (purple) and RUST_A03 (red).*
- **Samples NOB_C**
The sample NOB_C was sampled in the “noble” part of the façade, it shows many similarities with the layer RUST_03-intonachino, and consequently with all the other plaster layers. A similarity can be immediately noticed by means of stereomicroscope and confirmed by the spectra obtained by FT-IR (Fig. 2). A characteristic that connect the two layer is the ochre/gray colour of the binder, the presence of cracks or pores and the presence of the same amount of white lumps.
The mineralogical composition of the mortar is: presence of both magnesium carbonate, as hydromagnesite, and calcite for the binder fraction, and quartz, albite, kyanite, muscovite and dolomite for the aggregate characterization.
Furthermore, in both samples, some residual traces of a further finishing layer are located between the mortar and the overlapped layer, and appear as pink-coloured grains.
A meaningful difference between the two samples is the absence of degradation compounds (gypsum and nitrates) for the NOB_C.

![FT-IR spectra: comparison between the samples RUST_A03 (red), RUST_A02 (purple) and NOB_C (green)](image)

- **Samples RUST_A04**
The superficial ochre layer (RUST_A04) consists in a lime finishing of about 200 μm thickness. Microscopic observation of the polished cross-section of the finishing layer shows that it is completely detached from the support (RUST_A03) and the gap between the two layers is filled by powdered soot material.
In addition to the calcite, traces of weddellite are revealed by FT-IR analyses, together with the presence of an organic binder, most probably a polymeric resin (alkyd or acrylic resin).
This layer is completely deteriorated consisting mainly of gypsum with a negligible fraction of binder.
Finally the peak at 1740 cm⁻¹ could be ascribed to

- **Samples RUST_B**
Sample RUST_B was taken from a plaster crack. It consist in an inner mortar layer (arriccio), an overlapped superficial one (intonachino), traces of a discontinuous blue and white painted layer and an external ochre finishing layer (RUST_A04). FT-IR and XRD analyses of the inner mortar layer show the differences between all the other mortars analyzed. The main differences are ratio binder/aggregate of 1:2 and the absence of gypsum and nitrates.
Many replacements of new mortar are visible in the façade and the sample RUST_B is probably a recent addiction to restore a plaster lack.
### Case study: historical center of Castiglione Olona

Samples | calcite | quartz | kyanite | muscovite | albite | dolomite | gypsum | binder | aggregates | ratio B/A
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
**Original mortar**

| RUST_A01 | ++ | ++ | ± | ± | ± | calcite | quartz, albite, kyanite, muscovite, dolomite | 1 : 1 |
| RUST_A02 | + | ++ | ± | ± | ± | calcite | quartz, albite, kyanite, muscovite, dolomite | 1 : 1.5 |
| RUST_A03 | ++ | ++ | ± | ± | ± | calcite | quartz, albite, kyanite, muscovite, dolomite | 1 : 1 |

**Replacing mortar**

| RUST_B | + | + + + | + | + | ± | calcite | quartz, albite, kyanite, muscovite, dolomite | 1 : 2 |

*Table 1a - Comparison between XRD results on mortar’s powdered samples. The ratio binder/aggregate, here expressed, is not quantitative but allows to perform a quick comparison between the samples.*
3a. CHROMATIC SURVEY

_INSTRUMENTAL CHROMATIC SURVEY OF THE STREET FRONT OF CORTE DEL DORO. CIE L*a*b* SCALE_

The chromatic data are obtained from the on-site survey of the current state of the street front of Corte del Doro in the historical center of Castiglione Olona. The data are detected by means of spectrophotometer in reflectance in accordance with CIE L*a*b* parameters. The final chromatic coordinates are obtained from a statistical average of the surveyed data in different points of the surface. The measurements interested each architectural elements and features which characterize the building external façades.

In the following table (Table 2a) is reported an example of chromatic survey with the final chromatic coordinates of each architectural element obtained from averages.

<table>
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<th>Description</th>
<th>Location</th>
<th>L*(D65)</th>
<th>a*(D65)</th>
<th>b*(D65)</th>
<th>L*(D65)</th>
<th>a*(D65)</th>
<th>b*(D65)</th>
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Table 2a - Instrumental chromatic survey of the street front of Corte del Doro. CIE L*a*b* scale

_CHROMATIC SURVEY OF EACH ARCHITECTURAL ELEMENTS IN FAÇADE; STREET FRONT OF CORTE DEL DORO. MUNSELL SCALE_

The table 3a shows the current chromatic state of the façade expressed in Munsell parameters, transformed starting from the final chromatic coordinates elaborated in average in CIE L*a*b* (Table 2a). The building is divided into the two architectural unit from which it is composed: rustic part and noble part. In the table are reported the Munsell parameters of each architectural element, in that case: ground, main entrance, doors and windows shutters, handrails, decorative elements.
### 4a. THE COLOUR PALETTE

Graphic representation of the colour palette related to the street front of Corte del Doro. The surveyed chromatic data for each architectural element in façade is contained in the colour palette. It propose the current chromatic state of the building.

In that case, many coordinates of the same architectural element are proposed. It is due to the presence of different hues in the same façade, as for the ground surface.

<table>
<thead>
<tr>
<th>BUILDING</th>
<th>GROUND</th>
<th>MAIN ENTRANCE</th>
<th>DOOR</th>
<th>SHUTTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>via Roma 29</td>
<td>ochre 10YR 6/2</td>
<td>ochre 2.5Y 7/4</td>
<td>ochre 2.5Y 7/4</td>
<td>ochre 2.5Y 7/4</td>
</tr>
</tbody>
</table>

Table 3a - Chromatic survey of each architectural elements in façade; street front of Corte del Doro. Munsell scale

**COLOUR PALETTE** - street front of Corte del Doro, Castiglione Olona- Munsell scale
5a. PROJECT CRITERIA

The façade of the Court of Doro is divided into two distinct architectural units (rustic and noble). Many motivations lead to the proposal to adopt a uniform surface for the ground, without distinguishing the two units. The reasons are related to the fact that currently the intended use of the building is the same for both parts and the main access to the noble architectural unity is from the rustic courtyard. So the functional distinction that existed in the past is no more coherent with the current destination of use. Another motivation is provided by the results obtained from diagnostic investigations: the characterization of the plaster allows to conclude that the mortar is the same for both the rustic and the noble part. This indicates clearly that the two part (rustic and noble) were built up with the same materials and finishings.

Diagnostic investigations in laboratory show that the layers of historical plaster are still in a rather good state of conservation, despite a general presence of gypsum and nitrates. The superficial finishing is most deteriorated layer. As described in the conclusions of the diagnostic investigations, the finishing probably is a polymeric resin layer (alkyd or acrylic resin), and almost completely disaggregated from the plaster support. The advanced state of detachment and disaggregation of the superficial finishing leads to its necessary removal, trying anyway to keep intact as much as possible the underlying layers of plaster, so as to maintain the historical memory of the techniques and original materials.

The authenticity of the built heritage is to be understood and preserved as much as possible. Within the choice of a repair mortar, several performance requirements are to be addressed, such as: function, compatibility, durability. Since these are general, the way in which they are to be considered, is to be judged by the responsible restoration architect for each particular case study in detail. The minimum intervention principle applies, to enable maximum preservation as possible. Compatibility is defined as using materials that do not have negative consequences on the authentic materials. As such, attention should go to physical, mechanical, chemical properties that shouldn’t be too much different from those of the original mortar. A compatible and reversible repair mortar thus behaves similarly as the original mortar and does not give origin to new types of damage.

The intervention of finishing substitution can be outlined as follows:
1. The removal of the surficial layer of external finishing must be conducted with care, preserving the innermost layer which is well adherent to the masonry. The first phase takes place by means of manual or mechanical brushing and should be followed by a general cleaning with nebulized water to remove the salts.
2. The cleaning process consisted of a water nebulization system for a slowly and gently removing of soiling materials. A cleaning project is indispensable to retard the deterioration by removing soiling materials, as gypsum and salts present both in the mortar and in the superficial finishing, that may damage the masonry. It also provide a clean surface to accurately match repointing mortars or patching compounds, or to conduct a conservation survey of the masonry.
3. After a prolonged period of drying in adequate season (spring-summer), it’s possible to proceed with the restoration of plaster’s lacks.

The choice of the new plaster for the restoration to be used must be set according to the evaluation done by diagnostic investigations. In this case, the plaster will be realized with a natural lime mortar in the ratio binder/aggregate 1:2. The aggregates, the most similar to the ones used in the existent mortar, will be of fine granulometry (up to 2 mm) and brown or gray in colour. The mainly composition of aggregates will be quartz, together with, dolomite, albite, kyanite and muscovite.

The binder will be light gray coloured and could be mixt, calcium and magnesium carbonate based.

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10 See Diagnostic investigations: samples RUST_A03 and NOB_C.
The restoration architect will have the task of provide, to the companies appointed for the promotion of products for the restoration, the appropriate directions for the realization of mortars similar and compatible to the existents.

4. After about 90 days the plaster can be covered with a lime or mineral finishing, coloured with natural pigments according to the indications given in the chromatic guidelines proposal (see next paragraph).

6a. GUIDELINES FOR THE COLOUR CHOICE

The guidelines proposal concerns all the architectural elements making up the façade which have been surveyed and recorded in the colours palette. The chromatic proposal evaluates each element of the front that’s to be treated.

The guidelines provide instructions to follow lessening the possible chromatic choices according to certain parameters evaluated on the basis of external factors such as illumination, environmental conditions, location, state of conservation, perception. This limitation of choices, is not an imposition, and leaves the opportunity for owners to express their aesthetic taste.

The starting point of the new chromatic proposal is the colours palette, then the guidelines will be expressed according to the Munsell Color System, too.

The guidelines here expressed appositively for the street front of the Corte del Doro, are based over the more general indications gave for via Roma\textsuperscript{11}, in which the building is located.

The choice of the hue is restricted to two chromatic coordinates, excluding from the proposal for via Roma the most dark because of maintaining the hue the more similar as possible to the currently existent. The decorative elements will have the same hue of the ground for reaching a coherent and uniform perceptive result, but value will be higher than the ground, as it is nowadays.

The current chromatic situation of the doors and windows’ shutter is very chaotic: the colour palette present four different coordinates all in the same façade. A real reason to exclude some hue doesn’t exist, so the purpose is to make a choice of one of the existing four chromatic coordinates and use it for all the doors and windows in façade. In this way a uniformity of perception is assured, trying at the same time to maintain a chromatic continuity with the current state.

The handrails and gratings will have the same hue chose for the shutters, but darker (minor value and minor chroma).

<table>
<thead>
<tr>
<th>FAÇADE'S ELEMENTS</th>
<th>HUE</th>
<th>VALUE / CHROMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUND COLOUR</td>
<td>10YR</td>
<td>6 / 4</td>
</tr>
<tr>
<td>DECORATIVE ELEMENT</td>
<td>10YR</td>
<td>&gt; choice made for ground</td>
</tr>
<tr>
<td>BASEMENT</td>
<td></td>
<td>- / -</td>
</tr>
<tr>
<td>MAIN ENTRANCE, DOOR</td>
<td>7,5YR</td>
<td>4 / 2</td>
</tr>
<tr>
<td>DOOR AND WINDOW SHUTTER</td>
<td>10Y</td>
<td>4 / 4</td>
</tr>
<tr>
<td>SHUTTER</td>
<td>5G</td>
<td>3 / 2</td>
</tr>
<tr>
<td>HANDRAIL, GRATING</td>
<td>5BG</td>
<td>5 / 2</td>
</tr>
</tbody>
</table>

**CHROMATIC GUIDELINES** - street front of Corte del Doro

\textsuperscript{11} See Appendix b. *Via Roma*: Guidelines proposal.
Restricting the choice according to the guidelines proposal exposed, however the results could be potentially unlimited. Below are exemplified three example of possible results using the guidelines proposal for Corte del Doro.

The graphical representation permit to visually understand how the same colour could be perceived in a different way, depending on the context and the hues around it.
b. **VIA ROMA**

Via Roma is taken as case study for the methodological protocol application aimed at the proposal of guidelines for the chromatic project. Via Roma has a particular conformation: all the buildings that overlook to the street have the same typology that consists in an internal courtyard closed on four sides with just a front facing to the public street. Moreover, it’s possible to recognized easily the original compositional structure of the façades although now is covered by many changes of plasters, decorations, windows and doors’ shutters, with the adding of invasive technical systems. The main necessity of via Roma (as same as the whole historical center), to achieve a new global cohesion and identity, is not only a proposal of a chromatic range for the fronts, but also a definition of a conservative intervention for the materials with suggestions about the adequate products compatibles with historic substrates. The proposal of adequate products is engaged singularly for each building, as in the case study of the Corte del Doro. Via Roma, instead, is in-depth analysed from the chromatic point of view. Therefore via Roma can be used as methodological guide lines for other similar situation, in particular it is emblematic for all the historical center of Castiglione Olona.

*Location of via Roma within the historic center of Castiglione Olona. In plant is shown the particular courtyard typology that characterized this street.*
### 1b. CHROMATIC SURVEY

**INSTRUMENTAL CHROMATIC SURVEY OF THE STREET FRONTS OF VIA ROMA. CIE L*a*b* SCALE**

In the following table (Table 1b) is reported an example of chromatic survey over the entire street via Roma. The chromatic data are obtained from the on-site survey of the current state of via Roma. The data are detected by means of spectrophotometer in reflectance in accordance with CIE L*a*b* parameters. The final chromatic coordinates are obtained from a statistical average of the surveyed data collected in different points of the surface. The measurements interested each architectural elements and features that characterise the building façades.

#### NORTH SIDE

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<th>a*(D65)</th>
<th>b*(D65)</th>
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</thead>
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<td>1</td>
<td>VIA ROMA 14 - ground ochre/orange coloured superficial finishing</td>
<td>61.26</td>
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<tr>
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<td>53.51</td>
<td>9.59</td>
<td>33.09</td>
</tr>
<tr>
<td>2</td>
<td>VIA ROMA 16 - ground ochre/orange coloured superficial finishing</td>
<td>71.48</td>
<td>8.1</td>
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<tr>
<td></td>
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<td>59.33</td>
<td>7.73</td>
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<td>3</td>
<td>VIA ROMA 22 - ground white coloured plaster</td>
<td>83.04</td>
<td>1.1</td>
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<tr>
<td></td>
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<td>0.28</td>
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<td>76.83</td>
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<td>71.20</td>
<td>0.70</td>
<td>7.73</td>
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#### SOUTH SIDE

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<th>a*(D65)</th>
<th>b*(D65)</th>
</tr>
</thead>
<tbody>
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<td>11</td>
<td>VIA MATTEOTTI 6 - basement light grey coloured cement plaster</td>
<td>54.25</td>
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<tr>
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<td>3.73</td>
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<td>48.47</td>
<td>-0.03</td>
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<td>53.62</td>
<td>0</td>
<td>4.67</td>
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<td>49.49</td>
<td>0.07</td>
<td>4.57</td>
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<tr>
<td>12</td>
<td>VIA MATTEOTTI 2 - ground ochre/orange coloured finishing</td>
<td>73.15</td>
<td>9.54</td>
</tr>
<tr>
<td></td>
<td>75.47</td>
<td>9.14</td>
<td>39.33</td>
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<tr>
<td></td>
<td>74.57</td>
<td>9.23</td>
<td>39.</td>
</tr>
<tr>
<td></td>
<td>72.33</td>
<td>8.25</td>
<td>36.13</td>
</tr>
<tr>
<td></td>
<td>74.31</td>
<td>9.37</td>
<td>39.72</td>
</tr>
<tr>
<td>13</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>73.97</td>
<td>9.11</td>
</tr>
<tr>
<td>14</td>
<td>VIA ROMA 14 - exterior the front brown metal</td>
<td>51.06</td>
<td>-0.87</td>
</tr>
<tr>
<td>15</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>49.57</td>
<td>-1.07</td>
</tr>
<tr>
<td>16</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>51.56</td>
<td>-0.89</td>
</tr>
<tr>
<td>17</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>53.3</td>
<td>-0.78</td>
</tr>
<tr>
<td>18</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>49.93</td>
<td>-1.48</td>
</tr>
<tr>
<td>19</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>51.08</td>
<td>-1.11</td>
</tr>
<tr>
<td>20</td>
<td>VIA ROMA 16 - exterior the door green wood</td>
<td>51.06</td>
<td>-0.87</td>
</tr>
</tbody>
</table>

#### CHROMATIC SURVEY INSTRUMENTAL CHROMATIC SURVEY OF THE STREET FRONTS OF VIA ROMA. CIE L*a*b* SCALE

- The chromatic data are obtained from the on-site survey of the current state of via Roma.
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- The final chromatic coordinates are obtained from a statistical average of the surveyed data collected in different points of the surface.
- The measurements interested each architectural elements and features that characterise the building façades.
### Case Study: Historical Center of Castiglione Olona

#### VIA ROMA 26 - Ground Ochre Coloured Plaster

| 70.5 | 7.77 | 29.99 |
| 70.72 | 7.83 | 30.2 |
| 70.39 | 7.61 | 29.54 |
| 68.35 | 7.09 | 30.16 |
| 68.36 | 8.02 | 30.07 |
| 69.66 | 7.84 | 29.99 |

#### VIA ROMA 26 - Rolling Shutters Brown Metal

| 33.44 | 12.06 | 12.34 |
| 32.9 | 10.28 | 11.18 |
| 33.26 | 11.11 | 6.1 |
| 32.54 | 10.24 | 9.98 |
| 32.68 | 9.65 | 9.54 |
| 32.97 | 10.64 | 10.93 |

#### VIA ROMA 32 - Ground Light Grey Coloured Plaster

| 78.63 | 0.51 | 7.01 |
| 82.38 | 0.43 | 5.94 |
| 83.63 | 0.37 | 5.5 |
| 83.21 | 0.57 | 6.57 |
| 79.74 | 0.08 | 8.26 |
| 79.8 | 0.29 | 6.03 |
| 82.42 | 0.28 | 6.12 |
| 84.18 | 0.23 | 6.36 |
| 80.59 | 0.31 | 6.31 |
| 82.63 | 0.42 | 7.45 |
| 81.72 | 0.41 | 6.56 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 36.21 | -9.81 | 0.04 |
| 35.93 | -9.75 | -0.13 |
| 36.14 | -9.89 | 0.09 |
| 36.17 | -9.91 | 0.04 |
| 36.37 | -10.08 | 0.7 |
| 36.15 | -9.80 | 0.27 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 26.32 | 8.88 | 6.22 |
| 29.14 | 8.86 | 9.01 |
| 30.58 | 8.62 | 10.98 |
| 28.08 | 6.74 | 9.92 |
| 28.29 | 8.14 | 8.43 |
| 28.08 | 7.85 | 8.31 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 45.81 | 3.45 | 14 |
| 46.19 | 1.9 | 9.06 |
| 37.89 | 2.54 | 10.74 |
| 42.41 | 3.04 | 13.15 |
| 37.88 | 3.26 | 14.05 |
| 42.02 | 2.84 | 12.20 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 54.85 | 3.37 | 15.16 |
| 57.61 | 4.44 | 16.1 |
| 51.75 | 4.5 | 15.11 |
| 49.80 | 5.2 | 13.45 |
| 44.30 | 3.06 | 12 |
| 51.69 | 3.71 | 14.36 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 19.81 | 2.32 | 4.05 |
| 20.54 | 2.51 | 5.13 |
| 22.41 | 1.4 | 3.06 |
| 23.61 | 1.24 | 3.12 |
| 25.34 | 2.11 | 5.89 |
| 25.33 | 1.59 | 4.41 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 66.29 | -1.26 | -1.16 |
| 66.33 | -1.28 | -0.88 |
| 66.13 | -1.26 | -1 |
| 66.28 | -1.26 | -1.06 |
| 66.52 | -1.27 | -1.02 |
| 66.31 | -1.27 | -1.02 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 52.64 | 5.54 | 16.77 |
| 51.65 | 4.39 | 16.68 |
| 51.32 | 3.36 | 13.81 |
| 61.39 | 3.47 | 16.47 |
| 61.76 | 5.46 | 17.09 |
| 55.81 | 4.44 | 16.16 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 30.94 | 7.77 | 8.15 |
| 30.52 | 7.79 | 7.85 |
| 30.59 | 8.26 | 8.2 |
| 30.96 | 7.82 | 7.98 |
| 30.38 | 8.07 | 7.96 |
| 30.68 | 7.94 | 8.05 |

#### VIA ROMA 32 - Main Entrance Brown Wood

| 64.68 | 4.83 | 16.34 |
| 59.62 | 4.32 | 14.85 |
| 57.05 | 3.68 | 13.58 |
| 57.84 | 3.85 | 14.07 |
| 61.82 | 4.59 | 15.41 |
| 60.28 | 4.98 | 14.86 |
| 66.85 | 7.72 | 19.98 |

#### VIA ROMA 32 - Grating Green Metal

| 28.11 | -9.39 | 3.66 |
| 28.21 | -9.26 | 3.72 |
| 28.1 | -9.19 | 3.71 |
| 28.05 | -9.27 | 3.72 |
| 28.12 | -9.21 | 3.72 |
| 28.14 | -9.29 | 3.71 |

#### VIA ROMA 32 - Decorative Element Light Gray Plaster

| 69.91 | 0.02 | 7.54 |
| 70.59 | 0.04 | 7.84 |
| 69.22 | 0.03 | 7.43 |
| 72.43 | -0.18 | 6.98 |
| 71.46 | -0.13 | 7.09 |
| 70.72 | -0.04 | 7.36 |

#### VIA ROMA 32 - Grating Green Metal

| 29.33 | -9.17 | 2.87 |
| 28.08 | -9.34 | 2.78 |
| 28.99 | -9.39 | 2.85 |
| 29.18 | -9.26 | 2.71 |
| 29.14 | -9.21 | 2.85 |
| 29.14 | -9.27 | 2.81 |
Colours and materials of historical centers: sustainable conservation and management

<table>
<thead>
<tr>
<th>7 VIA ROMA 46 - ground ochre coloured plaster</th>
<th>17 VIA ROMA CD 29 RUST - ground yellow/ochre finishing</th>
</tr>
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<tbody>
<tr>
<td>VIA ROMA 19 - door green wood</td>
<td></td>
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<tr>
<td>27.69</td>
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<td>VIA ROMA CORTE DEL DORO RUST - door green wood</td>
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<tr>
<td>30.01</td>
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<td>VIA ROMA CD 29 RUST - ground yellow/ochre finishing</td>
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<td>VIA ROMA 52 CLERICI - main entrance light blue wood</td>
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<tr>
<td>62.05</td>
<td>6.09</td>
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<td>VIA ROMA CD 29 RUST - decorative element light ochre plaster</td>
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<tr>
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<td>6.09</td>
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<td>77.00</td>
<td>3.06</td>
</tr>
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<td>VIA ROMA 52 CLERICI - ground ochre coloured plaster</td>
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<tr>
<td>VIA ROMA CD RUST NOB - ground yellow/ochre finishing</td>
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</tr>
<tr>
<td>VIA ROMA 37 - ground fair faced cobblestone and brick masonry</td>
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<tr>
<td>VIA ROMA 37 - main entrance brown wood</td>
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</tr>
<tr>
<td>63.9</td>
<td>3.67</td>
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<td>63.7</td>
<td>4.14</td>
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<td>39.98</td>
<td>11.01</td>
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</table>
### Table 1b - Instrumental chromatic survey of the street fronts of via Roma. CIE $L^*a^*b^*$ scale

<table>
<thead>
<tr>
<th>20 VIA ROMA 41 - ground dark red coloured plaster</th>
<th>21 VIA ROMA 43 - ground ochre coloured painting</th>
</tr>
</thead>
<tbody>
<tr>
<td>48.57</td>
<td>14.02</td>
</tr>
<tr>
<td>46.28</td>
<td>13.61</td>
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<tr>
<td>44.11</td>
<td>16.13</td>
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<td>44.08</td>
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<td>45.29</td>
<td>16.05</td>
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<tr>
<td>46.87</td>
<td>15.06</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>19 VIA ROMA dopo porta - ground cement plaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.38</td>
</tr>
<tr>
<td>45.9</td>
</tr>
<tr>
<td>34.21</td>
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<tr>
<td>29.58</td>
</tr>
<tr>
<td>36.94</td>
</tr>
<tr>
<td>36.80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>22 VIA ROMA dopo porta - ground ochre coloured painting</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.38</td>
</tr>
<tr>
<td>45.9</td>
</tr>
<tr>
<td>34.21</td>
</tr>
<tr>
<td>29.58</td>
</tr>
<tr>
<td>36.94</td>
</tr>
<tr>
<td>36.80</td>
</tr>
</tbody>
</table>
The table 2b shows the current chromatic state of the façades on via Roma expressed in Munsell parameters. The data here expressed in Munsell comes from the transformation of the chromatic coordinates in CIE L*a*b* elaborated in Table 1b.

The fronts of via Roma are divided into original architectural units. Table 2b reports the Munsell parameters belonging to each architectural element, like: ground, main entrance, doors and windows shutters, handrails, gratings, decorative elements.

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>CONSTITUENT CHARACTERISTICS</th>
<th>ARCHITECTURAL ELEMENTS</th>
<th>MUNSELL PARAMETERS</th>
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<tbody>
<tr>
<td></td>
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<td>COLOUR</td>
</tr>
<tr>
<td>NORTH SIDE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Via Roma 14</td>
<td>3 floors Court building With arched main entrance to the court</td>
<td>Ground: rough mortar with ochre superficial paint Basement: gray mortar</td>
<td>ochre/orange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shutters: brown painted metal. rolling and fixed</td>
<td>brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decorations: white frame around some windows</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handrail: brown paint</td>
<td></td>
</tr>
<tr>
<td>2) Via Roma 16</td>
<td>3 floors Court building</td>
<td>Ground: rough mortar with ochre superficial paint Basement: gray mortar</td>
<td>ochre/orange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doors: green painted wood</td>
<td>green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decorations: stone frame around the doors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handrails: brown paint</td>
<td></td>
</tr>
<tr>
<td>3) Via Roma 22</td>
<td>3 floors Court building</td>
<td>Ground: white mortar Basement: gray mortar</td>
<td>white</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shutters: green painted wood. fixed</td>
<td>green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decorations: painted decoration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handrail: gray paint</td>
<td></td>
</tr>
<tr>
<td>4) Via Roma 26</td>
<td>2 floors Court building With squared main entrance to the court</td>
<td>Ground: ochre mortar Basement: rough gray mortar</td>
<td>ochre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main entrance: wood natural colour</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shutters: brown painted metallic. Rolling and fixed</td>
<td>brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handrails: brown paint</td>
<td></td>
</tr>
<tr>
<td>5) Via Roma 32</td>
<td>2 floors Court building With arched main entrance to the court</td>
<td>Ground: light gray mortar</td>
<td>light gray</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main entrance: wood natural colour</td>
<td>brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doors and shutters: green. Fixed</td>
<td>green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handrails: dark gray</td>
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<tr>
<td>6) Via Roma 40</td>
<td>3 floors Court building With arched main entrance to the court</td>
<td>Ground: ochre mortar</td>
<td>ochre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main entrance and shutters: green. fixed</td>
<td>green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decorations: white frame around the windows and string course</td>
<td>light gray</td>
</tr>
<tr>
<td>7) Via Roma 46</td>
<td>3 floors Court building</td>
<td>Ground: ochre mortar Basement: rough gray mortar</td>
<td>ochre</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Door: brown wood</td>
</tr>
<tr>
<td>---</td>
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<tr>
<td>8) 9) Via Roma 52</td>
<td>Court building With arched main entrance to the court</td>
<td>Ground: ochre mortar Side: ochre mortar. Very deteriorated</td>
<td>ochre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main entrance: light green/ light gray</td>
<td>green/gray</td>
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<tr>
<td></td>
<td></td>
<td>Decorations: sandstone frame around the main entrance</td>
<td></td>
</tr>
<tr>
<td>10) Via Roma *</td>
<td>Retaining wall</td>
<td>Ground: gray cement mortar</td>
<td>gray</td>
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</tbody>
</table>

**SOUTH SIDE**

<table>
<thead>
<tr>
<th></th>
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<th>Door: brown wood</th>
<th>Shutters: green. fixed</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>11) Via Matteotti 6</td>
<td>3 floors Court building</td>
<td>Ground: white/light gray mortar</td>
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<tr>
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<td></td>
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<td>5Y</td>
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<td>Shutters: brown wood. Fixed</td>
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<td>Decorations: stone frame around the entrance, stone balustrade</td>
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<td>3 floors Court building</td>
<td>Ground: ochre/orange mortar mortar</td>
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<tr>
<td></td>
<td></td>
<td>Shutters: brown wood. Fixed</td>
<td></td>
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<tr>
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<td></td>
<td>Handrails: windows dark gray</td>
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<tr>
<td>13) Via Roma *</td>
<td>2 floors Court building</td>
<td>Ground: ochre mortar. very deteriorated</td>
<td>ochre</td>
<td>10YR</td>
<td>5/2</td>
<td>too much deteriorated</td>
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<td>Handrails: gray</td>
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<td>Ground: ochre mortar</td>
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<td>10YR</td>
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<td>2,5YR</td>
<td>2,5/2</td>
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<td>5/2</td>
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<td>Decorations: stone pilaster to the side of the main entrance, beige mortar around the main entrance and the windows</td>
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<td>Handrails: dark gray</td>
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<tr>
<td>15) Via Roma 13</td>
<td>2 floors Court building</td>
<td>Ground: ochre mortar. very deteriorated</td>
<td>ochre</td>
<td>5B</td>
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<td>Doors: brown painted wood</td>
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<td>2,5YR</td>
<td>3/2</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Shutters: green painted wood. fixed</td>
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<td></td>
<td></td>
<td>Handrails: dark gray</td>
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<tr>
<td>16) Via Roma 15,17,19,21</td>
<td>3 floors Court building With arched main entrance to the court. Shops at the ground floor.</td>
<td>Ground: ochre mortar. Basement: gray cement mortar</td>
<td>ochre</td>
<td>7,5YR</td>
<td>6/4</td>
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<td></td>
<td></td>
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<td>green</td>
<td>2,5BG</td>
<td>2,5/2</td>
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<td>Doors: green paint</td>
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<td>7,5Y</td>
<td>3/2</td>
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<tr>
<td>17) Via Roma 29</td>
<td>2 floors</td>
<td>Court building</td>
<td>Ground: ochre mortar, Main entrance: brown wood, Shutters: brown, Handrails: green paint</td>
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<tr>
<td></td>
<td></td>
<td>With arched main entrance to the court</td>
<td>Proloco at the ground floor</td>
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<td>18) Via Roma 29</td>
<td>2 floors</td>
<td>Ground: ochre mortar</td>
<td>Door: brown wood, Decorations: beige mortar, Handrails: green paint</td>
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<td></td>
<td></td>
<td>Court building</td>
<td>Around the entrance</td>
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<tr>
<td>19) Via Roma 37</td>
<td>2 floors</td>
<td>Ground: cobblestone wall</td>
<td>Main entrance: brown wood, Decorations: painted mortar</td>
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<td></td>
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<td></td>
<td></td>
<td>Court building</td>
<td>Doors and shutters: brown wood, fixed</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>With arched main entrance to the court</td>
<td>Around the main entrance</td>
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<tr>
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<td></td>
<td>Ground: ochre mortar</td>
<td>Decorations: painted mortar and stone decorations around the main entrance</td>
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<tr>
<td></td>
<td></td>
<td>Main entrance: brown wood</td>
<td>Doorknobs: painted mortar and stone decorations around the main entrance</td>
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<td></td>
<td>Doors and shutters: brown wood</td>
<td>Around the main entrance</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>fixed</td>
<td>Decorations: painted mortar and stone decorations around the main entrance</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Handrails: dark gray</td>
<td>Around the main entrance</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>20) Via Roma 41</td>
<td>3 floors</td>
<td>Ground: red mortar</td>
<td>Main entrance: green painted wood, Shutters: green wood, fixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Court building</td>
<td>Handrails: dark gray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With arched main entrance to the court</td>
<td>Ground: ochre mortar, Main entrance: green painted wood, Shutters: green wood, fixed</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>Ground: ochre mortar</td>
<td>Main entrance: green painted wood, Shutters: green wood, fixed</td>
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<tr>
<td></td>
<td></td>
<td>Main entrance: green painted</td>
<td>Handrails: dark gray</td>
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<td></td>
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<td>wood</td>
<td>Around the main entrance</td>
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<tr>
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<td></td>
<td>Shutters: green wood, fixed</td>
<td>Doorknobs: painted mortar and stone decorations around the main entrance</td>
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<td></td>
<td></td>
<td>Handrails: dark gray</td>
<td>Around the main entrance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21) Via Roma 43</td>
<td>3 floors</td>
<td>Ground: ochre mortar</td>
<td>Door: brown painted wood, Shutters: brown, fixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Court building</td>
<td>Grating: brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ground: ochre mortar</td>
<td>Grating: brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 2b - Chromatic survey of each architectural elements in the street fronts of via Roma. Munsell scale*
2b. **THE COLOUR PALETTE**

Historical-archival researches about the case study of Castiglione Olona haven’t provided any information about the original colour of the façades and it wasn’t possible to make diagnostic analysis on every building. Therefore, the methodology proposed for the chromatic project is based on the current chromatic state, that is the colour palette.

Table 3b graphically represent the colour palette related to the street fronts of via Roma. The main architectural elements that constitute the façade are reported in this summary colour palette: grounds, main entrances, doors and shutters.

<table>
<thead>
<tr>
<th>BUILDING</th>
<th>GROUND</th>
<th>MAIN ENTRANCE</th>
<th>DOOR</th>
<th>SHUTTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NORTH SIDE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma 14</td>
<td>10YR 6/4</td>
<td></td>
<td></td>
<td>7,5YR 4/2</td>
</tr>
<tr>
<td>via Roma 16</td>
<td>10YR 6/6</td>
<td>5Y 5/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma 22</td>
<td>10Y 7/1</td>
<td></td>
<td></td>
<td>7,5G 3/2</td>
</tr>
<tr>
<td>via Roma 26</td>
<td>10YR 6/6</td>
<td>2,5YR 3/2</td>
<td>10BG 3/2</td>
<td></td>
</tr>
<tr>
<td>via Roma 32</td>
<td>10Y 8,5/1</td>
<td>2,5YR 3/2</td>
<td>10BG 3/2</td>
<td></td>
</tr>
<tr>
<td>via Roma 40</td>
<td>10YR 6/6</td>
<td>5G 3/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma 52</td>
<td>10YR 4/4</td>
<td>2,5G 5/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma *</td>
<td>7,5YR 7/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,5Y 3/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SOUTH SIDE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Matteotti 6</td>
<td>5Y 5/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Matteotti 2</td>
<td>10YR 7/6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma 7</td>
<td>10YR 5/2</td>
<td>2,5YR 2,5/2</td>
<td>2,5G 5/2</td>
<td>2,5G 5/2</td>
</tr>
<tr>
<td>via Roma 13</td>
<td>10YR 7/1</td>
<td></td>
<td>2,5YR 3/2</td>
<td></td>
</tr>
<tr>
<td>via Roma 15, 17, 19, 21</td>
<td>7,5YR 6/4</td>
<td>2,5BG 2,5/2</td>
<td>5G 3/1</td>
<td>7,5Y 3/2</td>
</tr>
<tr>
<td>via Roma 29</td>
<td>2,5Y 7/4</td>
<td>7,5Y 4/2</td>
<td>5BG 5/2</td>
<td>5G 3/2</td>
</tr>
<tr>
<td>via Roma 37</td>
<td>10YR 6/2</td>
<td>10Y 4/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma 41</td>
<td>5YR 4/6</td>
<td>7,5G 3/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>via Roma 43</td>
<td>10Y 7/4</td>
<td>2,5YR 2,5/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,5Y 3/2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COLOUR PALETTE** - via Roma, Castiglione Olona

Table 3b – Colour palette of via Roma, Castiglione Olona. Chromatic coordinates of grounds, main entrances, doors and shutters expressed in Munsell scale.
**GROUND COLOURS IN FAÇADES: THE COLOUR PALETTE**

Table 4b is an in-depth analyses related only to the current chromatic state of the building plasters in via Roma. The colour palette is represented divided in Munsell’s hue, to better understand the predominance of the hue 10YR compared to the other ones.

It is helpful in the project phase: the decision to maintain the 10YR hue as common base is automatic, starting from a sectorial lecture like this one.

<table>
<thead>
<tr>
<th>5YR</th>
<th>7,5YR</th>
<th>10YR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/1</td>
<td>8/2</td>
<td>8/6</td>
</tr>
<tr>
<td>7/1</td>
<td>7/2</td>
<td>7/4</td>
</tr>
<tr>
<td>6/1</td>
<td>6/2</td>
<td>6/4</td>
</tr>
<tr>
<td>5/1</td>
<td>5/2</td>
<td>5/4</td>
</tr>
<tr>
<td>4/1</td>
<td>4/2</td>
<td>4/4</td>
</tr>
<tr>
<td>3/1</td>
<td>3/2</td>
<td>3/4</td>
</tr>
</tbody>
</table>

*Munsell Scale* - 5YR

<table>
<thead>
<tr>
<th>5YR</th>
<th>7,5YR</th>
<th>10YR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/1</td>
<td>8/2</td>
<td>8/6</td>
</tr>
<tr>
<td>7/1</td>
<td>7/2</td>
<td>7/4</td>
</tr>
<tr>
<td>6/1</td>
<td>6/2</td>
<td>6/4</td>
</tr>
<tr>
<td>5/1</td>
<td>5/2</td>
<td>5/4</td>
</tr>
<tr>
<td>4/1</td>
<td>4/2</td>
<td>4/4</td>
</tr>
<tr>
<td>3/1</td>
<td>3/2</td>
<td>3/4</td>
</tr>
</tbody>
</table>

*Munsell Scale* - 7,5YR

<table>
<thead>
<tr>
<th>5YR</th>
<th>7,5YR</th>
<th>10YR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/1</td>
<td>8/2</td>
<td>8/6</td>
</tr>
<tr>
<td>7/1</td>
<td>7/2</td>
<td>7/4</td>
</tr>
<tr>
<td>6/1</td>
<td>6/2</td>
<td>6/4</td>
</tr>
<tr>
<td>5/1</td>
<td>5/2</td>
<td>5/4</td>
</tr>
<tr>
<td>4/1</td>
<td>4/2</td>
<td>4/4</td>
</tr>
<tr>
<td>3/1</td>
<td>3/2</td>
<td>3/4</td>
</tr>
</tbody>
</table>

*Munsell Scale* - 10YR

---

*Table 4b - Ground colour palette. The colour palette in Munsell scale shows the plasters’ hues of via Roma – Castiglione Olona.*
COLOUR PALETTE REPRODUCTION

The colour palette reproduction specifically for via Roma in Castiglione Olona was done in the “Laboratorio Color”, Departamento de Expresión Gráfica Arquitectónica de la Universidad Politécnica de Valencia.

Laboratorio Color, Departamento de Expresión Gráfica Arquitectónica de la Universidad Politécnica de Valencia.

To create a colour palette12 as close as possible to the real wall supports, but nevertheless easy to handle and comfortable to use, “colour samples” are created in laboratory using natural pigments and gypsum on a paperboard support (table 5b).

The paint created appositely for the palette colour of via Roma is a mix of gypsum, water and natural pigments and it is applied directly with a soft paintbrush over a cardboard base.

The most used pigments for reproduce the actual chromatic situation of via Roma range from the amarillo (yellow) to the ocre (ochre), considering also the intermediate type of pigments like amarillo oscuro (dark yellow) or ocre sin (light ochre). The pure pigment mixed with the gypsum indicate the chroma of a colour measured into a Munsell Scale.

Pigments, as sombra tostada (toast shadow), ombra bruciata (burned shadow), ombra natural (natural shadow), amalgra, negro (black) and negro mineral (mineral black), added just in little amount, allow to darken the value of a paint. Oppositely the pigment blanco titanio (titanium white) is used with the intent of lighten the mixture. Then, simplifying, the value is the result of proper quantities of white and black pigments.

Finally the required hue is reached mixing different pigments. Each created paint have been controlled and evaluate by means of the spectrophotometer, and corrected at every turn until reaching the wanted chromatic code expressed in Munsell Scale.

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12 See ATTACHMENT: Colour Palette: historical center of Castiglione Olona, via Roma.
Preparatory phases of the colour palette with shown the material used and the samples made. Laboratorio Color, Departamento de Expresión Gráfica Arquitectónica de la Universidad Politécnica de Valencia.

Photographs of the painted colour samples taken in the Laborator Color, Universidad Politécnica de Valencia, with natural light and a digital camera. The photographs are taken with natural light, to simulate the lighting of an external surface.
In succession the digital colour palette specifically for via Roma in Castiglione Olona is reported. The texture inhomogeneity is due to the faithful reproduction of the paper “colour samples”. In fact the photographs of the original painted colour samples are here inserted. The photographs have been taken with natural light, to simulate the lighting of an external surface, by means of the digital camera Canon EOS 550 D optic 67, 18-135 mm.

Colour notation: Munsell Color System

COLOUR PALETTE - via Roma, Castiglione Olona
Colours and materials of historical centers: sustainable conservation and management

FAMILY 10YR

7/2

6/2

7/6

6/4

6/6

COLOUR PALETTE - via Roma, Castiglione Olona

Colour notation: Munsell Color System
Case study: historical center of Castiglione Olona

Colour notation: Munsell Color System

COLOUR PALETTE - via Roma, Castiglione Olona
### Table 5b - Colour Palette of via Roma, Castiglione Olona, realized in laboratory with material compatible with historic supports and natural pigments.

<table>
<thead>
<tr>
<th>Colour Palette</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAMILY 5Y</strong></td>
<td></td>
</tr>
<tr>
<td>5/2</td>
<td></td>
</tr>
<tr>
<td><strong>FAMILY 10Y</strong></td>
<td></td>
</tr>
<tr>
<td>8.5/1</td>
<td></td>
</tr>
<tr>
<td>7/1</td>
<td></td>
</tr>
<tr>
<td>7/4</td>
<td></td>
</tr>
</tbody>
</table>

Colour notation: Munsell Color System
Case study: historical center of Castiglione Olona

3b. GUIDELINES FOR THE COLOUR CHOICE

GUIDANCE IN THE CHOICE OF THE CHROMATIC COORDINATES
The intervention guidelines concerns all the architectural elements making up the façade which have been surveyed and recorded in the colours palette. The chromatic proposal evaluates each element of the front that’s to be treated.
The guidelines provide instructions to follow lessening the possible chromatic choices according to certain parameters evaluated on the basis of external factors such as illumination, environmental conditions, location, state of conservation, perception. This limitation of choices, is not an imposition, and leaves the opportunity for owners to express their aesthetic taste.
The starting point of the new chromatic proposal is the colours palette, then the guidelines will be expressed according to the Munsell Color System, too.

<table>
<thead>
<tr>
<th>FAÇADE'S ELEMENTS</th>
<th>HUE</th>
<th>VALUE / CHROMA</th>
<th>notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUND COLOUR</td>
<td>10YR</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>DECORATIVE ELEMENT</td>
<td>10YR</td>
<td>&gt; choice made</td>
<td>-</td>
</tr>
<tr>
<td>BASEMENT</td>
<td>10YR</td>
<td>-</td>
<td>&lt; choice made</td>
</tr>
<tr>
<td>MAIN ENTRANCE</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DOOR SHUTTER</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HANDRAIL GRATING</td>
<td>10YR</td>
<td>= main entrance, door, shutter</td>
<td>&lt; main entrance, door, shutter</td>
</tr>
</tbody>
</table>

CHROMATIC GUIDELINES - via Roma, Castiglione Olona
Table 6b - Chromatic guidelines for via Roma, Castiglione Olona. Operative table for the choice of the colour of all the elements in façade.

Ground colour
The colour palette encloses all the current chromatic coordinates in Munsell parameters of all the plasters of the façades overlooking on via Roma. The family recurrent for the plasters of via Roma belong to the range from the 5YR to the 10Y (5YR; 7,5YR; 10Y; 2,5Y; 5Y; 10Y). Comparing the buildings belonging to each hue, the main Munsell family presents in via Roma is the 10YR (Table 7b) with several coordinates from the 4/4 to the 7/6 (see colour palette Table 3b-4b-5b).
The limitation of the contrast between too much shades in the same street, that perceptively gives to the visitor the impression of a chaotic surrounding, and at the same time the maintaining of the main colours that determine the imagine of the city, can be done proposing for the future intervention the restriction to only three coordinates belonging to the main family 10YR: 4/4, 6/4, 7/6 (Table 8b).
The differences between this three variables consist in saturation and brightness (4/4 light; 6/4 medium; 7/6 dark) and the choice, with a view to an operative intent, will be realized considering the natural illumination of a building, related with the exposition of his fronts to the cardinal points, his location and the context in which is situated, as below exposed.
Colours and materials of historical centers: sustainable conservation and management

**Table 7b -** Case study of Castiglione Olona, ground hues surveyed in via Roma. On the left current chromatic state with expressed how much buildings belong to each hue. On the right the hue proposal chosen relatively to the most used hue.

<table>
<thead>
<tr>
<th>Chromatic project proposal - via Roma, Castiglione Olona</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/1</td>
</tr>
<tr>
<td>7/1</td>
</tr>
<tr>
<td>6/1</td>
</tr>
<tr>
<td>5/1</td>
</tr>
<tr>
<td>4/1</td>
</tr>
<tr>
<td>3/1</td>
</tr>
</tbody>
</table>

**Munsell Scale - 10YR**

Table 8b - Chromatic project proposal for the ground of via Roma, Castiglione Olona. Chromatic coordinates of the ground colours proposed for the intervention expressed in Munsell scale.

**Decorative elements and basements**

The aim is to give uniformity to the façade without visual and perceptive contrasts and it can be reached using the same hue for ground, decorations and basement. In via Roma the decorations are characterized by chromatic coordinates brighter than the ground. This is the reason why the proposal for the intervention is the increasing of the brightness, maintaining the hue of the ground. On the contrary the basements are darker then the hue, so the guidelines will indicate the same hue of the ground with minor chroma.
Main entrances, doors and shutters
The current situation in via Roma at Castiglione Olona is currently so compromised and chaotic that is impossible to elect one reference hue for the requalification, because each element surveyed in the street belongs to a different hue (see colour palette Table 3b-4b-5b). Then each architectural unit should be analysed singularly, making particular attention into the individuation not only of the colours but also to the materials employed. The choice of the hue for the project should take place among the chromatic values of the elements that are already present in the front.

Handrails and gratings
With regard to the iron elements, for instance handrail and grating, they will have the same hue of the doors and the shutters, but with a minor saturation and a minor brightness, as well as the current tendency pointed out in via Roma where the iron elements are darker than the other parts that compose the fronts.

CRITERIA BEHIND THE CHOICES
Orientation and illumination
Via Roma stays in shadow for the most part of the day, but the central part is a little bit more opened and can receive the natural illumination during the sunset. Taking into account these preliminary remarks, also the graphs obtained by means of the software SpectraMagic can be very useful for helping into the choice of the most suitable new plaster colour for each architectonical unit (Table 9b). The comparing in CIE L*a*b* scale between the chromatic data of the north and the south sides of via Roma shows that the plasters belonging to buildings in the south side are darker than the ones in the north side: in the south side L=58,88 and in the north side L=61,20. The minimum value is equal for both the sides, but change the maximum because for the south side reached the 71,76 while for the north side is at 86,67. It isn’t a big ΔL difference but it’s easily perceptible at waked eyes, intensified by the tightness of the street. Furthermore the data show a situation opposed to an hypothetical good chromatic setting: the more illuminated part of the street is characterized by the most brightness surveyed, whereas the west and tightest part of via Roma has the darkest colours. Consequently the intervention proposal will evaluate the orientation of each building, then the level of brightness based on the shadows and the illumination.

Table 9b - Comparing in CIE L*a*b* scale between the chromatic data of the north side and the south side of via Roma – Castiglione Olona. Graph elaborated by means of the software Spectra Magic.
C. REFERENCES

_Bibliographic and iconographic documentation_

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Colours and materials of historical centers: sustainable conservation and management

_Historical-archivistic and iconographic documentation_

ARCHIVIO DI STATO DI MILANO
- Fondo per il Catasto Teresiano
- Fondo per il Catasto Lombardo-Veneto
- Fondo per il Catasto del 1954
- Fondo Araldica

ARCHIVIO STORICO CIVICO DI MILANO

ARCHIVIO DELLA CURIA ARCIVESCOVILLE DI MILANO
- Fondo delle Visite Pastorali, sezione Castiglione Olona

ARCHIVIO DELL’OSPEDALE MAGGIORE DI MILANO

ARCHIVIO BERTARELLI

ISTITUTO PER LA STORIA DELL’ARTE LOMBARDA - ISAL

UFFICIO TECNICO DI CASTIGLIONE OLONA

CIVIC LIBRARIES
- Biblioteca Comunale di Castiglione Olona
- Biblioteca Civica di Gallarate
- Biblioteca Comunale di Lozza
- Biblioteca Comunale di Morazzone
- Biblioteca Comunale di Tradate
- Biblioteca Comunale di Vedano Olona
- Biblioteca Centrale di Palazzo Sormani
- Biblioteca Civica di Saronno

POLITECNICO DI MILANO LIBRARIES
- Biblioteca Campus Durando
- Biblioteca Centrale di Architettura
- Biblioteca del Dipartimento di Architettura e Studi Urbani
- Biblioteca del Dipartimento di Chimica, Materiali e Ingegneria Chimica “Giulio Natta”
- Servizio tesi e documentazione – TeDOC
- Archivio Lavori Didattica e Tesi di Laurea. Laboratorio di diagnostica per la conservazione e il riuso del costruito. Dipartimento di Progettazione dell’Architettura

UNIVERSITAT POLITÈCNICA DE VALÈNCIA LIBRARY
- Biblioteca Central

_Cartographic documentation_

ARCHIVIO DI STATO DI VARESE
- Fondo per il Catasto Teresiano
- Fondo per il Catasto Lombardo-Veneto
- Fondo per il Catasto del 1954
The selection of products for the restoration is a delicate and crucial phase for the final quality of the conservation project. For this purpose, a debate about the needing of identifying specific performance requirements and defining guidelines for their guarantee, is still open. The issue can’t be approached without considering the fundamental aspects related to compatibility and durability of materials. A restoration mortar can be considered “compatible” if it is able to meet the specific performance and the aesthetic requirements explained by the intervention, without causing, directly or indirectly, any further damage to the substrate and in the meanwhile ensure the maximal durability. The “durability” of a mortar is the period of time in which it maintains the initial properties, considering the same condition of implementation. Furthermore, once installed, the restoration mortars are subjected to the same environmental conditions and potential degradations which afflict the original mortar. A conscious use of new products with their compatibility cannot disregard a complete knowledge of their chemical, physical and mechanical properties. Then, diagnostic is one of the available basic tools and is of service of technicians in orienting the choices during the complex phase of materials selection for the intervention.

The conservative “ready to use” products, particularly the multitude of commercial paints and different finishes for historical buildings surfaces, have been available in the market for a long time, but, especially in recent years, their presence has considerably increased, in terms of both companies and composition. The usage of premixed products simplifies the raw materials supply in the building site and enables the utilization of a less skilled workers labour. On the other hand, these factors may easily lead to an indiscriminate use, not always compatible with the specific characteristics of each case, even more considering that technical forms are sometimes poorly detailed.

The definition of an exhaustive survey of the leading products on market is hard, because of an extreme variability due to constant evolution, strictly connected with technological innovation and marketing decision.

An extremely significant survey about the current market of finishes for historical buildings has been led by Politecnico di Milano, as part of the research about the durability of the restoration materials, conducted by laboratory MaMeCH – Materials and methods for Cultural Heritage1.

An extensive survey of about thirty of the principal European companies of materials for architectural heritage conservation has been conducted and over 400 different commercial products for walls preparation and finishes have been cataloged and inserted into a specific database.

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1 Laboratorio MaMeCH - Materiali e Metodi per il Patrimonio Culturale, Dipartimento di Chimica, Materiali e Ingegneria Chimica del Politecnico di Milano; http://midar.chem.polimi.it
1. Plasters

The collaboration between companies, municipalities and professionals working at different levels for the requalification and management of the historical centers, together with the awareness campaign carried out by the Superintendence, turns out into an intensive research and industrial development in the production of commercial solutions for coatings compatible with the historic supports. Indeed, the close collaboration between the professionals and the companies is essential for the search of ad hoc solutions compatible with different contexts.

Almost all companies engaged in the restoration field offer at least one line of specific products for the restoration of historical masonry. In any case these solutions provide premixed systems that meet the needs of realizing plasters according to traditional stratigraphy. The differences between premixed "packets" of materials depend on the substrate and are divided as follow: products for rinzaffo, for arriccio and for intonachino. This "packets" are binder mixtures (mainly natural hydraulic lime or slaked lime), with aggregates of various nature and additives. In particular pozzolana and cocciopesto are commonly inserted to simulate the appearance of historical mortars and to give hydraulic characteristic to the mixtures of slaked lime. Especially in superficial finishing layers (intonachina) the range of aggregates used is extremely wide, satisfying the most common aesthetic requirements: marble powders, travertine or Botticino stone, in addition to siliceous and calcareous sands. The choice of the aggregate, together with the addition of colored earths, inorganic pigments and mineral fillers, is determinant for the final shade definition. The additives are added to alter the mechanical properties or the workability, making the mortars "special" (macroporous, reclaim, thermic, etc.).

While on one hand the increasing use of pre-mixed products ensures a reduction of lead times and a greater economy, on the other hand it involves the progressive loss of all the specificities linked to local traditions and to a culture of "know-how", laying its foundations on operator’s skills.

Even if the referential normative defines function and denomination of the different layers, it doesn’t provide any kind of indication in terms of composition and performances. Thus, frequently happens that market offers several extremely different products, collected under the same denomination; for instance intonachino gypsum, silicate or siloxane based. However these products have very different characteristics and hence incomparable performance and durability. The lack of a common vocabulary and often the incompleteness of technical details, inhibit the identification of significant differences between the products and pose serious limitations for a compatible materials usage.

Comparison between a characteristic degradation of a lime painting which ages mainly by erosion (on the left-Castiglione Olona, VA) and a not compatible polymer paint which degrades principally by exfoliation, fragmentation and blistering (on the right-Lomello, PV)

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2. Finishes
The finishes of historical surfaces play an important role in defining the perception of the architectural heritage, and thus contribute in a decisive way in maintaining (or changing) their identity. The interest in these issues has consequently fed market areas in constant development: even more than the mortars and finishes sector is improving, satisfying every kind of needs with frequent products’ proposals, also for the use in new construction. Natural materials, like earth and mineral pigments, are used in the preparation of mixtures, that can in this way acquire characteristic of semi-transparency of the tint, softness of shades and richness of colour, typical components of historical colourings. A wide range of products based on synthetic substances of various nature are available, with the same aim, but favoring the durability and versatility aspects: for instance the finishing plasters mass-coloured are furnished in form of premixed powders or paste, while paintings in form of pasta or in emulsion state. In absence of a specific national normative that rules the production, composition and denominations for the market, many companies refer to foreign laws, although currently available just for a limited type of materials3. The current existence of a multitude of commercial solutions limits the designers in an aware choices targeted for each case of application. As a matter of fact several considered products are hardly comparable each other due to the uncertainty of the provided technical indications; for instance, there are many cases in which the term intonachino, is used indistinguishably for coating and painting, as if they were synonymous.

A generic systematization within this heterogeneous overview has been done using a compositional criterion and subdividing the products into lime, potassium silicate and synthetic resins based. These three types allow to include almost the entire production of commercial finishes for the historical buildings and show a certain prevalence of synthetic resins (43%), in respect of lime paints and coatings (32%) and, even more, of those potassium silicate based (25%) (Tab. 1). A closer examination towards synthetic resins reveals that among the various, possible formulations, the production is mainly focused on the acrylic and siloxane resins. Obviously each synthetic polymers family has unique characteristics which confer to the products the required properties: film-forming, water resistance or capable to ensure a proper adhesion against already treated supports. Also in this case, a disinclination occur to provide technical details in both compositional and performance terms and the choice between different types of finishes may be rather arbitrary if carried out by a not adequately informed operator.

![Superficial finishes](image1)

![In depth examination: synthetic resins](image2)

**Tab. 1 – Distribution on the market of finishing and coating products (on the left) and in depth examination of commercial mixtures of synthetic resins (on the right)**

3 Technical normative DIN 18363 for the use of potassium silicate based products (in the basis of organic compounds are less or more than 5%).
3. Indications and choice

The market survey of pre-mixed and "ready to use" products for restoration has shown an extremely wide and heterogeneous situation, in particular in the field of surface finishes. The multiplicity of the offer may potentially constitute a vast collection from which draw the better solution in relation to the problems of each specific project: localization, materials on site, extent and typology of intervention, state of conservation, specific aims. However, actually this possibility clashes with a not nearly thorough knowledge about characteristics and performances of various products. On one hand, professional’s stock of scientific and cultural knowledge, supported by an appropriate diagnostic approach, must be thorough enough to guarantee a support into this chaotic market; on the other hand the producer’s course of action should follow the direction to provide the maximal information using a shared technical-performance language, not only functional to marketing logics, but also to a real common comprehension. This latter aspect may be solved giving a meaningful input to normative field, because operators feel the need for official documents or guidelines, missing at the present, such as aid in the choice of products.

4. References


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