# ENGLISH VERSION

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## THE IMAGE OF VENICE

What is it that forms in our eyes – or in our minds before our eyes – the image of Venice? Reflecting about its changing image inevitably arouses the question: to what extent is it the fruit of physical reality, of its buildings and atmosphere and to what extent is it a result of the overwhelming stratification of visions, pictorial representations and historico-literary readings over the years. I suspect that the images, testimonies of its already having been seen, enshroud our gaze. Still today, when we look at the St Jean d'Acre Pillars, we find it hard to elude the temptation of seeing them once more bathed in rain like in John Ruskin's watercolour.
But we are aware that the image known all over the world is only in part Ruskin's. The real image of Venice, overrun by stereotypes that go beyond the limits of kitsch, runs the risk of becoming the non essential corollary of an icon-idea that has a life of its own and seems to serve only for arousing foreseeable and conditioned reactions in those who visit it.
In this situation there is a risk that the mental icon will gain advantage and reduce the physical image to a marginal fact almost taken for granted, dissuading us from paying the changes taking place the attention they deserve. Or even that it will incite one more or less consciously to try to apply the changes in the real image to the mental one, and that the latter may not be inspired by the vision chosen by the thinkers of the past but that more disheartening one sought by hasty, easy-to-please tourists.
The image of Venice constitutes a semantic labyrinth, fashioned by the eyes of those who have read, interpreted and described it over the years – and this is no doubt its extraordinary bounty – as well as by its current reality. But anyone who worries that Venice may continue to be herself and manage to bear comparison with the gazes of the past must fight to prevent her architecture and atmosphere from being subjected to a stereotyped image that would progressively convert her into something disappointing.
The renovation of the capacity to read and observe directly and attribute a new meaning and role to this knowledge can help in the struggle against this stereotype. As an example we can take some technico-constructional elements of the building of the lagoon that can also be appreciated by comparison with the nearby cities on dry land.
The main characteristic of Venice is not only the one that stands out above all in common sense, the fact that it is built on water with an urban construction where the canals fulfil the functions performed by streets in other places. In fact, Venice is a city formed in time with often exclusive features, to the point that it constitutes a different technico-cultural enclave because of its completely unique constructional endemism. The concatenated ensemble of characteristics and constructional principles, languages and solutions consolidated by use goes unnoticed at first glance but can clearly be seen if the details of any Venetian house are compared to a contemporary one on firm land in the Veneto or, better still, in the neighbouring regions of Emilia or Lombardy. The foundation systems are different, obviously, but also the coping of the roofs with stone corbels of limited width, the characteristic drainage system or the shape and structure of the roofs. The characteristic way of supporting the façades by means of special tie beams (known as fiube in olden times) often connected to the frames and the way they are made and paved with Venetian-style terrazzo. And furthermore, the prolonged use of arched bays, the role and form of the woodwork in them or the chimneys are also typical of Venice, but above all the treatment of the external surfaces, which are entrusted with a complex role of architectonic finish, imitation and protection different from other parts of the building.
Although exchange with mainland Veneto was more intense from the 15th century onwards – and although the mainland architecture that adopted Venetian features is more abundant than the contrary – there are still many elements and characteristics that are exclusive to Venice and only there were so widespread as to constitute an unquestionable system and practice. For example, in the cities on the mainland, there are few examples of trusses with a stone keystone– fiube – nevertheless they can be found in thousands of instances in Venice, linked to the particular structural conception of buildings that often led to the initial construction of the perimeter walls slightly leaning towards the interior of the building.
The image of Venice, although we are tempted to say the real image of Venice, is the result of all that is still visible today of those unique features and customs. It is a series of details whose overall significance we can recognise.
Therefore we must delve deeply into Venetian construction and study it in order to understand the connection between the whole and the parts and show what we believe is its true image. Each building in Venice is at the same time the result and the testimony and vestige of production determined by its culture, and any iconic simplification, even in the restoration of the most modest dwelling, can only betray it.
One of the peculiarities of Venice resides in the exceptional resistance to change it has shown throughout its urban and constructional history and its ensuing stability even in evolutional adaptations over the years.
From the 13th century on, changes in Venetian construction took place with substantial continuity from a technical, constructional and typological point of view. The system described above of supporting the façades with tie beams applied to 13th century buildings continued to be used without change until the early 20th century. Residential construction models transferred by late Gothic tradition to Renaissance culture, to which it adapted, continued to be adopted with slight variations until the beginning of the 19th century. The continuity of the techniques, materials and models is so strong that it metabolises them by absorbing the stylistic changes linked to the changes in architectonic language until it reduces them to changing decorative elements applied to a stable structure. The transformations, often

carried out by readapting and reusing prior elements and configurations, were intended to achieve a new formal unity on a substantially stable body, where stylistic heterogeneity was often freely tolerated. These changes involved a sort of updating that the current term "restyling" successfully describes. There have been many cases of bays modernised by maintaining the Byzantine or Gothic stone jambs while replacing or refashioning the stones to achieve a round Renaissance arch.

Seldom do we find in Venice stratification as we know it in other cities in the vicinity, such as, for example, Verona, which we could define as stratification by elision and concealment of the previous configuration, due to the great differences between Romanesque, Gothic, Renaissance and successive phases, and within each of these. On the contrary, in Venice re-adaptation to the new configuration of the existing fabrics and bays prevails, synthesised in a substantial continuity ensured by the survival of the same typological and iconic model. Still today, the elements of the different historic stages frequently stand side by side in a single façade forming part of a stylistic compositional typological scheme that combines them in figurative but not stylistic unity, formed by a network of perdurability and modifications that constitutes, to use a clever definition recently coined by Javier Rivera Blanco, a harmonious diachrony.

The reconfiguration of a building is rarely carried out by radically altering its layout, unlike on the mainland. To go back to the city of Verona, in the transformation of medieval tower-houses into palaces in Veneto style, with rooms and galleries, few architectonic elements from the original construction, either bays or fabric walls, are left naked in the new configuration. In contrast, in Venice the mullioned windows Byzantine or Gothic window remains unchanged for seven or eight centuries in the centre of a building readapted in or after the Renaissance period.

On the façades of the buildings on the lagoon we seldom find stratified configurations completely different from the last one still in use, if we exclude perhaps the Byzantine structure of warehouses abandoned and boarded up after profound functional and typological evolutions.

The sometimes only apparent unity and architectonic completeness of the façades is therefore the result of a continuity of the long period of transformations and adaptations that are only partly annulled and that, above all, reaffirm configurations and older parts by appropriating them and conserving them. So we can affirm that this is a character peculiar to the city that we must keep in mind. To go back to a stratigraphic category, Venice presents with great naturalness, and not only in its monuments but also in its dwellings, period interfaces of extraordinarily long duration, things and objects accepted and included in later configurations.

However, despite the predominant stability of the configuration of the façades, in Venice one finds a clear chronological succession in the way of treating the façades and their surfaces, so the chromatic and material image that forms it changes a great deal. Stone, repeatedly used for structural elements, corners, cornices and outlines, is associated at the oldest Byzantine stages with the carefully fashioned naked brick fabrics with filleted joints, at the Gothic and Late Gothic stages with brick fabrics that can be glimpsed beneath a thin layer of rendering and often with frescoes imitating an idealised brick fabric. From the late 15th century onwards, it is common to find brick fabric completely covered with Istria-stone-coloured (marmorino) or brick-coloured (cocciopesto) plaster or painted with frescoes, and also with surfaces completely made out of stone; and this lasted with few variations until the 19th century. We can affirm that every historico-architectonic model of buildings includes and provides, if not for a certain type of finish for the surface, for a small group of similar variables that determine a specific, almost two-way, correspondence between the formal characterization of the façade and the treatment of its surface. Therefore we recognise some groups of buildings endowed with a strong constituent character that impregnates and distinguishes them from others as belonging to the same period and the same architectonic model, which includes as a relevant element the type of treatment of the fabric or the rendering.

The modification of the surface according to the fashion of the time is often accompanied by the organic transformation of the constructions or the restyling of the façade. But the original surface was just as often conserved in the old building, and until the late 19th century interventions merely aimed at concealment are seldom found. We think we can affirm that the instinctive awareness of the diverse nature and character of the buildings has always been conserved in Venice until recent times, and it is as though applying an "inappropriate" rendering without a contextualised transformation would have been considered an inappropriate operation to be avoided as much as possible. It is as though Venetians continued to perceive that each building should have a suitable costume – and therefore an image – although it may be old-fashioned, especially if its age also contributes to identify the family that owned it as being of long-established lineage. Therefore the buildings that constitute the image of Venice are very rich as far as surfaces are concerned; there is no hegemony, but complexity and heterochrony instead of synchrony. This variety and superposition of the image arising from all this allows us to perceive a great time lapse that permits us a picturesque reading, which has in turn been created by motivated facts, events and buildings rich in meaning in their own right. The coexistence of similar constructions that are at the same time different from each other is not a feature exclusive to Venice, as analogous processes can be found in other cities too. Nevertheless, for their extension, for the number of buildings conserved and how clearly the phenomenon can be perceived, Venice has no rival: the Venetians have kept the diversity of images alive for a longer period of time.

One of the unique characteristics of Venice resides in the fact that an important part of the components used for the layer of rendering is the result of reusing waste or recycled products, taking full advantage of

the resources available since necessity is the mother of invention. This is the case of both fragments of tiles used to prepare cocciopesto or Venetian pavements and of slaked quicklime, comprising aggregates with a larger amount of silicates or not quite fired, used as fragments in Venetian renderings and pavements – known as cristallina – or even chips and dust from Istria stone, often used as an aggregate in the plaster called marmorino. In time, this systematic recycling has created a greater material and chromatic harmony than in other places in the layers of cladding and other building components, since they are other ways of using and preparing the same materials. These layers of plaster have been used, with slight alterations and variations, for nearly four centuries, and have made a crucial contribution to the unique image of Venice. Much more so than in other areas, even what were apparently the simplest renderings were always prepared with great care in order to ensure from the outset that they would be long-lasting, and later prolonged with maintenance works, which consisted traditionally in partial repairs or protective measures of the surface, for example by applying linseed oil.

Lime wash or lime wash with earth pigments on top of dry plaster, a very popular technique in other cultural areas which required periodical maintenance with the application of new coats, is not part of Venetian tradition. In Venice, plasters have often been left naked all their life without covering the initial surface, which has thus become a long-lasting surface, where the signs of long-term degradation and maintenance have been visible for a very long time or, in any case, longer than in other places. Just like stone or brick surfaces, these renderings are attributed that "special authority" and "high resonance" that Ruskin referred to acquired with the passage of time.

The deinsularising process of the city of Venice (by connecting it with the mainland), which started in the mid 19th century with the construction of the railway bridge, has also diluted little by little the peculiarities of the construction and the transformation of buildings, even after not always successful resistance and attempts to adapt to the conditions of the lagoon. Techniques that had never before been used in Venice for the treatment of surfaces were implemented, such as thicker sand and lime plaster levelled by wooden, instead of metal, trowels and bearing a lime wash coloured with earth pigments. Ruskin, Zorzi, Boni – who coined the famous expression "made-up Venice" – and Morris protested about these interventions and not only about the "restoration" of important monuments.

But regardless of the speed with which the city became a symbol-city, it is restoration in Venice that we must examine carefully. The theory we propose is that in this field too the city has gone its own way, and that still today our work is unwittingly influenced by it. Conservationism and resistance to change for the sake of a well tried and tested tradition – which there was no reason to relinquish – have constituted for a long time a fertile ground for the practice of maintenance and conservation, and, at the same time, have given rise to banal operations that avoided confrontation with restoration principles. It is as though the ease with which they continued to work on old buildings, often imitating or refashioning them, were a deeply rooted characteristic of Venice. We think we can affirm that Venice has put up a certain amount of passive resistance, and still does in some aspects, to restoration as it was practised and developed throughout the 20th century.

Venice has suffered only a fraction of the systematic trend to eliminate rendering in the name of restoration that has profoundly transformed the current appearance of Ferrara or Assisi, for example.

Scientific restoration that involved accentuating, showing up and integrating in simplified fashion fragmented existing parts, which was performed in other places, was not put into practice in Venice either. And this is due either to the relative scarcity of completely heterogeneous concealed stratified remains in the predominant configuration or to a kind ofestrangement detected in the context of Venetian culture. It is a type of restoration that has frequently been applied in Verona, Treviso, Padua and other cities on the periphery of the mainland, but far less in Venice, where it has only been used to reopen closed bays or accentuate the completion of a configuration despite the presence of what were deemed foreign elements. And this was carried out by adhering more substantially to Venetian tradition than the restoration and novelties it involved.

The system encouraged by philological-scientific culture of distinguishing more or less clearly the added or replaced parts from the existing ones has not often been adopted in Venice. And when it is, it seems to be for reasons of constructional functionality, completely free of the conceptual content that scientific restoration grants to the fact that it is distinguishable. Rarely do you find a simplified replacement of missing elements or additions identified as new by means of an intentional material distinction and rarely do you find newly inserted elements that are dated.

It is not easy to put down to critical restoration the testimonies made in the field of museum installation, as is the case of Carlo Scarpa on the Fondazione Querini-Stampalia, the Academia or the Museo Correr, or the lively way the architect Egle Renata Tricanato exhibited the old capitals replaced in the Palazzo Ducale. The innovative solutions adopted for the woodwork of important buildings like the multiforate windows of Ca' Foscari can be attributed to the architectonic project that runs parallel or adopts the theory of critical restoration.

Therefore there is endemism also in restoration in Venice, and it seems to want to make its own rules, imposing a system that reduces or confines the highest conceptual aspects of restoration and only accepts that which serves to confirm and reinforce a traditional image and procedure, both in conserving and renovating. It is a proven fact that Venice has rejected both the new languages of architecture and the most innovative restoration variants.

Venice seems not to want the distant past to be perceived as something separate and remote but as a reality that survives in the present without interruption. When it accentuates the distance between the present and the past, restoration practice seems

stranger and more unnatural in Venice than anywhere else. We must also take this fact into account when considering current interventions. Does the same thing occur in England?

The factor that most seems to undermine the unity and dignity of façades and require that they be restored is not the frequent and physiological adoption of heterogeneous elements from a historico-stylistic point of view but rather their physical degradation, which in Venice takes on unusual macroscopic forms. This degradation, mainly but not exclusively linked to rising damp and saline crystallisation, which attacks fabrics, renderings and stone from below, determining the most stratified surface in Venice due to the periodical interventions to replace the bottom part of the walls. Added to this is the more serious degradation of the walls facing north, which was often mitigated with different treatments using cocciopesto rendering.

Echoing the definition offered by Paolo Torsello, it can be said that in Venice the effects of degradation at the base of the walls caused by damp constitute an accessory form of every building and consequently of the whole city, a phenomenon which must be taken into account from an organic point of view. The strip where the tide breaks and the rising damp generated in the buildings is the most obvious place to see the interaction with the atmosphere, and the ensuing image is a warning about the sensitivity and the risk involved in the relationship between the city and the water.

Geometric accidents also play a part in the definition of the unique image of Venice. All the façades of the historic buildings were erected to slant inwards (1-1.5%), which determines an intentional irregular geometry often accentuated by posterior deformation. On the other hand, in the walls the plastic pseudo-flatness of the naked brick fabrics and the old plastered surfaces, made up of usually thin layers, moulded – rather than spread – on the fabric by insistent flattening and pressing with the side of the trowel, takes on especial importance. With this application procedure, the old surfaces of the renderings adopted the plastic shape of the underlying bricks, now made visible by the effect of the light. The surface vibrates and contributes largely to the mobile liquid image which in a way makes Venetian buildings look like their reflection in the water. All of this has been lost with the proliferation of thicker rendering spread with a wooden trowel, which flattens and roughens the surface, preventing the modulation of the light and turning the building into a duller and more rigid geometric solid. Besides, the different way old materials and techniques deteriorate compared to modern ones that lack tradition is evident, as is the different image derived from each. In the former, degradation is usually slow and progressive, starting at the zones near the base that undergo a greater degree of damp and saline aggression, and it reveals the layers of preparation, often cocciopesto, not very different from a material and chromatic point of view from the finishing materials of the surface itself and, in any case, they are similar to each other. Erosion and chipping caused by degradation, along with chromatic alterations, are perceived as a material evolution, which, instead of endangering the image of the ensemble, represents a sort of expected complement. On the other hand, the materials used in recent interventions suffer degradation that is sometimes only localised but fast and devastating, and it provokes a kind of visual collapse of the image of the refurbished façade. The disappearance of the preparation layers, often mortar or cement, shows that the rendering (even if it has only come loose in one spot) is an insincere skin as regards the finish surface and the basic surface, in turn, often refashioned with industrially produced brick. By revealing this deception – a rendering that strives to tell us it follows tradition but which conceals materials that have nothing to do with Venice – disappointment and rejection are instinctively aroused. As Dante would say, *desencanta*, it suddenly strips it of all its magic.

In these cases, as Dante would say, one runs the risk of activating degradation that disheartens, whose manifestations do away with all the illusion by revealing the deceit. When a gap opens up in the cocciopesto revealing the dark layer of cement underneath, we see that the exterior is not coherent with the interior, and that it is all fabricated, adulterated and carelessly executed. Therefore we must concern ourselves with the forms degradation can adopt, discover their future and plan their images and coherence.

In Venice, where it is necessary to put up with salinity and damp in the walls, any new surface treatment should foresee and outline methods, forms and colours – that is, image and perception – of the deterioration that will soon begin to transform it, that is, what lies under the surface, as well as the surface itself. Drastic rejection of degradation, an attempt to prevent it and counter it completely, often gives rise to insensitive, unnatural results, as is the case of very thick coats of rendering defined as "very permeable". This thickness causes the surfaces to be flat and generates grotesque effects in the sunken parts that are created to leave the structural stone elements visible.

In the last few decades, the drastic fall in the number of residents has been exacerbated by the progressive increase of tourists today, which has involved more buildings being used as hotels and the real estate market selling more and more property to non residents.

All this has brought about, and is still bringing about, a substantial change in Venice, a perhaps inevitable denaturalisation but no less brutal and dramatic for all that, whose importance is probably greater than the changes it causes in its exterior image. Rather, in this process what most determines the image, that is, the façade, must remain similar to itself, even offending decorum, and must be able to change greatly even while maintaining its configuration. This circumstance is a token of the positive side of the process, which allows Venice to fight against its own decadence and rescue itself without appearing to change at all. But the price, extremely high from a social and cultural point of view, is also very high as regards image. Only the massive advent of buyers, companies and technicians, unaware of the mentality, sensibility, customs and technical languages consolida-

ted by Venetian tradition, who import their culture and mentality, brings solutions that have nothing to do with the city, or generate technico-constructional sub-products with results that are often ridiculous and arouse malaise and displeasure. Let us take the example of *cocciopesco* (sic), a brand of pre-dosified mortar for rendering whose name may be a funny malapropism or a grotesque pun, but it is above all a false coating of tradition a genetically modified plaster that makes reference to peach colour at the same time. Joining forces to try to make the buyers happy, Venetian real estate agencies and entrepreneurs adapt to this cultural decadence, accepting the technical globalisation brought about by economic tourist phenomena as the last act of deinsularisation of Venice.

But we still wonder what forms the image of Venice in our eyes and mind. Venice is an itinerary slowed down by the narrowness of the paths that run alongside walls altered by damp and the always timber framework of the colonnades. As one writer put it, using a clever simile, it is a city written in Braille, where touch almost replaces sight and each image encapsulates and implies, more than in other places, a tactile component. The building materials – stone, brick, wood, plaster, in most cases with signs of degradation – are in full view so that they can and must be examined at close range and touched. That is why changes of material are more visible than in other places, and even in imitating a colour or confirming an architectonic configuration, this multi-sensorial image can be betrayed. For that reason, the awareness that the surfaces of Venetian architecture are changing fast and, as a result, the tactile-visual image of Venice alarms us because it means the loss of a profound unique identity, the fact of being Venice.

If the effects of degradation, particularly those caused by damp, represent the most immediate symptom of Venice's physical decadence, the most explicit and visible way of fighting it consists in erasing the signs. But since degradation attacks matter, to do so the matter is replaced by renewing the fabrics of the base, along with the rendering, damaged by rising damp. Then, since the aim of an intervention, according to common sense, consists in restoring decorum to the building – albeit in order to sell it better – and since the heterogeneities and the irregularities of matter are seldom accepted in this logic, replacement of the damaged or missing part of the plaster usually ends in the renovation of all the rendering.

This is a sort of exorcism against the decadence of Venice, often motivated by real estate reasons. Suffice it to read the sales advertisements at the agencies – very well restored or as good as new ¬ to realise how economic motives are behind most renovation, a private selfish reason that does not take public impact into account.

Venice is rather scornfully said to run the risk of turning into Disneyland. The comparison is not very appropriate, because precisely in Disneyland many buildings simulate the effects of degradation to recreate the signs and suggestion of the passage of time, whereas in Venice they are systematically erased.

In Venice, the effect of emulation together with the exasperating renovation that harms the constructions that belong within the same perceptive context progressively accentuates the importance of change, fuelled both by public funding and private investment.

Inappropriate and unpleasant new forms are involuntarily generated. Let us mention, for example, the consequences of keeping the base of the constructions visible. This option intends to avoid the rapid deterioration of the rendering, reconstructed from the first storey upwards, creating a clear geometric separation – an actual border – between the upper part rendered with very thick plaster, so that the buildings treated look as though they are suspended or unnaturally lower than they actually are.

More generally, buildings tend to be homologated with one another by means of renovating surfaces which, despite their different constructional character, are treated with the same plaster, which on the other hand has nothing to do with tradition or only – although not always – from a chromatic point of view, ignoring material and textural aspects. In this way, the correspondence between the surface and the construction character proper to each building, which is an important element of identity in Venice, is undermined, and this is often accompanied by the removal of old patches of plaster, a testimony of its old rendering. Homologation often occurs also between the different façades of the same building, using the same plaster for the façades, the side walls, the raised floors and interior courtyards, which we have usually found to have been intentionally given different treatments. A natural understanding of the different functional and hierarchic role of the parts is undermined, and often with the intention of making heterogeneous parts the same, huge mistakes are made in architectonic orthography.

In this generalised trend, interventions of strict conservation are few and little publicised, and this can be explained either because they are more expensive and technically difficult or they are not considered capable of defeating degradation, which in Venice means fighting against the causes – rising damp – but above all eliminating the effects and, therefore, it implies more an idea of repair and reconstruction than in other places.

Although the conformation of the façades – the dimensions, bays, etc. – does not vary, it sometimes produces a radical change in its architectonic configuration, its colour and the visible matter.

The systematic contemporary renovation of surfaces leads to a flattening of time, a reduction of thickness and of the historic articulation perceptible in Venice. This occurs both at a level of immediate instinctive understanding and at a rational level, which can be verified by a stratigraphic analysis. It is enough to compare the diagram (the Harris matrix) resulting from the stratigraphic analysis carried out on an old, deteriorated surface transformed by time with a diagram of the same façade once the rendering has been renovated. One can see that the initial complexity formed by numerous stratigraphic layers and negative interfaces, belonging to other phases that have successively coincided in time, is reduced to the intervention made at one, or at the outside

two, recognisable phases with very few units and no negative interface.
This does not mean objecting to any intervention that reduces, minimises or even cancels the signs of degradation present in the surfaces along with the traces of events and building history. But it does involve thinking through the different aims and relevant actions, because these signs do not only provide a historico-constructional reading made by specialists but also the perception of the temporal historic importance of the buildings and the city.
We wonder what proposals restoration can offer today to conserve the image and essence of Venice. How should we act to continue its history while fulfilling the greater requirements of decorum and the fight against degradation?
The antibodies that Venice has created over time to fight against restoration seem to be related above all with the ways in which restoration attempts to sanction the discontinuity between past and present: archaeologisms and accentuated forms of distinguishing the new from the old on the one hand and, on the other, completing the fabric with fragments of a structurally new language.
We note that it is always continuity with herself that Venice wants to communicate either though her own image, in the abiding forms of her buildings and surfaces, or in the persistent use of the same materials or the same projects, even for modernising them or building new ones, only updating the linguistic details. Therefore, paradoxically, conserving the old to the point of exhaustion or renovating it so that reference of its pre-existence may be obtained.
If we do not want cocciopesto culture to go on forever, because it can interpret in a simplified and popular way this instance, we must propose a ductile, non ideological idea of restoration that can meet the expectations proportionally in each situation and interpret the need for naturalness and continuity deeply rooted in Venice. We must resign ourselves to limiting recourse to the solutions that are too elaborate conceptually and formally, typical of some restoration stances that seem unnatural in Venice.
We have two buildings in front of us. In the first, the old surface has been conserved in part and deteriorated or lost little by little by slow, progressive degradation, which advances according to the time elapsed, without generating or fearing any sudden collapse or destruction. We could call it benign degradation, which gives new value to the building because it contributes to the instinctive perception that it has come directly from the past. In the second building, very old too, the rendering has been replaced inappropriately in recent times and, as is often the case, degradation has hit it like a visually devastating collapse.
Restoration must be able to propose two different solutions against the homologation of the two buildings. In the first case, in a conservative or integrating-conservative model, with greater tolerance for the effects of degradation and a more accused respect for patinas as tokens of time. In the second case, in a reconstructive model, undertaking, after removal, to look for a plaster in keeping with the historico-architectonic configuration of the façade and using materials and craftsmanship that respect the old techniques and methods: to continue not to imitate. Between these two attitudes – conservation and reconstruction – there is a myriad of balanced solutions depending on the nature of the buildings to be treated, and the problems of proximity that the perceptive context of each building requires…
Within a desirable direction of the ensemble, we must be willing to adopt different restoration strategies and variants to apply to the surfaces and walls, from strict physical conservation to conservation with integration, not forgetting reconstruction depending on the nature of the buildings, the context they belong in or even the combination or prevalence of degradation over good conservation. In this variety of positions, the legitimacy of each one depends on being able to offer a response we deem ideal and important in at least one real situation. So it does not constitute a sort of theoretical restoration eclecticism, but merely an opening up and a heeding of the experiences and positions that the discipline of restoration, as a whole, has produced over time. In Venice, more than in other places, this broad range of restoration methods must contribute to the maintenance of that special mixture of the old, the new and the renovated, in continuity with each other, that has characterized the image of the city from the outset.
In the first place, restoration culture must point out the role of landmark and irreplaceable testimony of the uniqueness of Venice inherent in the old surfaces and other constructional elements that make up the context of the most evident architectonic stone elements, like the single and the mullioned windows. If the conservation of the most evident elements is considered rather obvious in certain aspects, it cannot become the part that does away with the whole because one runs the risk of isolating them in a building whosebasic tissue or textured surface changes radically. These old duly registered surfaces, sometimes limited in size, sometimes large, must be protected in a rigorous and precise fashion to guarantee their physical conservation. It is necessary to build a Noah's Ark, not only metaphorically speaking, to safeguard all the elements that must survive as documents of the building technique and architectonic finish, to avoid physical destruction even in the conservation of the building as a whole due to carelessness or an underestimation of the degradation.
In Venice's urban fabric there are buildings that represent and symbolise more than others their age and their long-suffering duration in time. From this point of view, these buildings constitute, more than others, actual monuments. It is often precisely the buildings or fragments studied and drawn in John Ruskin's drawings, watercolours or photographs. Let us take the façade of Palazzo Zane in Campo Santa Maria Mater Domini or the buildings in Campo del Milion. We would like them to go on looking the same as they are, without the aseptic meticulousness of specialised restoration that eliminates patinas, colour and time. Let us let them be and conserve them intact, so that they may become landmarks of time and icons that will provide us, for a moment, with the emotion of sharing the image that John Ruskin saw.
We are not seeking the period city as an

urban extension of the period room, but the materialisation of a slow-moving time where some objects do indeed change, but at a very slow rate in comparison with the rest of the city. Let us look at the façade of Ca' da Mosto on the Grand Canal, where the Byzantine part with its marble cladding has had two differently superposed stories, in fact two different buildings, added to it. The current consumption, not degradation, lessens the great distance between the three parts and allows them to cohabit. In the next intervention should they decide to renew the rendering of the added parts and clean the Byzantine part completely, it would accentuate the difference between them and make their image unbearable. It is better that in a well-defined group of cases the restoration should knowingly take a step backwards and limit itself to necessary discreet interventions to preserve and conserve the existing building. However, in most situations, physical conservation alone is not sufficient, because the degradation that weakens the building's defences exposes it to progressive deterioration. For that reason, maintenance as restitution of the degraded and missing surfaces is congenital to Venice and its history. The issue consists in how to combine maintenance as the restitution of the only damage suffered and, therefore, in the physical conservation of the existing parts and the integration of the missing parts and not in periodical integral renovation. Restoration should prioritise conservation-integration interventions that conserve the old surface that is still present and integrate the missing or irretrievably degraded parts in a similar manner so as to restore unity to the architectonic object and decorum and protection to the ensemble. In reality, in any case the possibility of distinguishing the parts is guaranteed: even if we tried, we could never confuse the new integrated part with the old, degraded and with its patina. So it is not necessary to do anything special to favour it, such as sinking parts or giving them a different treatment; it is enough to respect the interfaces and join the false border as the simplest solution. The rest will follow automatically.
This sort of interventions, still few and far between in Venice, favour the conservation of the heritage of the opaque plasters still conserved, applied to the whole façade from the 16th century to the beginning of the 19th, and takes into consideration the need for chromatic and material unity that these architectures usually require. They have specific problems regarding contact and coexistence between the old and the new. In fact, the technical and conceptual problem often arises about integrating the gaps in the already conserved plasters whose surface has been altered or degraded in a different manner by forms of erosion that leave the underlying layer or the base naked. In these cases, the surface that is now visible constitutes a degradation interface that may have deviated from the initial condition to the extent that it has lost part or all of the colour, finish and traces of works on the surface. If we try to fill in the gaps of an old plaster with a degraded surface with a new rendering that attempts to imitate the initial undegraded state, in most case an inharmonious effect will ensue, a leopard-skin configuration where the renovated parts stand out visually from the old ones because of greater colour saturation, surface shine or homogeneity. This produces a rather unacceptable result both for common sense and for those who wish to retrieve an architectonic dignity for the old building.
If we intervene to compensate broadly the toughness and chromatic diversity of the degraded old surface, even partially covering it up to protect it, we run the risk of manipulating it to such an extent that it totally or partially loses the significance of being an authentic part, even in the event of being eroded by the time that has elapsed. But also after cleaning and partially repairing the old surface to lessen the distance from its original condition, it is very hard to achieve visual harmony between this and the new integrations of the missing parts, unless they are made to imitate the degraded parts or, in any case, chromatically and texturally compatible with them. Can we aim to make integrations matching the surface in the different states of degradation that exist in a single façade? The problem is more common and real than it looks at first sight, if the aim is to increase the possibility that the old parts of the plaster can be conserved by integrating them in a new unified configuration – a new period interface – and not preventing them from being destroyed during restoration. And all of this with the principal objective, let us not forget, that consists in the desire to provide the building with a visually perceptible state of decorum. It is necessary to know how to measure the solutions with the varied morphologies of degradation and with the types of surface present in the different groups of Venetian houses. For example, the saturation level of the rendering and the unity sought or the tolerance of the effects of degradation, above all, when they have not yet achieved an irreversible gravity from a perceptual point of view. All of this can give rise to a sophistry of reference, useful to gauge the different solutions to apply in actual cases and to transfer positive experiences regarding technical and operative aspects.
Buildings that lost the finish corresponding to their architectonic configuration a long time ago should be reconstructed in keeping with their original character, which general knowledge of the general character should allow us to identify with sufficient accuracy. A large part of restoration culture shuns reconstructions made on an analogical or documentary basis, so this subject often arises in the case of a façade whose plaster has recently been replaced and are integrally out of keeping with the pre-existing one, and that has afterwards been degraded so much as to require replacement again. In the absence of historical documentation or samples of the old treatment that might have been conserved and that it is worth searching for carefully, assuming a criterion of analogy and historico-architectonic pertinence when choosing the treatment to apply is a useful pretext against the arbitrariness and the choice arising from one's personal taste and seconds the already mentioned continuity so deep-rooted in Venice.
On the other hand, possible tendentially objective reproduction is based on the variation of treatment and the predictability of the different types of façade and surface renderings. For example, in a late gothic

façade, even with the presence of fragments of painted decoration – and even more so, without this presence – we cannot apply large integrations because the surface, as well as being a "painting" applied on brick and so not a homogeneous layer but a fabric modulated by the craftsman's hand, usually comprised a complex drawing, only partly predictable. Therefore, the intervention should adopt a mainly conservative attitude, avoiding reconstructions based on guesswork.
On the contrary, when classical buildings have plasters on cornices and homogeneous and geometric layers, with predictable divisions, they are usually easy to reconstruct and complete.
In this case, the issue shifts to the capacity to make rendering similar, as regards material and method, to the traditional ones, that is, to reconstruct the craftsmanship both in producing and preparing the raw materials to free Venice from the invasion of industrially produced materials and standard application methods.
Restoration should take into account the forms the degradation of a new material may take in order to avoid the fast visual collapse often seen in new materials attacked by the salinity present in the walls. The point is to foresee a natural and perceptibly compatible way of aging and deteriorating, for example, by not placing renderings containing cement under the finishing mortars and using the traditional *cocciopesto* more.
In any case, it is necessary to address the ways of preventing degradation and raise the threshold of tolerance to its effects, including them to a certain extent in the image of the restored building rather than tending to eliminate them definitively with radical interventions, which is in fact impossible, above all at the base.
On the whole, restoration should try to verify all the forms of drastic renovation even in the complementary elements, such as, for example, the woodwork and railings. In particular, it should keep within the limits of conservational usefulness cleaning works, reducing the elimination of stable patinas, as in the recent example of Ca' Granda.
In Venice, the challenge that restoration has to face up to consists in proposing a decisive but ductile action, according to the different situations the city fabric presents. This involves being open without prejudice to different restorations ideas and methods, which may seem contradictory with each other from a theoretical viewpoint, but which only as a while can complement each other and cover the wide scope of characters and conditions of the different buildings in the city. We must remember that each individual intervention presents a particular need for adaptation to the environment and balance with the context in order to preserve that concordia discors that inhabits every corner of Venice in an always diverse and particular manner.
We consider that this orientation or a similar one may permit restoration culture to be better accepted in Venetian tradition, which many recent interventions threaten to subvert and may contribute to prolong the image of Venice in time.

**A. Squassina**

English translation by Elisabeth Power

## TIME THAT DESTROYS, TIME THAT CONSERVES. The meaning of time and conservation awareness

*[…] In Venice time does not go by as in other places. The city is outside […] [the] points of reference that are never the same age, cohabit and become confused with one another, mixing with the past and crisscrossing it ceaselessly. There are not different languages, but a single language made up of all of them. […] Harmony, fusion, and also timelessness. […] The Piazzetta hypnotises us just as it hypnotised Marcel Proust. […] Passions […] mark all the landscape […] with the tints of closeness, with the hues of distance […] (F. Braudel, 1949).*
Braudel's remark about the fusion of languages and times in the characterisation of a place gives us an excuse to test different levels of reading in the appreciation of a work, and specifically, in restoration, based on a reflection about the relationship between conservation awareness and perception in time. It is an issue suggested by the new approach to contemporaneity in monuments, which are no longer seen as expressions that transcend the reason of time but as works, partly generated by time, that are documents of myriad generators of experiments in constant renovation. The ever-changing role of monuments in culture stems from this new gaze, the result of a greater opening up to pluralism and relativisation of judgement criteria. But also of a greater willingness to accept the action of time.
The reference to T.S. Eliot's paradox – time that destroys and time that conserves – reveals the double value of the main artifice of change: on the one hand, Chronus, voracious time responsible for the process of consuming matter, and, on the other, Aevum, the passage of time that takes on positive connotations in duration, as a vector of interest that contributes to the work a certain density and depth of meaning, inciting its conservation.
In this article, the semantic load, evocative of traces, the physical testimony of temporality, is recognised as a component of the historic fabric, like a first attention deposited in its connection with degradation, where the concept of degradation confronts the perception of equilibrium between permanence and change. There is a broad range of options to appreciate the expressive potential of the material object linked to the perception of time, which strives to arouse greater conservation awareness. The test is divided into three parts:
- Time as the fourth dimension of the object: the evolution of heritage in the light of the new sense of time in science and culture between the 19th and 20th centuries.
- Time as an instrument of critical reading of restoration works.
- Temporality as an "object" to be conserved. The temporal experience in the restoration project.

### TIME, FOURTH DIMENSION OF THE OBJECT

*The evolution of heritage in the light of the new sense of time in science and culture*

*between the 19th and 20th centuries.*
The evolution of restoration can be inserted in a broad context from the second half of the 19th century onwards, with the parallel development of the field of science, historiographic research and art criticism, which accepted little by little the concept of spacetime. For example, whereas relativity linked the perception of time to the type of system and its speed, geology generated awareness of the multiplicity of time scales and the limited extension of the scale that the human being can experience. The very birth of the discipline of restoration could also be interpreted in this context of resizing the meaning of man, relating the feeling of the past with the desire to prolong human time scale via architecture, understood as "past in a solid form".
On the other hand, the valorisation of the concept of duration arose in almost every cultural sphere between the late 19th and the early 20th century, from physics (spacetime) to philosophy with Bergson and the so-called philosophies of subjective temporality, not forgetting literary reflection, with Proust and Joyce, medicine with research into psychoanalysis, and even art, with the impressionists first and later the futurists attempting to represent the dynamism of time.
One of the most important achievements is the renovation of the phenomenology of time brought about by thermodynamics – particularly by the law of irreversible growth of entropy formulated in 1865 by Rudolf Clausius, which introduces the so-called "arrow of time", that is, the concept of temporal unidirectionality – to which the surmounting of classical dynamics, based on the reversibility of phenomena or "temporal inversion", is attributed. The opening up of physics to temporality implies accepting the process of development as a component of things, that is, the "creative" side of instability, by means of which a phenomenon is not a foreseeable and controllable fact but an "event". The shift from the idea of "fact" to the concept of "event" – endowed with a specific development in time and individual spatiotemporal coordinates – constitutes one of the bases of contemporary culture, which links the destinies of science and historiography in the common need to overcome the determinist stance and the acceptance of the value of the convention of the historicity of knowledge and its laws. The crisis of 19th century culture and relativism run parallel to factors like the loss of the temporal nexus or the irresoluble paradox according to which, in contemporary man, "the time of growth becomes also the time that drives things to nothingness. Chronophilia ends up becoming chronophobia."
On the other hand, dualities like duration-expiry and progress-degradation form part of a debate that has lasted from the 19th century to the present, which is tackling with new sensibility issues anticipated by romantic culture – the incomplete, the fragment, irrational cognitive experiences – with a certain inclination towards a more elastic experience of time and its articulations.
The sense of expiry, which denies the evidence of progress, characterizes all the culture of the Austro-Hungarian Empire, where tutelage was institutionalised with the contribution of Alois Riegl and Max Dvorak. At the same time, the revival trends of the time were even interpreted as a sort of regressive utopia, sustained by a "programmatic desire to alter the historical succession of times by bringing the past to the future".
If history becomes the only human possibility of knowledge, on the other hand there arises the possibility of a maturation of the idea of historicism as a plurality of facts and times, stripped of hierarchical structuring and in constant change. Thus, in Braudel's history of n dimensions, micro-events stand side by side with great events, short periods with long durations, in a "dialectic of duration […], in the intimate clash, indefinitely repeated, between the instant and time that goes by slowly". The importance of diachrony, not as a chronological arrangement, but, above all, as a place of the future, modifies the consideration of facts and values; the typical "explanation" of progressive historicism is replaced by the succession of interpretations in time, in which the historian "rewrites history ad infinitum". History itself turns into narration, since temporality is both the essential character of human experience and the object of the narration, as in Ricoeur.
In the dialectic between narration (Erzaehlung) and explanation (Erklärung), Benjamin signals how it is precisely from the absence of explanations that the cognitive value of the narration stems, due to the fact that "the narration is not consumed but […] even after a long time [it is] in condition […] to produce stupor and reflection […], a horizon of vibrations that is missing in the information". G. Mari signals precisely in this toujours recommencé sense of the narration the only form of eternity that man can achieve.
A parallel development in other disciplines follows immediately. Thus, the evaluation of this process contributes to the transition from the concept of artistic object to the historical testimony of material culture or expression of doing, which underlies an idea of art understood in a phenomenological sense, as a description of reality in transformation. This also involves the transition from canonical aesthetics to contemporary aesthetics, where the loss of reference systems – frame of reference or guide images, in Adorno's words – and phenomena of the fragmentation of experience. There is a kind of modern rediscovery of the concept of sublime, which involves the juxtaposition in the "static, harmonious, symmetrical" constants of classical aesthetics, with other parameters or "expressive […] in-constants, asymmetry, disharmony, arrhythmia", in so-called Asymmetrical Aesthetics.
The mutability of the relationship between work and subject in time is another of the concepts that are coming to the fore in several disciplines, from relativity to historiography. The concept of Weltanschauung also arises, which synthesises the main mission of hermeneutics, interpretation, which becomes the pursuit of an experience of truth outside the scientific method. And there arises also the theory of reception in the artistic and literary field, according to which "the artistic experience, both for the person who proposes it and the person who enjoys it does not exist but happens, it does not refer to absolute objects but to an event, a dialectical encoun-

ter between concrete subjects, introduced into the historicity of existence".
The need to overcome the determinist attitude of history is also reflected in restoration, where certainties connected to the concept of need for restoration slowly start to waver and the problem of assuming the responsibility of the choice arises, directly involving consciousness, both in a cognitive and an ethical sense.
"The crisis of historicism […] has led to the renunciation […] of any systematic aspiration […] without prescriptions but analysis; without pursuing truth, but pursuing meaning." With these words, Alois Riegl designs a new approach to the matter of the past, beset with the idea of pluralism, with different variants of reading and different temporal perspectives, complementing each other. Braudel's dialectic has contributed also to this amplification, between instant and time that passes, which has a parallel in the shift of attention from the monument – understood as a great event, linked only to the original moment and the personality of its author – to the stratified fabric, full of signs of man and his micro-histories, characterized by all the traces accumulated in his history.
Benjamin offers another parallel with the affirmation that every narrator, leaving a mark similar to that of the potter on a vase, contributes to "a slow superposition of fine, transparent layers, which gives the most exact idea of how the most perfect tale stems from the stratification of successive narrations".
Thus, the object to be conserved becomes the product of a type of stratification that is both material and interpretative. A sort of stratification of sense that becomes indispensable and that involves an unforeseen and surprising dilation of the object in itself and the concept of the integrity of the work.
In terms of materiality, we see the transition of interest from formal integrity to materia signata, or the whole of the material traces. To this opening up that leads the aesthetic instance to the broadest course of the historical instance, the possibility of an aesthetic delight of objects not necessarily endowed with artistic intention is added.
In terms of temporality, two connotations comprised in the notion of duration acquire importance: that related with creation, which is no longer confined to the origin of the work but extends also to its transformation process; and that which has to do with the perception of the object in time, which can be a diachronic or synchronic approach or even a kind of intertwining of different temporalities.
Once again Alois Riegl is our reference. K. W. Forster emphasises Riegl's modernity in his awareness of the transition of the time of culture (historical time) to the time of nature, in which its destructive force is legitimised as a stamp of distance. Preserving the signs of natural decadence means conserving the capacity of matter to convey the sense of this evocative distance that constitutes the historical depth of ancient objects.
The encoding of this "temporal depth" into a value represents the possibility of contemporary culture of a first conciliation with the past, where the melancholy of temporality becomes the nostalgia of transcending. Life turns out to be "antithesis-complementariness of fidelity and metamorphosis, change and duration. The secret is to adopt this antithesis as complementariness and live this tension as harmony."
Philosophical concepts, whose repercussion on the discipline of restoration is undeniable if we legitimise the supremacy of time that, if it destroys on the one hand, on the other confers value.

## TIME AS AN INSTRUMENT OF THE CRITICAL READING OF RESTORATION INTERVENTIONS

Le Goff's history is the science of time, guided not so much by memory as by the type of perception of time structured according to a complex system of relationships, mainly in continuity/remoteness regarding the past and progress/degradation regarding the future. Since Antiquity, this duality, efficiently represented by the image of Benjamin's Angel of History, is connected too with the alternation between the circular notion and faith in the cyclical character of events. G. Mari has established a maturing of historical awareness that can be related with a different perception of time. It is an interpretative model applicable also to the reading of some cases of restoration, chosen as an example from the 19th century until the present, because of the possibility of observing a link between different conceptions of time (some connected to the work, others to the observer) and approaches to the work. Each temporal perspective involves a peculiar approach to the building to be restored, which becomes an interpretative stratification of the same object in time. A critical reading can be made of some emblematic passages in the history of restoration where we can observe the evolution of the concept of conservation (and the idea of integrity proper to the origin of restoration) in parallel with a change of the experience of time. We can also find a drift from the notions of homogeneity and reversibility, typical of 19th century determinism and absolute historicism, often linked to an attitude of temporal abstraction and an interest focused on the original integrity of the work, towards the ideal of positivist progression. The latter goes hand in hand with a linear vision of time and a system of evaluation of the work entrusted to a synchronic vision considered recognisable and accessible, which represents a specific important moment in temporal succession. The time of the work is thus segmented in the subdivisions of historical time.
Meanwhile, the slow posterior confirmation of the irreversibility of the events unites the perception of the object to the natural time and introduces the idea of a diachronic identity, where transformation becomes character, apart from being a parameter to evaluate the work as a whole.
The dissolution of linear historical time into heterochrony – or perception of a temporal heterogeneity – is reflected in two almost contemporary cases where, on the one hand, a desire to affirm the addition by contrast vies with the pursuit of a more mature form of continuity, on the other, which does not further analogical reproduction but respect for the meaning linked to the evolutionary process of the fabric and the conservation of its stratigraphic legibility.

*The homogeneity of cyclical time and the continuity of progressive linear time: the abbey church of Ste. Marie Madeleine de Vézelay (1840-59)*

This intervention appears under "Restoration" in the Dictionnaire, as a standard example. In Vézelay conservation aspects seem to prevail, such as the maintenance of the Gothic choir in the interior of the emblematic Burgundian Romanesque monument. However, the replacement of three Gothic sections with others in Romanesque style reflects Viollet's interest in the coherence of style, for which he retrieves separately and independently in this case: the Romanesque nave and the Gothic choir. Viollet gauges the authenticity and the duration of the work, respectively, in accordance with the generating principle, disregarding the material replacements required to achieve these goals.

Together with defects from source, time is the major agent of degradation, since it even eliminates each of the signs of style. The style retrieved "conquers" time and becomes a law of universal validity. The relationship of Viollet-le-Duc with the past and with time responds to historiographic and cognitive models defined as "nomologico-deductive" and "rational explanation", which involve a scientific approach based on the certainty of the causal connection that permits one to foresee and, where necessary, repeat phenomena.

Like a historian, Viollet rationally places himself in the shoes of the man of the past in seeking the principles that determined his conduct and which are still considered valid to explain the present and construct the future; as Leniaud says, it is an attitude that depends on intelligence rather than memory. Although he is fully aware of the temporal distance regarding preceding periods, Viollet acts for the sake of a logical methodological continuity with his predecessors, not in order to "do what they did" but to "proceed as they proceeded". In this way, Viollet can either turn to the past or the future of the building, because unity of style involves indifference regarding the passage of time, legitimising the restoration as continuity of the work, which does not belong to the historical past but to an ideal past, freed from time and therefore "timeless".

It is an approach that somehow involves an experience of homogeneity of time that, however, in Viollet-le-Duc does not seem to assume the appearance of cyclicality, the idea of "eternal return" but a sort of sublimation of progressive linear time, which produces a sense of rational and cognitive continuity where the method survives at the same time: "Isn't exhuming forgotten truths […] one of the most active means of accelerating progress?"

The complexity of the figure of Viollet-le-Duc can also be interpreted in temporal terms as a condition in which the eternal side of architecture (or "science") challenges the temporality of history, becoming a sort of place where the author struggles somewhere between timelessness and temporality.

*The "suspension" of time: the Fondaco dei Turchi in Venice (1861-69)*

The commemorative plaque of this restoration reflects the history of the Fondaco del Turchi, built in the first half of the 18th century as an aristocratic residence, which it continued to be until the 17th century, when it was transformed into a warehouse or fondaco, whence its name, and was later totally abandoned until the Council bought it and restoration works were carried out by the engineer Federico Berchet.

As a building representing the mercantile origins of the city, its ruin symbolically evoked the decadence of Venice and, for that reason, it was restored to retrieve its original character of "Venetianness", "whatever the vicissitudes that had taken place over the years". It is an intervention that strives to stop time in a conceptual sense, understood here solely in destructive terms and represented by degradation and transformation, both signs of decadence. The study of the relationships of proportion and decoration and the stylistic analogy with similar buildings were the principles used in its reconstruction, where the rigour of the intervention was taken to the extreme of failing to invent any compositional details (Berchet said he had not added "even the slightest moulding of his own accord"). This respect was limited only to the image, since it did not take into account the demolished, added or replaced materials, as in the intervention on the marble of the façade, where no differentiation was established between the elements maintained, those retrieved or pillaged and the reproduced parts. On the contrary, to "restore the splendid original integrity and original beauty to the façade", the old marble was also submitted to a refashioning and polishing treatment, the same as the new ones or those that were relocated: a renovation of the surfaces to erase any sign of the passage of time.

In temporal terms, the recuperation of the physical integrity can be seen as a kind of symbolic reversibility, not understood as a return to a historically defined phase but as an abstract temporal inversion, to a phase of "ideal Venitianness" that involved turning the real building and its experiences into a mythical image. Located outside time, it an architectonic restoration work that formed part of the programme of cultural and political rescue of a powerful mercantile Venice, which survives in the frozen and almost abstract shapes and the "uniform and cold white" of the refurbished building.

*The idea of integrity and the traces of time: examples of conservation in the controversy about the treatment of Venetian marble*

The protests that arose in England against the restoration of the marble in the Basilica of San Marcos (1843-75), reflected in the writings of the Venetian Alvise Pietro Zorzi, gave rise to a debate crucial to bring about a change of trend in restoration principles, which also involved the restoration of the Fondaco dei Turchi. The latter was considered a forgery, "too complete and apparently incomplete: it is neither old nor new" (C. Boito), "the ghost of a palace now lost to art, to archaeology, to history" (G. Boni). Thus began a slow but constant process of shift of interest from the formal integrity of the work, corresponding to a mythical form of temporality, to material authenticity and appreciation of the signs of the original Ruskinian time, which Zorzi and Giacomo Boni described as conservation instance.

In the description of the Fondaco that Boni, following Ruskin, made before restoration, the idea of the accumulation of time in objects appears as a perception of duration, which stirs up memories: "The Fondaco dei Turchi looked really old and one could walk under its arches with a sense of peace, aware of its antiquity, as though it had seen the rapid changes that took place around it and had become a superior being unmoved by the passing of the centuries".
This resonance opened up a perspective of temporal dilatation of the work, whose value was not beginning to be perceived so much in the new integrity of a mimetic abstract reconstruction or the "pictorial" integrity of the treatments of artificial ageing, as in the integrity lost, because "in any living thing there are certain irregularities that are not only signs of life but also a source of beauty". Ruskin saw the irreversibility of time this way, as an awareness of the inability to reach the past and the intangibility of its material testimonies, which began to be seen operatively as the absence of intervention.

*Awareness of duration in the historico-material document: the restoration of the Bishop's Palace in Parma (1920-59)*
The Bishop's Palace in Parma, situated opposite the Cathedral in the main square of the city, is a stratified building whose original nucleus dates back to the 11th century and main façade to the 13th, characterized by a portico and trifore windows with double columns and an interior cloister with two orders of columns (15th century). At the moment of its restoration, the building was distorted by an 18th century intervention, which was eliminated by a long-drawn-out intervention (1920-59), the result of the cultural climate that prolonged restoration "in style" influenced by the personality of Alfonso Rubbiani throughout the 20th century.
After the interventions, the palace had lost all traces of the Baroque configuration and constituted a palimpsest in which the medieval configuration went side by side with the highest quality Renaissance elements. The case of Parma is representative of a long transition phase: from the abstraction of the stylistic and analogical criterion applied to the monument (first phase, repristination intervention), followed by the posterior philological pursuit of the historico-material document (second completion phase), to the abandonment of imaginative reconstructions (third phase, scientific restoration removing the Renaissance loggias and closing the arcades with modern woodwork) which preceded a maturation about awareness of the unrepeatability of the historic trajectory of the work.
However, even reviewing the shift from one intervention phase to the next, we can see that the logic of the project always responds to a global design of formal character, the retrieval of an image that represents one or more building phases univocally defined and set in time. Thus the 20th century restorations of the Bishop's Palace in Parma seem to enter the climate of Italian philology developed in the sphere of a historicist and determinist approach. Respect for the character acquired by the fabric over time is submitted to the coherence of a redesigned unity by means of the repristination of the main Romanesque configuration and the restoration of the Renaissance configuration.
Once restored, the building is a compendium of preexisting and reconstructed traces and gives the impression of a "tamed", in a sense planned, heterogeneity, through the selection of testimonies, which subordinates the stratification of an idea of unity in homogeneous parts. The temporal approach applied in Parma seems to confirm the survival of the sense of continuity of historic time as a concatenation of the events that can be seen in the parts deliberately selected, eliminating the whole network connecting microhistories and minor stratifications.
The contextual conservation of parts from different periods is no doubt a sign of maturation towards the acknowledgement of the irreversibility of time and the passage of time in the building's transformation process. Nevertheless, it is a diachrony frozen by the choice of only maintaining the parts that reflect recognisable values, perceived and transmitted according to a preestablished historiographic approach.

*Multiplicity and fragmentation of time: the restoration of the Castello de Rivoli (1961-95)*
The Castello de Rivoli, near Turin, is a residence of the Savoy family to whose design the major architects of the court contributed between the 16th century and 1718, with the important project by Filippo Juvarra, interrupted in 1743. The restoration, prompted by the attempt to create a "Beaubourg" south of the Alps, reveals the desire to update the building by making it respond functionally and figuratively to current-day standards. A concept repeated also in temporal terms by means of "a contemporary idea of time, where past and present exist at the same time and are already tomorrow". Therefore it is an amalgam projected towards the future between a meaningful past and the present that vouches for its value and organises it by selecting the parts and the inventiveness of the project.
The author's interpretation of Juvarra's restoration is interesting, perceived as "a large fragment in construction […], a marvellous fantastic space to be conquered", the raw material of the project. It is an intervention conceived from the point of view of ideal continuity, where the contribution of the project prevails over conservation, for which the architect feels "free to continue the thoughts of those who preceded him".
The reproduction on the pavement of the atrium of the outline of the unfinished parts of Juvarra's project can be defined as an intervention comprising the "construction of traces" with a symbolic value, which again evokes a material presence by means of its geometric reproduction, a little delayed essay of the old project.
The modern additions in the gallery or Manica Lunga or the completion of Randoni's staircase – a layout system endowed with material, compositional and symbolic autonomy that prolongs the existing ramp – take on a tempestuous character, a "counterpoint between the past and the present".
The past-present dialectic also seems to be the main logic of the panoramic bay window, which lets one see the unfinished atrium, showing the way the construction would have gone. The adjective "panora-

mic" does not quite give the meaning of the object designed, which comprises a "window, a retrospective and futurist observation point" over the 18th century work converted into the prime element that turns the building into a museum. A symbol of the whole project, the view from the top allows a perception of the unfinished atrium as in a plan, which is at the same time Juvarra's design and the restoration works.
Suspended in the past-future of his work, the designer describes in spatial terms the excitement of taking a look "outside the comfortable protection […] of a finished space", but this action takes on the characteristics of a daring temporal projection outside the "solid" protection of historic time, in the vacuum of an imagined time that never existed.
From a temporal point of view, this intervention reveals the coexistence of a plurality of times that intertwine. Above all, a sense of continuity in the idea of continuing to act on Juvarra's work, 250 years later, uniting a "retrieved" past with the future projection by means of formal and functional updating. But this continuity project consists precisely in a modern awareness of cultural and linguistic discontinuity, which tends to be distinguishable by contrast.
A temporal vision addressed as a kind of stopping of time can also be detected, with the stamp of the unfinished work, but this stop takes on the features of repristination (of the unfinished original), a modern version of Viollet's method.
The referent is, nonetheless, Juvarra's "large, disproportionate fragment" and therefore Andrea Bruno is not talking about unity of style but a more modern idea of style found in the fragment, with a vision that reveals the acquisition of contemporary aesthetics, apart from philology, the culture of 20th century scientific restoration and the creative legitimation of critical restoration.
One gets the impression that the "rehabilitation" of the Castello di Rivoli is an old and modern intervention at the same time. Old in its conception – the idea of repristination of a state considered ideal, on the basis of a historic and artistic opinion – and modern in its language but, above all, in the appreciation of the frankly flaunted incompleteness of the work.
The character of completed work – dreamed, desired and never achieved – is continually evoked, without the architect feeling the need to reconstruct it materially, as abstract as it is "not illusory", thanks to the strength of the project it stems from.
Perhaps the illusory element consists in the hope of "repristinating" – a term that in itself implies a retrospective vision – an action in course, that is, a genesis designed in the future, a contradiction in terms in the temporal sense. This condition presupposes a kind of future-of-the-past that the restorer tries to verify in a delayed fashion, to admit the perception of an ideal future – the promise of completion never fulfilled – by means of a sort of "temporal inversion", erasing the traces of the real historic development, that is, the material stratification.
Therefore, it is not too much to read about the coexistence of a plurality of temporal visions in this restoration of the Castello di Rivoli, where historic time has been replaced by the reversible time of the designer and the idea of continuity of an interrupted work blends with the repristination of an original state. And where the conservation of the past becomes the project material of an updating. The multiplicity of times intended to be reflected in this intervention reflects a broader condition of contemporaneity, described, on the other hand, in the field of psychoanalysis with the term "time in fragments" or heterochrony. It is the temporal equivalent of the multiplication of the systems of values underlying contemporary culture. In Rivoli, however, the sense of fragmentation goes hand in hand with the certainty of an image of reference, which continues to be a handbook of the project.

*The time elapsed as diachrony and the acknowledgement of the monumentality of small traces: The Convent of Saints Cosmas and Damian in Venice (1996-2004)*

The Convent of Saints Cosmas and Damian in Venice, articulated around the cloister, is on the Island of Giudecca, situated in a large green belt surrounded by a wall. Founded in 1481 and extended in several stages between 1497 and 1615, the convent was given different uses after the 1806 Napoleonic edict (warehouse of the Corps of Engineers, workshop, refugee camp during World War II). The building was finally subjected to a long period of neglect, which led to the collapse of a large part of the roof, the degradation of the surfaces and spaces and the almost total loss of the possibility of recognising its architectonic-functional characteristics.
The restoration had to resort to a great deal of compositional and technological innovation to rehabilitate it to make dwellings and workshops for craftspeople in the spaces giving on to the cloister and facilitate public use of the larger, more monumental spaces.
The intervention was conceived as a pursuit of equilibrium between conservation purposes and the requirements imposed by use and serious deterioration.
The attempt to maximise the permanence and legibility of the traces in the old parts were based on stratigraphy, adopted as a cultural tool for the conception, orientation and control of the project, to the extent that the restoration intervention was conceived in terms of deliberate stratification. This choice has affected the choice of use and location of the innovative architectonic contributions, allocated to the already transformed parts impoverished from a stratigraphic point of view in order to reduce alterations and losses.
In stratigraphically important contexts, the objective sought by the intervention consisted in not altering the material palimpsest by reducing expectations of decorum in favour of being able to enjoy the stratified space "to keep alive the tale of fragmented history of this place […], as though the unity of the atmosphere were replaced by […] this complexity […] in the ensemble […] as though all the traces were placed on the same warp". In his exposition of the general intervention criteria, the author suggests the idea of "imperfect restoration", where the term imperfection does not refer to a qualitative opinion but expresses the possibility for abstention in the project, and the impossibility of achieving a state

of conclusion of the restoration act to allow the permanence of the stratified context.
The most interesting operative aspect is represented by the desire to formulate a ductile building method, capable of allowing the workers to act differently on the surfaces conserving the characterizing remains of the stratification. Furthermore, the distinguishability of the additions and integrations was not entrusted to contrast in materials or shapes but to the "perceptive channel" of stratigraphic legibility in its condition of "structure of authenticity relations".
The conservation problems and visual and narrative aspects intertwine with each other, as does the conceptual approach and the different building techniques. Attention seems to stray definitively from the architectonic-figurative plane to the complexity of the stratified material and its interrelationships.
The main issue is the meaning of monuments today. Their passage through natural time and the human-induced mutation of historic time constitute the axis of a temporal distance that is directly perceived in the material traces, which have a physical and a metaphorical meaning capable of generating a sense that transcends the "deciphering of the traces".
The surrounding wall warranted a separate chapter, as an object without architectonic importance, simply marked by buttresses in a series of places and with a single opening, converted into the icon of its past vitality. Lacking functional issues and prospects of reconversion, the wall lent itself to an intervention in which the conservation of the traces took on a character of didactic element and in which different planes of reading, also of a temporal nature, were experimented, as described below.

## TEMPORALITY AS AN OBJECT OF CONSERVATION INTEREST. THE TEMPORAL EXPERIENCE ON THE HORIZON OF THE RESTORATION PROJECT

In the reciprocal semanticising process between time and matter, the former is found to highlight the latter, while matter – precisely because it is marked – allows one to assume the temporal experience as part of the same object. The capacity of being able to perceive the temporal distance and lead its appreciation through different readings of these traces is the result of observing the fabric through temporal filters, that is, by defining different forms of temporality and experiencing them as options for relishing historic construction.
Below we illustrate this diverse experimentation in three different images of the same object – the two columns of the Piazza San Marcos in Venice, the fruit of three descriptions, different albeit close in time, by Giandomenico Nardo, a member of the Venetian Institute of the Sciences, Letters and Arts, Giacomo Boni, a Venetian figure internationally renowned for his protection of monuments and an Italian politician and Marcel Proust, respectively, from a rational perspective, a perceptive approach and a poetic vision, which imply different conceptions of time.

*1 – "Objective" time and rational reading*
"Time is the number of the movement in respect of before and after" (Aristotle).
Giandomenico Nardo, 1864: [The columns of the Piazzetta] have been with us for nearly seven centuries […]. The dark granite one shows […] greater and greater erosion […]. It is necessary therefore to stop the process that is destroying it […] and the only means to do so […] is by renovating the surface […]. If the deterioration is allowed to progress […], this column may disintegrate in less than a century and a half, because with a diameter of 1.47 m […] even though it lost […] only half a centimetre every year, that would mean fifty centimetres a century.

*2 – "Interior" time and perceptive reading*
"We do not conceive real time. We live it, insofar as life transcends intelligence. The feeling […] of the evolution of all things in pure duration is there, and draws a halo around intellectual representation strictly speaking, a strip of light that fades away little by little during the night" (A. Bergson)
Giacomo Boni, 1883: I went up too […] and with my foot on the capital that measures three metres wide, I felt tiny because of how colossal the lion seemed to me […]. The difference between the old (feathers) and the restored ones in the wings was obvious; while the former are concave, rounded and whole, the restored ones are convex and cut short as if to make them look more natural […].

*3 – "Sensitive" time and emotional reading*
"[…] the miracle of an analogy had allowed me […] to find days gone by, lost time, at which the efforts of my memory and my intelligence always came to a deadlock […]. But it is enough that one experiences again a sound or a smell, heard or breathed once before in the past […] for the permanent and usually hidden essence of the things to be quickly released […] and […] men […], occupying a place […] drawn out for too long […] simultaneously touch, like giants submerged in the years, periods they have lived through so far away from each other, among which so many days in Time have lodged" (M. Proust).
Marcel Proust, 1900: "Yes, right in the middle of the square, at the heart of the present, partially altered by the testimony of […] that long-gone 12th century, looms a double display of granite. Around it, the present day, the day we live in, circulates and accumulates prowling around the columns, but there they stop all of a sudden and flee like frightened bees; for these tall, slim enclaves of the past do not belong to the present but to another time, where the present is not allowed to tread […], the columns push it away, preserving with all their thin thickness the inviolable place of the Past […] familiarly appearing in the midst of the present, with that rather unreal colour of things that a kind of illusion makes us see a few feet away, but which are actually many centuries away […], a phantom of a buried time; and there too, right in our midst, close, eroded, sleeping, motionless in the sunlight."
Walter Benjamin described the evolutionary process of language as "the passage from a sensitive and immediate correspondence of the subject and object (prophetic and hidden), by means of an immediate semi-sensitive (hieroglyphic and sacred) correspondence, until it achieves a non-sensitive and mediate (profane and semiotic)

correspondence". These different levels of language, conjugated with the three temporal structures shown before, permit us to define a correspondence – perhaps not univocal – between the reading genre (rational, perceptive, emotional), its cognitive objective (knowledge and foresight of the physical phenomenon, perception of the signs as a language proper to the work, emotional experience aroused by the object) and the type of timelessness implicit in the vision ("absolute", "relational" or in a broad sense "transcendental" conception of time). It is a conceptual-operative scheme, susceptible to become an interesting horizon for the restoration project, which is configured thus as a moment of convergence of several readings with different cognitive horizons and differentiated instruments and codes.

*The restoration project understood as the convergence of different readings; the wall surrounding the Convent of Saints Cosmas and Damian*

In the wall around the Venetian convent, the brick fabric – a primary architectural element – observed in its intrinsic functional and material characteristics, reveals a great contrast between its modest forms and the extraordinary richness of its design, which constitutes an indistinct and almost natural unity of stratification traces, building methods and manifestations of deterioration. The most immediate reading would be rational, which evaluates the phenomena and deterioration and suggests solutions. A reading sensitive to the potential of the wall would invite us to weigh up the options of the project and control its impact. An emotionally-oriented reading would even give rise to a sort of intimate appreciation, a cognitive channel of a poetic nature limited by the ineffability of some of its aspects, which constitutes precisely its main merit. None of the three approaches can assume the exclusive right to cognitive or deferential reliability. Furthermore, the cognitive instruments can be subjected to three different types of logic. For example, the stratigraphic analysis responds to a rational structure since it acknowledges the different transformative stages, adopts an eminently perceptive vision in the control of the transformations brought about and exalts the poetic and evocative aspect of the design. That is why close collaboration at these three reading levels is fundamental in the project, and can contribute to bringing to the fore singular details, further opportunities for understanding and new forms of appreciation.

*1 – Objective time and technical readings of the deterioration and transformation: interventions to repair, consolidate and fight deterioration*

What is known as objective time acts mainly as a variable in a rational approach to the fabric, where the diagnosis of the preliminary study and the design of the actions in the project are fundamental. This is undoubtedly the first step in guaranteeing the survival of the surrounding wall, essential to evaluate the conditions and the seriousness of the active phenomena, which has led to the consolidation of its structure. The vulnerable points and potentially damaging phenomena that had brought about the structural pathologies have been detected. In certain areas, the missing bond and grouting in the wall had to be replaced to restore stability, and some parts were disassembled, numbered and replaced without refashioning the buttresses or correcting their leaning.

It was decided to perform "imperfect" integration, even where parts that showed signs of previous reconstruction were concerned. The wall was partially repaired by reinforcing the transversal connection of the surfaces but leaving visible the most obvious remains of double joint or "support edge" of the two different adjacent parts in order to conserve their significance in the building.

The rationality of the approach resides in the fact that the aim of the project was to guarantee the wall's structural efficiency. Nevertheless, the intervention was reduced because of issues about the relationship between science and nature related with deterioration. Indeed, a merely technical approach – dominated by the pathological aspect of the phenomena – lacks qualitative aspects that reveal the passage of time in the work. The choice of an approach to deterioration in terms of attenuating the phenomena shifts attention from the idea of scientifically calculated durability of the repairs to an idea of duration calculated on the basis of meaning. The different states that characterize the permanence of the work are interpreted through a series of signs, physical effects, remains of the changes, which warrant a shift from "thought, quantitative time […] to lived, qualitative […] interior time", understood as duration.

*2 – To experience of the work by means of the perception of time: integration interventions maintaining stratigraphic legibility*

The perceptive relationship between the object and the observer is developed like an amalgam of rationality and intuition, in which spatialised time, understood as a succession of instants, contrasts with the idea of Zeitigen, the perception of the permanence of the work in time, which is not so much measured as felt, in a dorm of correspondence between object and subject, where the material traces are seen as figures of the work's specific language. From a semiotic point of view, we witness the shift of the concept of formal quality to quality understood as "a way in which matter appears", entrusted to the surface that "becomes an interface, that is to say, a privileged place of exchange of energy and information".

Stratigraphy is the main decoding system used in the restoration of the wall, which has been entrusted with the understanding of the different nature of the traces. In the thirteenth section there was a boarded door, whose jambs were in danger of collapse. It was very close to collapsing and therefore needed to be completed in order to make the damaged section safe and worthy. The conservation of the legibility of the section before collapse even after repair has maintained the perceptibility of the stratigraphic process that characterizes the opening from a temporal point of view. Similarly, partial painstaking rebonding has preserved the shape of a door that had been prepared but never actually made because of a change of

heart at the building stage.
Perception also influenced the criteria for differentiating the additions in this intervention, which has been carried out in terms of "subtle assonance and dissonance" according to the different degree of erosion and texture of the additions performed, the insertion of loose bricks retrieved from the missing parts and the new hand-made ones in the larger gaps, therefore endowed with greater specific conceptual and perceptive importance. Therefore, the contrast was not accentuated but neither was it attenuated or covered up, while large stretches of badly damaged brick although still valid from a matteric and structural point of view were maintained in place unaltered.
This choice reveals an attitude of cultural acceptance of deterioration, and is based on the power of perception to incorporate an object in historic time. "New", "obsolete", "unusual", "old" or "ancient" are adjectives whose positive or negative connotation depends on the peculiar relationship of temporal and cultural closeness or distance between the object and the observer. For fabrics closer to our time, deterioration is perceived only in terms of loss of decorum, whereas it is considered naturally acceptable in the case of an old wall, where the consumption of materials conveys precisely the sense of age or "temporal depth" that characterizes it. Like a two-faced figure, on the one hand, temporal depth augments in a continual manner consistent with ageing and, on the other, it is reduced in the natural modifications and restoration works with a great renovation component. In order to avoid this sudden reduction and conserve the dynamic perceptive quality of great aesthetic and emotional intensity of its old mortar, the joints of the fabric were caulked in a selective and limited fashion.

*3 – For a "sensitive" experience of time through the work: maintenance of the absences and failure to intervene as a choice in the project*

If rational knowledge permits one to see objects, sentiment makes their emotional properties emerge and invites one to embark upon an interpretative journey whose point of departure is the object, but only to move away from it towards different experiences of ulteriority. This third uncoded emotional reading may be reductive if it is understood in a strictly scientific sense, but the possibility of entering the non-rational sphere of subliminal messages gives rise to a remarkable increase in the possibilities of knowledge and enjoyment.
With the conservation of the aura of the fabric and the place as its main aim, the approach of the project led essentially to non-intervention, understood not so much as an ideological attitude as the possibility of abstention in the cases in which this choice of project allows the surfaces to go on transmitting the sense of temporal depth and communicate, in Simmel's words, "the fact that life, with its richness and changes, lived here once, [in] a present that can be immediately intuited".
In the tenth section of the Venetian wall there is a series of holes with uneven edges parallel to the remains of an eliminated roof. It is the demolition interface of a cantilevered body that, more than a gap, it rather express itself as an "absence", which suggests another configurationthe existence of missing parts. From the point of view of deterioration phenomenology, there is no point in attempting to differentiate the gaps (loss of parts of the surface) from the absences (interfaces of deliberate demolitions, loss of recognisable configured parts). Both conditions represent a gap in the material. But conceptually the lack means a loss of integrity that suggests completion, whereas absence merely suggests an action that took place and arouses questions about the events that occurred in the past. Like Benjamin's aura, defined as the "appearance of a remoteness, although what provokes it may be close", the idea of absence introduces a narrative component that leads to a sort of "other place" characterized by different spatio-temporal coordinates, alluding to a "depth of space" that can become an "allegory of temporal depth". Therefore, a symbolic form of time comes into play, Proustian or Junger's "hourglass time", which "lives in each of us […] as though deposited at the core of our essence [where] an instant can make up for a whole life". And like the souls imprisoned in things – in the Celtic legend quoted in the Recherche – the past and time need a body to make them tangible. By this contact with the material testimony, a sensitive form of experiencing time is configured by means of the intersection of physical sensation and memory, which activates the capacity to reconcile presence and absence, memory and oblivion.
Once the need for an intervention against the inevitable disintegration of the surface has been assumed, the simulation of different degrees of repair has suggested confinement limited to the missing areas, which has reduced the risk of further disintegration without arriving at excessively elaborate or conceptualised proposals or imposing the regularisation of the irregular edges of the bays, which would have led inevitably to a rational decoding of the design.
The desire to reduce the manipulation of the design to a minimum does not respond too much to a matter of taste. On the other hand, from an aesthetic point of view, in this case the meaning of aesthetics is being used in terms of reception and communication, addressed at the expressive capacity of matter rather than its formal qualities.
The pursuit of naturalness in this intervention aims at the enjoyment of the testimony of the stratified traces without turning them into a museum of themselves but simply exposing the fabric as objective memory. Thus, the lack of homogeneity due to the coexistence of rebuilt sections of wall together with some conserved and other degraded old ones is compensated by the perception of a sort of *contempo*, that is, a synchronic presentation of material testimonies of the past, present and future of the wall, which metaphorically lead to the same synchrony of different periods and the people who have constructed, restored and observed this wall over the centuries, in a unit that has become a work of man and nature today. The story of the wall is not entrusted to the architectonic elements but to the traces, where traces become objects of an encounter, whose meaning must always be revisited with a continual genera-

tion of memory and visions "geologically" stratified in this piece of matter. And where deterioration also participates as a poetic form of life: the "thickness of the events that took place", in Adorno's words.

IN SEARCH OF A NON-LINEAR CHARACTERIZATION OF TIME

A possible non-linear characterization of time is open to new experiences in the future since it conceives the approach to old constructions in a plural sense, recognising also the possibility of knowledge in perceptive and emotional channels. Here again we have Benjamin's idea of language as the fruit of evolution from the sensitive to the intellective, where "together with the spiritual communication of human languages there is a material proper to the language of things […] 'the magic of matter' […] the mute intensity of objects". Far from a desire to propose a sort of taxonomy of the forms of knowledge, the intention is rather to test its diverse potential, not understood as conflicting alternatives but rather as articulations of a complex complementariness. The emotional approach of a poetic reading can constitute a sort of "cul-de-sac" for the intervention but that same vulnerability of the object – the emotion of time – can become an efficient "tuning fork", capable of capturing the most subtle nuances of transformation. Preserving the power of old material to condense emotions and transmit time allows us to come into close contact with the idea or rather, the "sensitive side" of authenticity.

The possibility that time itself becomes the object of interest to be conserved imposes a reflection about the options and chances of enjoyment arising from different disciplines. Let us think, for example, of the requirements of a museum space or the multiple temporal experiences offered by the theatre. The most direct approach to time through a building, however, could be the literary approach, already seen as an opportunity to know and enjoy "other experiences that have taken place".

It is perhaps a problem of expounding with precision the reciprocal objectives besides establishing the terms of a kind of coordination for useful interactions. But perhaps only the assumption of free association between these different channels, in unprejudiced complementariness, can generate a broad technical and conceptual structure, capable of offering restoration new "creative" opportunities of interpretation.

Conservation understood as "participative conservation" of the sensitive context linked to the material context transfers the art of attention to the very idea of respect, understood – in the words of A. France – as the friendship of things, which involves a conscious use of the objects experienced and the places already crossed by time. This attitude can lead to the extreme of renouncing use, exalting the utilitarian aspect of the function in the appreciation of a sense of time "much more stimulating and exciting insofar as it is […] awareness of the lack, expression of absence, pure desire". Therefore it is not a question of trying to restore lost time but of still being able to enjoy a still perceptible part of past vitality linked to the present in an old building, thus alluding to the time that remains. "And in the time that remains resides the word […] that manifests itself before a disappearing world, turning into a word of hope".

**F. Trovò & P. de Dato**

English translation by Elisabeth Power

## ABOUT THE RECENT TREND TO RENOVATE THE EXTERIOR SURFACES OF THE BUILDINGS IN VENICE

"…It is probably the start of a city we do not know… The city is dreaming of being what it has always been. It is as though nothing had happened, the external structures are still there and that is a great deal: they wait, refer, evoke […] Unfortunately it is now repainted, in comparison with the others that await their turn over the water. Here a bright, smooth yellow: too smooth and yellow, all over the façade. A little farther away, an amazing radiant ivory white on another façade in the bright sunshine. All the façades they transform in an attempt to tackle degradation, but they no longer seem to live in Venice. They have lost their old colours, their changing consistency, their relationship with their surroundings, the centuries, time" (Paolo Barbaro, Venezia. La città ritrovata, 1998).

The debate about the present and the future of the protection of Venice has been rekindled recently after the award given by the Istituto Veneto di Scienze Lettere ed Arti to the article published in the British daily newspaper The Times on 1st March 2008, written by John Kay, a prestigious word-famous figure in the field of economy. If the provocative tone of the article can be seen in the title "Welcome to Venice, the theme park", nevertheless, as the jury pointed out, "calling Venice a theme park which should be handled as such […] is not in fact a desire but the denunciation (or the provocative acknowledgement) of a reality that is running the risk of being irreversible […] The urgent need for an equilibrium between the complexity of Venice as an extraordinary and delicate cultural asset and a suitable cultural level for those who wish to enjoy this asset indicates a possible way to manage the treacherous semi-destructive tourist phenomenon."

Beyond the provocative sally, as this episode has been defined by the mayor of Venice Massimo Cacciari, the real risk for the city is the progressive loss of real social and cultural values, as we can see from the massive exodus of the inhabitants towards the mainland and the often insurmountable difficulties related with the artistic and architectonic protection in the face of a growing degradation caused by cultural tourism. From this point of view, the paradigm of the Disneyfication is an invitation to analyse with the tools available today an evolutionary process with many crucial points. Among them, the transformation of the image of the city takes on great importance: if, on the one hand, the imago urbis venetiae created after the fall of the Most Serene Republic, consolidated throughout the 19th century, still survives, the maximum expression of this image is probably the romantic idea of a "sublime

decadent ruin" in John Ruskin's The Stones of Venice; on the other hand, there is a real tangible reality, somehow removed from the tourism that attracts millions of visitors to the city on the lagoon.

*Venice and historic resistance to change*

The history of Venice until the fall of the Most Serene Republic has no tales of assaulting the lagoon. No war had affected it: neither the Huns nor the Franks of King Pipino Brief, nor the Genoese, nor the confederate states of the League of Cambrai had managed to violate the well-guarded esplanade of the lagoon. There had been many fires, especially in the early centuries, and even towards the end of the 16th century one had broken out in the Doge's Palace, although the damage had not been very serious. The city never had to face the material need to reconstruct completely a large number of buildings because of war or natural causes. In fact the difficulties of working in Venice must be taken into account: if there was not a clear need building was reduced to strictly necessary operations, which coincided, in many cases, with frequent, meticulous maintenance works. Great changes in taste did not affect this peculiar resistance to change either: while, from the mid 15th century onwards, the Renaissance flourished in Florence, Rome, Milan and many other Italian cities, in Venice it was unenthusiastically received and the buildings in this style were defined as "Lombard", that is to say, foreign. Besides, the safeguarding of Venetian civic buildings – deeply rooted to such an extent that major works only affected jambs, lintels and windowsills of bays or other secondary elements – was often governed by necessity: the singular contamination of the traditional organism with some humanistic details in Mauro Condussi's Palazzo Zorzi, started in 1480, although it is an unusual case, is not the only example of this type of method.

In this case, it is not "a completely new construction, but a reunification of preexisting buildings". Codussi's idea was to respect the old tripartite scheme by adding two double pairs of triforate windows with capitals and dadoes to a large central single-bay window. Several elements show that the conception of this multiforate window was conditioned by the preexisting walls: its unifying function is obvious, and emphasised by the large balcony projecting underneath the central single-bay window. The same scheme is repeated on the east side towards the street. "Therefore the architect does not reject a renovatio more veneto, but formalises it in his own style. Thus coherence is combined with tradition in an explicit show of magnificence, with a clear intention of avoiding opulence or excessive ornateness."

Renaissance forms are out of place in Venice and the city does not take kindly to them. Especially in the first half of the 16th century, the characteristics of Alberti's new res aedificatoria established a difficult dialogue with the continuity, the diluted syntax and the incommensurable urban mesh of the lagoon, as we can gather from the local translation of the concepts of firmitas, utilitas and venustas. "[In Venice] Vitruvius' firmitas is governed by its own rules. Utilitas in the buildings of noble merchants is determined by the mechanisms and the conditions of life of a commercial city by the sea founded with circulation by water and therefore also governed by its own rules. As regards the language of architectonic forms, the language of Florentine Renaissance cannot help being incompatible with the Venetian language because of its origin connected with the Medicis, due to the widespread anti-Venetianism in Florentine circles […]. It is logical, therefore, that Venice openly avoids being 'Tuscanised'."

The conflict, however, is not limited only to forms. On the one hand, we have the sacralisation of custom, and on the other the cult to the new word – dressed in classical clothing – that implicitly attempts to annul the very value of that custom. How could Alberti's ideal as a humanistic architect who reforms the res aedificatoria form part of a universe like the Venetian one? How could the proud autonomy of this discipline harmonise with the supervision of the civil servants and suppliers of the lagoon? How could tradition and novelty coexist without renouncing the plenitude of the symbolic text that constitutes the continuity of Venice? The answer given to Palladio at the time was interesting: Venice can assume this language, although rejecting these proposals to its margins.

For that reason, in Venice prudence is a term with many connotations and meanings. It is prudence that guarantees the persistence of Venice in its own origin, that establishes criteria of justice, that allows the resistance of tradition to novelty. Furthermore, the internal regulations of the different trades and corporations in the city contributed to make this conduct continue, both for their staunch conservative attitude and the rivalry between them. For example, the protectionist practices of the stonemasons, who worked on Istria stone and marble and forbade the use of any other stone or the combination of stone with brick. It was a way of avoiding works that could associate the noble stonemasons' guild with plain masons, whose status was inferior. If we add to these socio-cultural issues others linked to the environmental and operative conditions of Venice, which, as we said above, determined the constant pursuit of durability in their works, the result is that "the changes of architectonic style, when they occur, are limited to and included in a substantial technico-constructional and typological continuity […]. The continuity of techniques, of materials and reference models is so strong that it metabolises the stylistic mutations related with changes in architectonic language to the extent that it reduces them to mere decorative elements applied to a stable structure." The age-old Serene Republic kept up this practice of resistance to change until the end of the 18th century.

*Imago urbis Venetiae*

After its surrender to Napoleon in 1797, Venice was seen as a negative example of corruption and misgovernment, both because of its domestic politics and the contacts consolidated with the East and its precarious relationship with the Rome of the Popes. It also represented an example of poor quality of life, due to its unhealthy

atmospheric conditions. After years of cultural and political decline caused by the change of local government and a defamation campaign by the French government, in Turner's paintings and Lord Byron's writings Venice began a new period of redemption, and was seen as a misty city, suspended between the sky and the sea, a ghost city between fancy and reality, which influenced all the pictorial production of the 19th century. Bunney increased its fame as an artistic work and John Ruskin placed Venetian architecture among the most prestigious, defining the Doge's Palace as a building at the centre of the world. The cult to ruins in the Western world in the late 19th century preferred an architecture with an old, ramshackle appearance rather than a pure, perfect one. What was appreciated was not so much the exemplary practice of a style as the free flight of fantasy or the stratifications of the building methods, and thus there arose respect for old buildings with their "blemishes" and imperfections. The Romantics rescued Venice's charm, while historians gave it back its elegance and nobility. A growing number of artists arrived in Venice in the years before the First World War: Nietzsche compared it to a pleasant musical experience; Henry James praised its material degradation, while Proust defined it as a work of art and turned it into the last stage of the déjà vu sensation. The peculiarity of the architectonic characters of its façades and the very forms of material degradation began to be considered a determining factor in the definition of its beauty.
Venice progressively acquired the character of an "open-air palace", as Sergio Bettini called it: "Venetian palaces are nothing but façades; surfaces that determine a system, not of in-depth planes and axes, but of light and shade, of recesses and reliefs". But this system "is [more] related with the canal or the street it looks on to than its own body", determining the limit of urban spaces as though the façades were really "walls of that interior space made up of the piazza, the canal and the street", so that they contribute unequivocally to the definition of the character of the city itself, which "is defined by the material and formal constitution of a place". In particular Venetian façades "are presented as finished architectonic facts, and they rise to more general issues of urban development by guaranteeing the individuality of the civic organism, making it live in the urban organism". These considerations give rise to the great importance of the façade in Venice not only for historiographic reasons strictly speaking, but also because it influences the perception and first impression one gets of the city: compromising its character is tantamount to distorting the character of Venice itself.

*The make-up of Venetian façades and the concept of congruity*

Notwithstanding the substantial character of permanence of the typology and form of Venetian buildings, it is possible to determine a chrono-typological sequence of the treatment variants for the façades (oils, plasters, frescoes) and their respective architectonic and constructional configuration (corners, cornices, window canopies). There is a strong link between the formal configuration and the type of finish, which is the testimony of a certain "material culture" typical of the Venetian reality that has deeply characterized the appearance and the very perception of the city for many centuries. The concept of congruous treatment has been associated with this strong concept. It is a typical and historically demonstrable building character, which has remained unaltered over the years and immune to revision processes, as a tangible expression both of the pursuit of durability proper to Venetian building and of the value of age linked to its architectonic expression.

<u>Veneto-Byzantine period (C12-13)</u>

The first Byzantine buildings whose remains can still be found scattered about the city were probably not rendered, as we can see from the subtly-bonded or filleted mortar joints; the walls were decorated with plaques of marble, disks, ceramic or mosaic. On the left hand side of the painting St Jerome and the Lion in the Convent by Vettore Carpaccio, we can see a porticoed building with a corner typology similar to the oldest ones conserved in Venice, from the late 13th or early 14th century, where groups of three stones are inserted in the fabric corner at framework level. We can see that the rendering follows the border of Istria stone without covering it, but rather emphasising its presence with coloured strips; the corner of the fabric, completely plastered, on the other hand, bears a decoration in the form of toothing bond. Another painting by Carpaccio, the Miracle of the Relic of the True Cross on the Rialto Bridge (1494), shows different fabric corners plastered and decorated with imitation stone. In the few buildings still conserved from this period, we can find some characteristic relationships between the bays and the typology of the cladding, whether in stone or naked brick fabric. Many of these buildings and, in particular, the palaces on the Grand Canal present a marble cladding on the whole surface, where the marble plaques are always a little sunken as regards the frame or curb of the bays and never superimposed upon them. Besides, we can observe the care taken in the details of the bay-fabric interface. Other buildings have a stone cornice decorated with bas-reliefs crowning the façade. This cornice is inserted in the stone cladding and always at a more sunken level. As Ruskin and others have documented, the examples of architecture from the Veneto-Byzantine period are adorned with stone or ceramic elements, which are incorporated into the naked brick fabric or covered with marble plaques. These are bas-relief disks or crosses with allegorical figures inserted over the multiforate windows of the façade. A common characteristic is that they stand out from the rest of the fabric, whether it is naked brick or marble plaque cladding. The first Venetians' love of polychromy can be seen in the practice of Roman origin of covering buildings of the classical age with marble and coloured stone, a practice that increased as they had more and more contact with the Islamic East, whose cultural references they drew from and whose materials they used to decorate their palaces.

Gothic period (C14-15)

Once the heritage imported from the Orient ran out because of the growing building activity and the end of its conquests and pillaging, Venice began to develop other forms of decoration for the façades. These were, for example, frescoes or stabiliture or coloured oils for façades – remains of which can be found above all on religious buildings – or frog bricks, made with a thin coat of lime mortar and sand in a pattern imitating bonded fabric. The tinted oils of the façade are interesting because of their peculiarity: superficial layers of red finish applied by brush on the previously polished brick fabrics made of natural soils and boiled linseed oil, on which fine white mortar grouting was painted to make it look like fabric bonding.

Some 14th century buildings reveal that it was common practice to construct the corners of the buildings from the ground floor up to the first framework with toothing ashlars, whose toothing was reproduced in the upper stories in the rendering. In buildings of a later period, the toothing ashlars at the corners run up the whole height of the building. In this case, it is logical that the plaster painted al fresco runs along the edge of the stone without covering it. Often, particularly in important buildings, the corners were enriched with a little column with a capital, which were replaced by spiral columns as time went by.

Buildings considered of secondary importance, have plain stone pilasters at the corners of the ground floor and on the upper stories stone ashlars with a structural function at framework level, set in occasionally painted brick fabric. The bays of the Gothic period evolved from a stilted to a three-lobed arch framed by a rectangular alfiz. The first type appears in naked or tinted brick fabrics, with the bays protruding from the fabric and the rendering carefully bordering the Istria stone, enhancing its presence with fascias painted al fresco, not covering them. The plain projecting stone occasionally indented cornices also belong to this type.

With the progressive increase of painted decoration, the rendering was enriched with the presence of strips of fresco underneath the cornice and at the sides of the bays. The uniforate and multiforate windows, in turn, framed by a large indented stone alfiz, were decorated with marble plaques or painted al fresco with allegorical or mythological figures. The bays and stone cornices always stand out from the fabric. Although plaster was never applied to stone, sometimes, particularly in the late Gothic period, the dentils of the alfiz moulding were painted gold and blue respectively.

Renaissance, Baroque and Neo-Classical periods (C16-18)

The advent of Renaissance language and the widespread use of plaster proper – what was known as *marmorino* and *cocciopesto* – the building tradition underwent a change concerning the treatment of corners.

In late 15th century buildings, the typical pillar inserted at the corner of the ground floor was sometimes left on view with a slight bevel to let pedestrians pass, while the upper part of brick fabric with ashlars at framework level was covered with plaster (the traces of *cocciopesto* found at some corners confirm this fact).

In the first half of the 16th century, with the arrival of figurative frescoes, vertical strips of fresco were painted at the corners. At a second phase and in more important buildings, the corner was completely bonded with ashlars whose edges were seldom carved because part of the stone was plastered over, marking a vertical border that left only 30-40 cm visible. In this way, they went from the toothing composition of Gothic corners to the Renaissance and Baroque composition with a regular vertical border.

Unlike what happened in the Gothic period, in the architecture of the following centuries the rendering and the stone are not independent elements, that is, they are not intended as decoration or precise finish but collaborate with each other by contributing to giving the building a uniform appearance. Therefore one cannot imagine a building from this period without plaster.

The Renaissance brought many changes in buildings that affected their appearance more than their layout and structure. The new configuration, the new typologies for the bays, the new decorative details on the façade all provide a new language. As regards the relationship between the type of surface and the bays, we find a change from the previous period that reflects a parallelism with the treatment of the corners described above. In fact, during the refashioning of the façades new types of bays were added whose ashlars in the jambs were not carved in contact with the fabric, for the thick plaster of the façade was placed on them making their outlines regular in shape. Plaster obtains a new role as an important element in designing the details of the façade.

The cornices and the decorated strips on the façade also acquire great importance in defining its configuration. Stone cornices increase their thickness, mouldings are enriched and their presence in a single building is multiplied: there appear imposts of frameworks, windowsills and lintels. They always stand out over the plaster, whether it is *marmorino* or *cocciopesto*. With the exception of the first Renaissance buildings, the strips are no longer painted al fresco, but fashioned out of stone or plaster also. It is important to emphasise that this type of strip always intended to imitate stone cornices and mouldings, so that *marmorino* plaster was the most suitable for this purpose.

Modern period (C19-20)

During the Gothic revival period, the configuration of the bondstone corner was retrieved sometimes made out of ashlars all the way up the building or of ashlars only at the base with plaster above. With this retrieval of the architectonic motifs of Gothic art, typical 15th century cornices also reappear, sometimes dovetailed. The building method is not very different from the Gothic, and the stone elements are carefully fashioned so that plaster is not used to cover up possible flaws.

Towards the end of the 18th century the first frescoes began to appear with lime and sand plasters, marking the beginning of the decline of *marmorino* and *cocciopesto* plasters and painting the city with diffe-

rent shades of colour: red and white. From this moment on and throughout the 19th century, these two types of plaster disappeared little by little as a result of the changes brought about by the fall of the Most Serene Republic. From then on, "civil-type" plaster made of aerial lime and sand became common, painted al fresco or in paste.

*The legislation in force and the façades of the buildings: a missed opportunity?*
With the exception of a very small number of buildings (about 1,500) under specific protection orders, the fate of most of the façades of Venetian civic buildings depends on ordinary regulations. Among these we have the Modification of the General Plan, passed in 1999, after a great deal of dramatic hesitation regarding the tutelage of Venetian buildings, whose operation is based on the acknowledgement of typological categories of buildings which are associated with a series of principles. In an absolutely predictable manner, the façade of each building typology, precisely because of its character of "unchanged structure" in the urban fabric, has different morphological aspects that are not contemplated in the Modification of the General Plan. And the fact is that the regulations contemplated in the Plan address categories characterized by very varied façade compositions from an architectonic and construction point of view and regarding the relationship between the different parts. The Plan defines prescriptions valid for all the façades that, at least in theory, foresee the need for conservation of their exterior surfaces, contemplating the possibility of substitution, depending on the project designer's criterion. What occurs, in fact, is that in the cases of demolition and reconstruction of plasters that maintain chromatic and textural characters similar to the existing ones, no specific licence or building permit is necessary by virtue of law 457/78, which defines Ordinary Maintenance as an uncontrolled activity, so the plasters can be changed freely provided they refer to:
- The presence of traces of painting on the surfaces
- The traditional colour schemes
- The evaluation of a fragment large enough to represent a probe of the colours that characterize the surroundings of the building
The arbitrariness of these rules and the lack of architectonic protection do not permit a conservative attitude towards the surfaces, the materials they comprise, the techniques and the colour. In fact the substitute plasters are white or red like marmorino or coccio-pesto, but the techniques and materials are very different from the traditional ones. The numerous interventions carried out allow us to affirm that the substantial modification of the plasters is concealed behind a few millimetres of a finish with the same colour as the previous one, applied on strange preparatory layers (cement mortars). In Venice, furthermore – the only case in Italy – interventions on the exterior surfaces of the city are subject to a report by the Safeguard Commission (a regional institution comprising the Regional and Provincial Presidents, representatives of the Ministry, of the Soprintendenza, the Council and the lagoon area). But how does this commission determine control of the transformation of the external surfaces?
In the cases of plasters similar to the old ones, we have seen how the Modification of the General Plan and law 457/78 permit substitution without any control, whereas in the cases of substitution with different plasters, a vote of the commission is mandatory, which, in view of what happened, is no greater guarantee of conservation. On the contrary, the commission has marked a trend in favour of interventions where the old plasters are completely demolished and reconstructed, sometimes even with different materials and colours from the previous ones encouraged by the very organisms that comprise the commission (Soprintendenza). Since 1984 state aid has permitted interventions on buildings for an approximate sum of 200 million Euros in the case of maintenance, restoration and conservation of structures, renderings and external finihes, roofs, stairs and other common parts. The state aids have brought about a progressive increase of interventions on the common building, with the aim of demographic maintenance without favouring the real practice of conservation of the plasters and external surfaces in the assignation of aids.

*The trend in interventions on external surfaces between 1984 and 2001*
The effect of today's planning and protection tools, apart from the state aids that promote interventions of the private sector on emblematic or minor buildings, has given rise to frantic activity of interventions to replace plasters. About 200 state-funded interventions have been observed (law 798/84) between 1984 1nd 2001, all recorded in the archives of Venice Council. The analysis has examined three phases: the state before and after the intervention and the state in 2002, in order to identify the operative tendencies and establish some considerations about their durability. Apart from this diachronic reading, the effect of the interventions on the architectonic parts and the façade as a whole were taken into account. In the first place, it was found that the state of conservation of the existing plasters was not the main determining factor of the different attitudes during the project and works and that, besides, the reading of the characters of the façades, whose value also depends on the presence of the plaster or the original treatment, was not guaranteed. Most of the interventions do not take into account the peculiarities of each building, characterized by a finish typical of its style and period. This determines not only the loss of construction and morphological testimonies, expressed by the materials of the old façades and the strict relationship between the building and its corresponding finish, but also, due to its urban extension, a radical and probably irreversible transformation of the very image of the city.
There is a very large percentage of interventions involving the demolition and substitution of old plasters and, at the same time, a very small percentage of conservation or reintegration interventions. In cases of diversity and heterogeneity of materials, styles and colour schemes – architectonic richness – there is a tendency towards homologation and serial repetition of the plastered surfaces: in this way the congruity between finish and construction character

proper of every building is threatened.
Another effect of ignoring the constituent characteristics of Venetian style is the voluntary or fortuitous composition of new geometries that alter the image of the building: frames on structural elements, emphasis on elements that were originally concealed or excessively thick plasters, which brings about a false reading of the combination of the parts. All of this causes an alteration of the perception of the urban space in a city like Venice, where the equilibrium between visual cones and public and private spaces is very delicate.
Furthermore, the materials and techniques that characterize the refurbishment usually include different waterproof plasters at the base, with a non-transpirable cement-base surface layer of limited durability compared to most of the old plasters. It is surprising how slowly the degradation process affects old plaster in comparison with modern ones. The reason lies in the loss of techniques developed over age-old experience and knowledge and the use of unsuitable products that are incompatible with the existing substratum, indiscriminate use of cement, which reduces the level of elasticity and transpirability of the surface, an increase of layers and thickness and the use of synthetic products that form a non-transpirable film, which causes the material to come loose after a short time.
The interventions carried out were not really for the purpose of conserving the old rendering, but for reasons of decorum, enhancing not so much the testimonies of the material culture as the homogeneity requisites typical of renovation works. For that reason, the degradation of part of the base caused by rising damp that is slow and progressive in old plasters is not considered an important element that characterizes Venetian buildings: it is not tolerated and it is counteracted with determination by the use of special inefficacious and long-lasting plasters (extra porous, cement-based…), creating a new image for the façade. Recent plasters present a strong, radical type of degradation with obvious colour contrasts between surfaces and substrata: an unacceptable, incompatible, violent, rapid degradation that generates a sort of visual collapse.
The analysis of the transformation of the image of Venice requires a reflection about the way the need for decorum has determined the transformation of the "skin" of the city in the last thirty years and its perception. In the same way, a large amount of historic matter that is demolished in pursuit of decorum: many old plasters (*cocciopesto, marmorino*, lime-based, false), which have a great documentary value, have been lost forever. If it is adopted as a reference, the practice of conservation can not only offer operative conceptual tools to counteract the loss of old building techniques, but also seek an equilibrium between the protection and conservation of the character of a building and decorum.

*Conclusions*
The large number of renovation works carried out on plasters allows us to identify a general trend towards the homologation of façades. This result may be an uncontrolled and unforeseen effect of civic practice, but no doubt it reveals that the problem resides, on the one hand, in the efficacy of the control tools, planning and protection of Venetian buildings and, on the other, in restoration tools. As regards the former, it would be a good thing to increase the forms of protection of external surfaces, saving those that still exist, with the possibility of counting on recent censuses. Subsidies for private interventions should be granted wisely, encouraging conservation or integration works on surfaces rather than indiscriminate forms of restoration. At the same time, the restoration solutions must aim at the analogy and historico-architectonic aptness of the finishes, prioritising conservation, integration and maintenance works. In this aspect, the recuperation of partially forgotten craftsmanship, permitting the reuse of recycled materials in preparing the renderings (cocciopesto and marmorino), and foresight regarding the forms of degradation of the materials used in order to avoid sudden phenomena that quickly impair the decorum of the façades that brought about the substitution of the plaster in the first place. Only in this way can the image of Venice be kept alive without turning it into a product of its growing random commercialisation.

**J. Warren**
Originally written in English

## CONSERVATION OF STRUCTURE IN HISTORIC BUILDINGS

INTRODUCTION
Structure is the prime determinant of the shape of buildings. Since shape determines aesthetics, we may see structure as fundamental in our perception of beauty and beastliness in buildings. Al its barest, consider building where structure exists in isolation - such as the Eiffel Tower, Clifton Suspension Bridge, or the Millenium Dome. Each has given rise to awareness of a specific shape is not the most economic functional form. The visual impact sets an aesthetic standard.
In more refined architecture, the lesson becomes more complex. The beauty of Gothic is in the bare structure : everything you look at is working, counter-balancing, thrusting, or bearing; stretched to counter gravity and distinctive in the way it is modulated by the hand of the designer. Every surface is a surface of a structural element.
When we turn to classical architecture, the problem becomes more complex again. The form of a classical building derives from a trabeated wooden prototype with a pitched roof that can be traced through even to the fixing nails. So the structural aesthetic survives in the well-detailed, eighteenth-century pedimented house and porticoed town hall, even though the timber posts have been replaced by drums of stone or plastered brickwork and the detailing has been modified time and time again. Historic classical buildings will be visibly structural although likely to be tricked out and enhanced with detailing from an arcane vocabulary.
Functionalist architecture of the twentieth century is even more likely to be structurally deceptive and in many cases architects

have delighted in trickery and disguise … the visible element invisibly suspended, the visible enclosure seen sometimes so barely that you walk straight into the glass. The perversion of the supposed honesty of the functional aesthetic is clear where the apparently solid wall is held up by an invisible steel frame. So while twentieth-century architects justified themselves on grounds of structural honesty, their implicit morality was not always carried through.
It is in the vernacular that structure is at its simplest and sets visible standards that burn themselves in to the mind as visual signatures. The hutments of the Marsh Arabs (hopefully to be regenerated), where every element is formed by a shaped bundle of reeds, are as powerful a structural statement as the medieval timber framing of north-western lowland Europe. Vernacular building tends to retain its integrity because it is essentially functional. Its builders are driven by practical demands. It is when architects are let loose on structural form that evolution happens. Then we have to wrestle with the urge in designers to distort and misshape. The adulatory term for this tendency is baroque – applied, of course, primarily to classical architecture, but visible in every developing style.
The Gothic became flamboyant and elsewhere developed fanvaulting with irrational pendants. The classical broke its pediments and curled the broken ends as though they had been made of wax brought too near the flame. And functionalist architecture has gone wildly awry in the structural distortions of Libeskind and Gehry. But whatever our feelings in these matters, it is a primary duty of conservators to understand the structures they are dealing with.

## MAKING GOOD

Repair, reinforce or replace – these are the options available to the conservator.
The structure itself may be dangerously self-evident "Dangerously", because it is too easy to presume its performance. To look at an element and deduce from a mere glance that it is doing its job is an easy mistake. The apparently solid timber beam whose surfaces are paper-thin , the core having been eaten away by termites; the massive pier of the cathedral tower that is no more than skins of ashlar containing loose rubble; the solid and priceless mosaic lining to an apse, which proves to be a detached skin of tesserae proportionately thinner than an eggshell and a great deal more fragile; all should serve as warnings. Make no assumptions about the actions of structural forces within an historic building: verify, verify, verify.
Understand the original intentions of the builders, and understand the nature of performance of the materials they used and their rates of decay. We now have an amazing range of techniques for inspection and analysis, and the skills widen continually. All the available tools must be used to the greatest effect. Experience and intelligence must come together in the conservator as the material evidence comes to hand. Sometimes, as was the case in York Minster, the information is so complex and the structural performance so critical that the analytical stage may take months or more, but whether the analysis is momentary or demands years of study, it is vital that it is done as a conscious exercise independently of the remedial work. The remedy, after all, depends on the diagnosis. Diagnosis begins when the structure, with all its ailments, its fully understood, and it leads to the choices already offered – repair, reinforced, replaced – or combinations of all three.
These words are deceptively similar. They are fundamentally different. You may repair a beam by cutting out a rotted piece of timber and inserting a new piece appropriately fixed. You may reinforce a weak beam by inserting reinforcement. This has been done historically with wrought iron. In timber, this is the old technique of flitching. You may replace a beam with new material, perhaps like for like, but retaining none of the original fabric; and it is the comparative ethics of these options to which we now turn.

## THE YORK PRINCIPLES

I hope I may be forgiven by others elsewhere, and with equally valid claims, if I talk about the York ethic – the York principles enunciated here over half a century of the academic study of conservation. They were ideas argued over by students and specialist tutors, such as Patrick Faulkner and Gilyard Beer of the Office of Works. Of course these gentlemen (who were in their lifetimes regular tutors here in York) would have been the first to disclaim ownership or authorship of the principles, but they must take some responsibility for a steady critical commitment to them and their adoption by generations of students. Their debates and lectures set objectives and standards that have gradually become identifiable.
So what is the York ethic? No one, so far as I know, has attempted to put it into a few phrases so this attempt is nothing if not worthy of criticism.
It is the determination to base restoration on the historic structural elements allowing them honestly to perform their original functions and be as apparent in doing so as the original functions and be as apparent in doing so as the original builders intended, any supplementary strength required being provided with the least possible visual impact but without pretence.
This definition, of course, extends only to structural issues.
Now to turn to the first of the available options – repair.

### *Repair*

The York ethic presupposes that repair is the preferred – the primary – recourse. We all recognize that repair, in its own right, is not always possible, and sometimes it involves return to a structure that is, by modern standards, unsatisfactory or plainly unlawful. But that structure is original and its authenticity is, in itself, a guiding criterion.
One compulsion towards repair is veneration for the original fabric. This is an idea not shared in some other cultures, notably, but not solely, in the Far East, where the replacement is the standard method. But for "Yorkists" the actual fabric is venerable and to be repaired where feasible. This brings two interesting reflections. The fist is emotive, but follows logically – the more of the fabric retained, the more meritorious the making good; and the second that, as an

important by product, the repair ensures that the original structural methods continue in use. So at one hit both the ancient fabric and the original structural methods are preserved. In this case the incentives carry us in the same direction.
Respect to the actual touchable material leads to retention of the structural method, wich, of course, is entirely intangible.
We can follow other ramifications of this primary principle – preference for repair and retention on the fabric. They provide for the retention of historic information – types of joint, painted surfaces, and so on – and further require that new materials must remain distinguishable although sympathetic. Yorkists have never espoused the notions taken up by extreme enthusiasts that repair must be eminently visible, nor, on the other hand, the practice of furniture restorers who take pride in the total invisibility of their restoration.

*Reinforce*

Let us now look at reinforcing the structure. When I talk of reinforcement, I mean neither to include nor exclude the use of steel. I mean simply making the structure stronger than it was previously. While a repair should be as strong as the original, a reinforced structure may be stronger. This may be necessary due to changes in the physical circumstance, legislation, or the purpose of the building. With new uses arise new demands, and this must be met.
Yorkists seem to have had no difficulty with the ethics of this approach, provided that the reinforcement is not paraded. If it does not distract from the quality of the building, but does ensure its survival, all is well. But they recognize that great care must be taken to ensure compatibility and to avoid adverse consequences. There are endless dreadful lessons – the Acropolis, Herculaneum, and many others – often involving cement and rusting iron. They do underline the need for the greatest skill and care in the choice of materials and method, to say nothing of control over implementation. When less of the original evidence is retained and the structural principles are less fully respected, then ethically we move away from the ideal.

*Replacement*

And now the really radical option: replacement.
Replacement may, in this overview, include addition in the sense that one structural system is augmented by another in order to preserve the fabric as completely as possible. On one occasion I inserted a complete light steel skeleton within a chapel ( the Calvinist Providence Chapel in Chichester, West Sussex) to retain the collapsing structure. It was absorbed visually and became almost unnoticeable. The vigour of the interior, with its high central pulpit, so dominated the cased-in columns that few were even aware of the insertion; and none disapproved. Likewise, Sir Bernard Feilden replaced the foundations of the central tower of York Minster. The piers look untouched, although they have been reinforced by grouting, but at the lower levels the great new foundations are available for inspection and clear for all to see.
Where a component of the historic fabric is replaced with care and attention to detail, it is likely that one vital aspect of the building will have been preserved – its structural principle. Although function is intangible, the notion of preserving it is important; perhaps as important as an axe, even when both head and handle have been replaced. It still brings us nearer to grandfather to have it, touch it, and use it. And if it is only the handle that has been replaced, we are that much closer. This illustrates the principle of degree. The smaller the replacement in proportion to the whole, the more acceptable the action. So it follows, by reductio ad absurdum, that to replace on girder on the Eiffel Tower would barely affect its structural status historically whereas to re-erect the Crystal Palace in Hyde Park utilizing one girder from the original building would produce a structure with little or no historical integrity, whatever the fascination of the project. Importantly, however, the structural principle would have been respected in the replication and the process does have merit from this point of view.
While this illustrates the problem of the extend or degree of replacement, we may also look at the counteracting effects of retention with radical structural change by comparison with total replacement.
The minaret of the Ulu Jami in Mosul, Iraq, is a circular brick shaft that has deformed seriously and enjoys fame as a leaning tower. The minaret was reinforced some years ago by the use of Fondadile cables. A series of curved drillings were made using techniques akin to those used for seeking oil, and cables were interested throughout the skin and then post-tensioned and grouted. The effect was to include compression throughout the structure. In theory it had become a coherent mass, which could be picked up and handled like a pencil.
By this method the fabric was saved although the structural principle has been abrogated. If the tower had been allowed to collapse, and it had then been rebuilt, the converse would have been the case. The fabric would have disappeared, but the complete rebuilding would (we trust) have retained the structural principles. Just such a thing happened a century ago. Having given due warning by developing fissures from which dust poured, the campanile of San Marco in Venice collapsed concentrically into a tall mound of brick and lime mortar. It was immediately rebuilt. So the present campanile retains the structural principles of the original (reinforced maybe by cements not available to the original builders), but of the original fabric nothing survives; except, no doubt, bricks salvaged from the ruin.
The element of time is the crucial factor here. Before collapse, you may save the fabric, perhaps at the expense of the structural principle. After collapse, the only option is to replace. The structural principle can survive, but the fabric is no more.
In such instances, where the options work against each other, it may be impossible to achieve both objectives and a choice has to be made; or the building may make ii for you.
The ethical arguments can become complex. Uppark, a great eighteenth-century mansion of the Sussex Downs, is a case of pint. After a serious fire in 1989, only the outer walls and some of the central core survived in a reusable state. Effectively the

structure had vanished as smoke and sparks into the night sky. But the contents had, almost entirely, been rescued. They were valued at a sum many times the value of the fabric. What then was to be done?
- The sell could have been safeguarded and left visitable among its historic outbuilding and gardens;
- Or it could have been removed altogether;
- Or completely rebuilt de novo to a modified design;
- Or it could have been restores to its original form, as indeed it was.
The structure was replaced – reinstated.
Our decision here had complex emotive and intellectual justifications. Primarily there was the wish (particularly in the public at large) to recover something lost, just like the citizens of Venice who wanted their world restored. But is this argument sufficient intellectually? Probably not. So we look at other aspects of the problem.
Restoring the structural integrity played little part in the decision-making, and the key argument was the external and internal integrity. Externally a restored house made sense of the landscape. To have left the landscape without its central originating feature would have left a void as big as the gap in a face without teeth; a space demanding a statement and having none.
But more importantly the collections of furnishing had an important coherence. They were one of the most complete, intact and comprehensive original suites of furnishing of any house of its type. To restore the space in which they could be displayed again became an object and a justification in its own right. This became the intellectual counter-argument used to defy the purist who called for total demolition without replacement on the grounds that any rebuilding would have too high a percentage of new fabric.
And the clinching argument was that the money was available. What does one pay insurance for? But regardless of this mundane aspect, I think your Yorkist would have approved.
The Yorkist will defend the principle of necessary replacement provided that work is kept to the minimum and is undertaken with honesty and minimal impact on integrity of the building. The original structure may be supplemented or superseded, but if the nature of its structural function survives as an historical statement, the case is made.
Lack of clarity in these principles can lead to dreadfully muddled thinking – a "disgusting medley of compiled observations and half-reasoned principles" (I borrow from Kant's Metaphysic of Ethics) – that may lead irreversibly to a wrong decision.
Let me illustrate this irresistibly pithy phrase with a fairly recent event. I discovered an engineer arranging to cut horizontal channels at high level on either side of substantial brick arches in the basement of a fine eighteenth-century house. These channels, he told me, were to receive precast-concrete lintels to satisfy a building inspector. Our engineer claimed that, being unable to calculate the strength of the arches, he was intending to insert lintels that would do the job. Yet he had authorized the work on the basis that even with channels cut out the arches would still hold up the building. The Yorkist in me rose, reached for his sword, and put an end to that escapade.

IMPULSION AND COMPULSION
It is perhaps worth, finally, making the effort to understand ourselves in relation to the problem.
Those things we feel propelled to do are matters of impulsion. We feel the need to keep much of the past. We may rationalize the concept, but we recognize impulsion in the underlying drive. None of us is forced to conserve buildings; each of us has dedicated time and effort to the task; and moreover we put as much into that dedication as if we were compelled. Probably we put more.
We argue out our standards and strive for ever higher levels of achievement. There is no cap on our efforts. We feel impelled to go on thinking through the philosophies, seeking the ideal.
Out of that thinking arise two forms of compulsion: the compulsion that springs from the restless inner spirit that sets our standards, and then sets them again, driving us on, and the compulsion that arises from the systems within which we work. Without the impulsions, there would have been no debate, no formulation of the rules, no listing procedures, no grant aid, and no conservation areas to set the standards within which we are compelled to function.
Compulsion defines "minima". Rules are established and we are compelled, or compel ourselves, to achieve these minima. We make decisions to meet the criteria laid down after the impulsions have set the whole process in motion.
Compulsion sets up the hurdles on the racetrack; impulsion sets our legs going and powers the muscles that carry us over the jumps. Impulsion and compulsion are complementary. And a crucial part of that complementarity is debate and training, some of which has been hammered out in York over the past 50 years.
Building conservation, like architecture itself, is a community art. In isolation, it has no significance. Its evolution responds to the needs and objectives of the community, led and served by those who study and mutually tech. while much has changed, much progress has been made. There are transitions: but the strength of the progress is in mutuality, in joint effort, in coherent thought, and also in the camaraderie that arise among those who practice building conservation.

**J. M. López Osorio**
English translation by Elisabeth Power

## RESTORATION OF THE TORRE DE LOS SECRETOS IN BAENA CASTLE (CÓRDOBA)

THE TORRE DE LOS SECRETOS IN THE CONTEXT OF BAENA CASTLE
*Chronology and building history*
The Torre de los Secretos cannot be approached without taking into account the historic evolution of Baena Castle or the history of the city of Baena in general. We shall focus our study, however, on the constructive periods of the fortress documented during recent archaeological excavations

that have made it possible to establish a fairly precise chronological history of the monument.

*Period I. Almohad era (C12-beginning of C13).*
Baena Castle was first built at the end of the 12th or the beginning of the 13th century according to the structures of rammed earth walls found in different sectors of the fortress and the masonry tower belonging to this period found embedded in the current tower in the north-east of the castle.

*Period II. C14-16.*
This is a broad period we associate with the Christian era, when the castle was mainly a military base and formed part of the line of defence of the castle from the neighbouring Nasrid kingdom. In this period, known as the alcazaba period, we find different phases: Phase I (before the end of the 14th century) documents a tower on a slope that is now embedded in the west wall of the citadel. Phase II (late 14th to early 15th century) constitutes the most representative moment of the tower, since in 1386 John I granted Diego Fernández de Córdoba the lordship of the city, an appointment confirmed in 1394 and 1401 by Henry III, when most of the castle structures were built. Finally, we find documentation of Phase III (15th to the beginning of the 16th century), when the Torre de los Secretos was erected, for in the archaeological intervention carried out the base of an old tower from the previous phase, on which the present tower rests, was found.

*Period III. C16-19.*
This long period of time was determined by the change of use of the citadel, because the area was no longer a border crossing and the castle ceased to be a military base. At this time an important siltation of the courtyard took place and rooms were added for the new use of the castle as the palace of the Duke of Sessa. At this time, which we call the palace period, domestic spaces were built, new entrances were opened up and some outhouses were attached to the exterior.

*Period IV. 1897-1989.*
The sale of the duke's palace at public auction and the fact that it was then used as a source of building materials constituted the worst destruction the castle has undergone. In a few years the top of the towers were knocked down to make use of the rubble and ashlars. A new era began in 1927, when it was decided to build two reservoirs inside the site, and the castle structures were covered by the excavation materials. The same occurred in 1958 and 1969, when another three reservoirs were built, so that the castle was practically buried. On the other hand, there is evidence that shows that there was a lot of activity in the castle during the Civil War, as we can gather from the bunker built on top of the Torre de los Secretos, for example (figs. 1, 3, 4 & 5).

*Period V. 1989-2005.*
During this period several refurbishment works were performed on the site, the most important of which involved the total demolition of the Torre de las Arqueras. The Torre de los Secretos was also repaired at this time due to its poor state of conservation.

*Period VI. 2005-2009.*
Between 2005 and 2009 systematic archaeological works were carried out all over the castle and the Torre de los Secretos was restored.

## TORRE DE LOS SECRETOS

*Geometric & building definition*
The Torre de los Secretos has unique features in the context of Baena Castle. The constructive method of lime-washed rammed earth was quite common in Almohad architecture. However, the reinforcement of the corners with brick fabric piers was similar to models of Castilian origin. This is the case of the Torre de El Carpio, dated 1325 according to the foundation stone, or the turrets of the castle in Castro del Río, two examples Mudejar architecture of Baja Andalucía in the province of Córdoba.
The tower has a floor plan of 8.6 x 8.6 m maximum dimensions and currently conserves a height, in most of its walls, of 10.15 m. The north-east corner is set back to receive the joining of the south and east walls of the castle. Half-way up is the mark of the staircase that must have given on to a horizontal platform from the parapet walk at a height of 8.75 m. This first level is separated by a wall going from east to west from a second platform with a larger surface on the current terrace level.
If we compare it with the Torre de El Carpio or the turrets of the Castle of Castro del Río, we can deduct that the Torre de los Secretos must have been 15 m high and could have been covered with a flat roof with a parapet and machiolations at the corners. The tower might also have had an interior vault-covered room with its floor at the level of the second platform described above. Nevertheless, these hypotheses could not be documented during the archaeological works, for the structures identified do not show clearly the springing point of walls that would prove the existence of this interior room.
From the constructive point of view, the tower is resting on the remains of an older structure that conserves a thickness of 1.6 m on the east façade and 1.0 on the south. From this level springs a base of rubble covered with two rows of bricks with a total height that ranges from 0.8 m in the west and south sides to 1.6 m in the east and north sides. The tower has sandstone ashlar quoins on which rest brick piers with pointed springers 3.5 and 2.5 feet thick. Four stonecutter's marks have been found on four ashlars in the corner of the east side of the tower. However, as they are very generic marks, they could not be attributed to any particular period.
The rest of the surfaces are lime-washed rammed earth pieces 80 cm high, as we can deduce from the marks of the pins used in the building process and which conserve the bond of the brick piers at the corners.

## THE PRELIMINARY STUDY PHASE

An architectonic elevation was drawn up on the basis of digital orthographies in which the stratigraphic analysis of the walls is recorded, and this information made it possible to identify the minimum constructive units present in the tower and the chronolo-

gical relationship between them (fig. 9). Furthermore, an analysis of the floor structure was performed, consisting in the following items: a study of cracks by means of vertical probing in the south wall, an analysis of the foundations by means of vertical probes in the projecting part of the foundation and a study of the land by means of dynamic penetration testing around the tower. The conclusions of these works revealed that the cracks were stabilised and the tower is built with a surrounding 45-cm-thick lime-washed rammed earth wall with two 10 cm thick compact, uniform lime mortar crusts with a high lime content (50%) and good compression resistance (50.5 kp/cm2). The interior mass of the wall is mortar with pebbles and ceramic fragments. This outer wall acts as a retaining wall for the inside of the tower, where there are empty spaces or cavities related with the cracks present in the walls. The filling material shows a slight lime content and is made up basically of clay, tumbled aggregate, fragments of rock and ceramic pieces. Pursuant to the tests carried out, this filling is slightly expansive (marginal critical, according to Lambe's classification).
The tower stands on soil made up of shale with marls, limes and clay and which has a bearing capacity of 4 kp/cm2. The stone of the base is limestone with 420 kp/cm2 compression resistance.
This information was completed with material characterization, which reveals that there are no important differences in the composition of the original mortars, in all cases well-measured lime mortars except for those plasters applied during the repair works, which indicate the presence of gypsum or cement.

## STUDY OF THE PATHOLOGIES

The tower conserved its current volume in the first decades of the 20th century when, as we mentioned above, a dome-shaped bunker was installed on top of it during the Civil War (fig.1). This element may have contributed to the appearance of the existing cracks, which were already there in 1940 when the construction of one of the reservoirs inside the castle began (fig. 4).
The tower presented serious deterioration at the end of the 20th century, when Baena Council performed emergency works to avoid impending ruin; these works consistied in underpinning the north-east corner and repairing the surface of the walls.
In 2007 the tower had superficial dirt, remains of parasitic plants and surface erosion on its walls. However, the most important pathology was related with the existence of a series of vertical cracks in the south and west walls, which affected the interior of the structure, as confirmed by a vertical probe carried out and the presence of cracks at the top of the tower (fig. 12).
The analysis of the floor structure indicates, therefore, that the tower stands on competent ground and the cracks are stabilised, so that they must have been caused by the thrust of the inner mass of the tower, a relatively poor material lacking proper cohesion and with slightly expansive features. The outer wall, only 45 cm thick, has failed to endure the stress to which it has been subjected.

## RESTORATION WORKS

*Structural consolidation*

The works commenced by cleaning and removing the materials accumulated at the top of the tower to restore it to its original level. Then the coping level was reduced to a depth of 45 cm, which made it possible to identify the cracks in the horizontal plane, and proceed to clean it and draw up graphic documentation, verifying that in some cases the cracks were as much as 15 cm wide and several metres deep (figs. 12 & 14). These works were carried out and followed up under archaeological control.
Consolidation started by filling in the voids with hydraulic lime mortar and completing it with different formulations and consistencies depending on each case. Structural stabilisation was performed by inserting a framework of oak laths and stakes in order to create a horizontal mesh that would brace the two levels of the tower's coping. These two planes of framework were also vertically connected with lengths of timber with a view to reinforcing the whole area (figs. 15, 16, 17 & 18).
In order to carry out this operation, vertical perforations were practised with a diamond drill bit in the mass of the wall. This was followed by the introduction of oak wood stakes with an octagonal section of 160 mm of exterior diameter and 2,000 mm long, with a point at the lower edge and a drill hole measuring 18 x 200 mm at the top, where an 18 mm diameter fibreglass rod was adhered with resin. The stakes were caulked with hydraulic lime mortar of fluid consistency and connected at the tip with 30 x 75 mm oak laths with orifices at the end to be connected to the fibreglass rods. The horizontal timber framework is anchored at the bottom of the tower and ensures its structural stability. Finally the timber elements were covered with rubble from the excavation, with the addition of 50% sand and stabilised with hydraulic lime in a 1:10 ratio. The filling was carried out by applying 10 cm layers compacted with a metal rammer to a total thickness of 35 cm. The structural reinforcement system with wooden elements that are concealed inside the solid mass of the tower is compatible with the original materials and guarantees their durability, for oak wood protected with an insecticide and fungicide treatment retains a relatively constant humidity content (figs. 19 & 20).

*The treatment of the roof*

The finish of the roof of the tower was performed with hydraulic lime concrete slabs laid out with different slopes to channel the drainage of water. The border or vertical side of the crossbeam is set back from the surfaces of the tower so as not to be visible from the exterior, conserving the existing lines. Sheet copper gargoyles were installed underneath the crossbeam described above for water drainage (figs. 21, 22, 23 & 24).

*The rammed earth fabrics and treatment of the grouts*

Works on the rammed earth walls began with the removal of the parasite plants lodged in cracks and cavities. This operation was carried out by means of manual procedures, cutting and extracting the pieces by hand, applying herbicide with glisophate

in places where the plants were growing inside the fabric. Then the plasters added in previous repair works that had been recorded in the stratigraphy studies were removed (fig. 9). In general, these were patches of gypsum or mixed mortar, and they were eliminated manually (fig. 13). At the north-east corner the hollow brick fabric that had been added during the repair works was eliminated also.

The treatment carried out on the rammed earth walls depended, fundamentally, on their state of conservation. In the case of rammed earth walls in a good state of repair, where the crust of lime wash was still in place, they were cleaned with a neutral detergent applied with a soft brush or by spraying water at controlled pressure. In the sectors where there were traces of moss and lichen, a preliminary treatment was applied to the surface with a biocide product, which made it easier to remove. This cleaning process was carried out with great care in sectors with reddish and yellowish coloured patinas, which were conserved.

In the sectors of rammed earth with an eroded crust, a similar cleaning process as the one described above was used, eliminating the loose fragments, taking special care not to damage the original surface. Great attention was paid to places where the crust had come away and there were holes, which were injected with hydraulic lime grout free of salt with a silica aggregate (PLM-M) using syringes and catheters. The structural cracks were filled to prevent water from leaking into the interior of the wall. This operation was carried out with hydraulic lime mortar of a suitable consistency to guarantee its penetration, then proceeding to repoint it and give it a sunken finish in comparison with the wall surface in order to allow the crack to remain visible and not try to conceal it. Finally the surface of the whole wall was consolidated with ethyl silicate dissolved in ethanol.

In some of the gaps there were still remains of the timber pins that served as a base for the formwork used in making the rammed earth wall. The pieces of timber were cleaned with a brush and a vacuum cleaner and, in the cases where they were swollen or shrunken, they were consolidated by means of impregnating and injecting them with acrylic resin (Paraloid B-72) in a low-concentration organic solvent.

On the rammed earth surfaces with all the outer crust missing the lost volume had to be replaced by applying masses of lime mortar or concrete, depending on the case, until the original shape of the wall was restored. A lime washed wall that has lost the surface crust that protects it leaves the earth inside the fabric naked, so that it is necessary to apply new surface protection to guarantee its conservation.

In this case, the works began with general cleaning of the eroded surface with low pressure air in order to eliminate the dust and disintegrated materials. Then preliminary consolidation works were performed on the surface with ethyl silicate sprayed on before proceeding to replace the missing material with lime mortar or concrete. When the reintegration volume was under 10 cm thick, the mass was applied in several layers of less than 3 cm each, with lime mortar paste with calcareous aggregate in a 1:3 ratio manually sprayed on. To enhance adherence to the original rammed earth, 12 mm diameter beech wood stakes tied to a hemp string were anchored to the surface to produce a continuous mesh on which the new material could be applied. In cases where the volumes to be filled in were over 10 cm thick, timber plank moulding was installed and covered with lime concrete in a 1:4 ratio, and then chipped and rammed. In this case, wooden stakes with a larger section were laid out to achieve a structural-type anchorage (figs. 25, 26 & 27).

In rammed earth fabrics with fairly serious cracks, structural suturing was performed with timber baywork similar to that described for repairing the roof. On the north side of the tower four horizontal stakes with laths laid out vertically were installed (figs. 28 & 29).

Once structural consolidation and the filling-in of mass had been carried out, a continual superficial finish was applied to unify the different treatments by means of "gap-filling" executed with aerial lime in a 1:2 ratio. This continuous cladding is flattened or sunken according to the original surface depending on the case (figs. 30, 31 & 34). In order to integrate the final finish the texture of the surface was raked and scratched, horizontally defining every rammed earth coffer joint coinciding with the height of each of the original rammed earth coffered walls of the tower. These horizontal lines were adjusted to the work phases, placing metal profiles that are taken away after completing the cladding (figs. 35 & 36).

Then the edges that were in contact with the original remains were carefully cleaned, a chromatic integration was performed by spraying a glaze of black and ochre pigment and the surface was finally consolidated by spraying on ethyl silicate. Finally, the whole surface was waterproofed with oligomeric organosiloxane in a 10% solution of saturated hydrocarbons, also applied by spray until the material was saturated.

*The brick fabrics*

The intervention focused mostly on the corners of the tower, particularly the north-east corner, which had been repaired in the late 20th century. Works were also carried out on the strip of bricks crowning the masonry base.

The brick surfaces that were in a good state of repair were cleaned with soft root brushes and low-pressure water. Then the surface of the sectors with cohesion problems were consolidated with ethyl silicate diluted in ethanol, applied with a brush or sprayed on in several coats, both on the brick and on the remains of mortar in the grouting. In these cases mortar was not systematically applied so as to avoid as far as possible the loss of the original textures, even though they were eroded, except in the parts where the lack of grouting could affect the stability of the fabric. In this case, grouting was carried out with lime mortar in a 1:3 ratio, and it was left sunken at the top part of the tower (figs. 32 & 33), or at the same level as the rammed earth (fig. 34).

In the north-east corner the brick fabric that had existed originally was reintegrated, replacing the hollow brick underpinning added during the repair works. The new fabric was executed with hand-made brick of a similar

format to the original and it was bonded with lime mortar in a 1:3 ratio, respecting both the original bonding and the existing toothing and modulation (figs. 34 & 36). As in the case of the rammed earth surfaces, the ceramic material added was chromatically integrated with a glaze made with potassium silicate paint applied with brushes. Finally sectors with cohesion problems were consolidated with ethyl silicate and waterproofed with products and methods similar to those described for the rammed earth walls.

*The stone fabrics*

The consolidation works on the stone elements focused on the ordinary masonry base arranged in rows and the springing of corner ashlars located at the bottom of the tower. In both cases the grouting that had been added was eliminated and the fabric was cleaned with water pressure, followed by the consolidation, galletting and selective repointing of the fabric joints with lime mortars in a 1:3 ratio, which remain sunken with respect to the surface. In certain places on the north side and at the north-eastern corner (figs. 34 & 36), several ashlars were replaced by sandstone blocks of similar characteristics, although making it clear that they were newly added elements.

FINAL RESTORATION PHASES OF BAENA CASTLE

The restoration of the Torre de los Secretos is part of the preliminary phase of a project to restore the whole of Baena Castle, which will be carried out in different stages. The first stage, already finished, executed between December 2010 and February 2011, consisted in the archaeological excavation of the castle and the consolidation of the historic structures. The second stage proposes to restore the design and urban outline of the fortress by partially replacing the missing towers and walls in contemporary language and formalisation. The third and last stage plans to recuperate the old water tanks and use them as a museum and cultural space.

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English translation by Elisabeth Power

## THE RESTORATION OF THE DONJON OF REQUENA CASTLE (VALENCIA)

The donjon is the principal tower of Requena Castle. It was built in the 15th century beside the Islamic castle in the refurbishment or updating works on the fortress In the Christian era, to guard the northern entrance to the site. Today the tower is an emblematic element of the city, located on the castle hill and the main entrance into the historico-artistic Villa quarter.

The interventions described below focused on the interior spaces of the monument and the roof structure, with a view to restoring them and adapting them for public use as a centre of interpretation of Requena fortress. The works were performed in 2010 and 2011 in two consecutive stages: the first, funded by the Plan de Dinamización del Producto Turístico de Requena, involved the restoration of the interior, and the second, funded by FEDER, focused on the structural rehabilitation and conditioning of the upper part of the tower. Still pending after these works is the restoration of the façades and the conversion of the tower into a museum.

METHODOLOGY. PRELIMINARY WORKS

When drawing up the project in 2008, we had to vie with many unknown facts about the building, because it had undergone refurbishments and adaptation works in modern times, and we saw the need to carry out preliminary studies as the basis of our project. Between 2008 and 2009, Requena Council promoted an archaeological intervention directed by A. Martínez, which we were able to coordinate by planning probes in the pavements and walls of the whole building in order to gather information about the building, history and documentation of the monument. Apart from the probes, archaeological excavations were carried out all over the ground floor. One of the prime objectives was to locate "a fresh water well" described in the oldest documents. This well was found under the modern pavement beside the current entrance. Remains of the prison were found and original loop windows or openings that had been closed up.

During this phase we were able to access the chamber under the roof and see the poor condition of the framework made in 1960 and the brick vault covering the second floor. The problems arising from the interaction between the modern structure resting on the vault, and the vault itself were later studied in greater detail by the engineering firm Incosa. The conclusions of this study gave rise to subsequent more in-depth interventions, such as the replacement of the roof frame or the reinforcement of the vault, which were carried out during the second phase.

Regarding the initial schedule for the donjon, no documentation was found when A. Martínez examined the archives, but other documents appeared that showed that the tower had been used as a prison in the last four centuries. We were also able to analyse the documentation of a project by the architect G. Valentín Gamazo in 1960, which included photographs and notes that revealed interesting data about the recent history of the monument and its state of repair before these refurbishment works were performed. Given the scant information about the building, we had to resort to the archaeological interpretation before starting the intervention, for the process of drawing up the projects and during the works. The archaeological interpretation was performed by F. Blay by gathering essential data from the unwritten historic documentation at some unrepeatable moments during the works, such as, for example, the demolition of the frames or roofs in order to be able to evaluate the design of the restoring process. In all these steps, architects and archaeologists worked hand in hand and all the works performed finally permitted us to discover and restore elements of interest that had been concealed by modern works and learn more about the architecture and history of the tower.

DESCRIPTION OF THE BUILDING

The donjon was built in the 15th century to modernise the Islamic fortress. The donjon

and the remains of two other towers, the "Cubillos", situated on either side of a bridge leading into the castle, are vestiges of these alterations. The tower has a square plan and comprises three storeys. Its thick walls with fabric of local ashlars are built on the rock base. The general appearance of the tower is solid and hefty. Beside the solid volume there is a section attached to it with an interior staircase joining the ground floor with the parapet walk that is united to the tower by a double door with skew arches. This staircase must have been the only way into the donjon, because the current entrance was built at a later date and was opened in the existing wall. The battlements crowning the roof of the donjon contrast with the original ashlar surface and were added on during the 1960 rehabilitation works. The shape of the original parapet is still a mystery and no facts have been found to date to throw any light on the crowning of the tower.

The ground floor was subdivided into two spaces by a large ashlar arch, and contains a well that is 10 metres deep. The well is connected to an ashlar conduit that runs through all the floors of the building and brought water to all the rooms. When it was used as a prison, the well was used to drain the latrines and during the 1960 works it was used as a dump. At the present time the ground floor is accessed from the street through an opening made in the 4-metre-thick ashlar wall. This entrance crosses the conduit of the well. Besides, there are other bays that were also opened in modern times for different prison requirements.

The first floor is subdivided into two rooms covered by plastered brick skew vaulting. One of them housed the prison chapel, which had a small baroque plaster altar. The bays are the original ones, but there are no traces of the original flooring, which might have been made of timber.

The second floor is a large square open space with plastered brick vaults. The hall has two lintelled windows with three stonework pieces. No doubt it was designed as the noble level of the tower. Under the pavement there are some remains of the old prison latrines, because this room was used as cells and lavatories. In 1960 a Catalan-style roof was built over this hall on an independent frame leaning on a reinforced concrete breastsummer running through the centre of the vault. Besides, a coffer was built to give access to the roof and the current battlements. The stairs in the donjon are made of ashlars with stone steps. The different flights embedded in the walls are covered with brick or stone vaults.

## HISTORIC USES

A donjon is "the most outstanding defence of a fortress, conceived as its last redoubt of resistance and which should therefore be isolated from the rest of the fortifications of the stronghold and offer a certain degree of functional economy especially for the water supply," according to Luis de Mora-Figueroa. Nevertheless, the Requena donjon might initially have been conceived as a residential building that could also function as an element of passive defence, due to the design of the water supply and the typology of spaces and bays, more typical of a residential than a military purpose. The ground floor was used as a storeroom for food but might also have been intended as a wine cellar, given the presence of a stone gargoyle with a spout facing towards the interior and connected with a sink in the exterior, which could have been made for an interior winemaking plant of which only this vestige remains (according to F. Blay's interpretation).

But for the moment it has only been possible to verify its use as a prison from the 16th to the mid 20th century. We have a fairly exact idea of Requena prison's layout thanks to the 1947 plans located by A. Martínez and confirmed by the archaeological excavation. After the rehabilitation of the roof in 1960, the building has been used as a municipal exhibition gallery and this use has continued until the present day.

## FUNCTIONAL PLAN. GENERAL INTERVENTION CRITERIA

As no museum programme had been drawn up a priori, the restoration of the interior spaces of the building was designed with the idea of giving the maximum importance to the building itself as a museum in its own right and a centre providing an interpretation of the whole fortress to turn it into the point of departure for a tour around the historic site and a vantage point over the Villa district. The interventions carried out respected the essential characteristics and values of the building and the contributions of different periods that enriched the original values or bore testimony to its history. Compatibility between old and modern materials treatments was a priority.

In the intervention elements that were out of place or in a poor state of repair thus causing pathologies were eliminated. Newly designed elements like stairs, banisters, benches, lights, catwalks, roof housings, woodwork and frames were included. The design of the new elements pursued reversibility and the maximum integration in the monument. To that end, forms, materials, shades and textures related or compatible with the building and suitable for new uses were sought. The project encourages a new look based on the interpretation of the building and its history and focused on the design of the interior spaces.

## DESCRIPTION OF THE INTERVENTIONS

The steps taken in each area and the problems that arose and needed solutions are described below.

### *General treatment of the walls and cladding*

The walls are made of ashlar fabric of local stone, a very porous, irregular lime tuff. Brick was also used in vaults and arches, the stairs and some of the rooms. All the stone and brick surfaces were cleaned by projecting glass microspheres at low pressure in order to remove the outer layer of dirt and lime which concealed the joints of the walls, revealing textures, graphite and stonemason's marks.

The joints and grouting were cleaned and maintained, and the missing parts were filled in with compatible lime mortars of similar composition, texture and colour,

although slightly different from the original. The steps of the stairs were cleaned by the same method and the gaps were filled in where necessary. The original loop windows and bays were retrieved and the fill-in material removed and then they were cleaned and rebonded, restoring the volume in some places with a special stone mortar.

*Interventions on the ground floor*
After excavating and cleaning the well, a glass platform was made to cover the gap and give access to the room. Some Tramex side pieces were inserted to provide ventilation, access and lodging for the installations and to facilitate maintenance works. On the already excavated floor a concrete stone pavement was laid, similar to the lime mortar pavement of the prison, leaving a stone border with an open trench to house the installations.
In the other space, where the excavation is deeper, the same concrete pavement was laid on a surface ceramic deck resting on brick partitions, thus creating a ventilated chamber on top of the rock where some remains of the prison walls still exist. At the deepest part, a gap was left to show the ashlar walls emerging from the rock base. The 1960 stone staircase joining the ground floor with the flight of stairs inside the wall was replaced with a lighter timber one. The latter was installed by resting it on the same points to allow a back view of the ashlar walls and the batter of rocks underneath, since the previous stairs had concealed them. The closed or sealed bays were retrieved, the woodwork of the windows was replaced and the old doors were restored.

*Intervention on the first floor*
The framework of the first floor had been built for the prison in recent times, and presumably there had originally been a timber one resting on modillions and a beam. This modern framework comprised four large timber beams embedded in the walls and logs with little vaults of poor building quality. On the framework, a pavement of clay tiles was laid on top of a soil filling to make the flooring of the first storey. It was in a very poor state of repair. Therefore it was decided to replace the framework, maintaining the oldest main beams and making the new one with rectangular-section pine joists resting on a double wooden deck with a sandwich-type chamber to house the new installations. Besides, this solution offered greater load-bearing capacity for public use. Furthermore, the cladding of the first floor vaults was restored and a few sections were left naked to show how they had been built. The niche of the prison chapel was also restored and the arches and bays were recuperated.

*Interventions on the hall on the second floor*
In the main room of the tower, timber flooring was placed on a plywood deck and crossbeams, instead of the modern clay-tiled floor that was in a poor condition, acting as a technical floor and allowing the installations to be embedded in it. When the clay flooring was removed, the whole area could be examined. The lighting in this room is provided by projectors fitted into the floor, illuminating the walls and vault from below, highlighting the textures of the ashlars and leaving the walls of this noble room free from appliances.
The windows with their window seats at a higher level were restored and wooden benches with illumination were installed. The woodwork of the windows that concealed the original stone jambs and lintels was replaced with lighter panes of glass that allow one to see the shape of the original bay. Besides, the vault was restored and the cleaning, reinforcement and consolidation works described below were performed on the interior of the room.

*Restoration of the vault and roof structure*
The brick vault over the room on the second floor had several pathologies that endangered its stability, so interior and exterior restoration interventions were performed and the roof and framework made in 1960 were replaced. Some of the causes of these pathologies were the lack of ventilation in the chamber between the modern roof and the vault, the lack of waterproofing of the roof and the fact that the framework was resting on the old brick vault.
The vault presented general damp on all the surface because of constant leaks from the roof and condensation in the chamber, which had formed many calcareous precipitations in the interior, deteriorating the ceramic materials and joints. There were also longitudinal and diagonal cracks in the corners and beside the keystone due to the stress undergone by the vault from the structure of the framework of the modern roof. In order to assess the damage and the behaviour of both systems, a structural and material study was performed by the company Incosa to determine the state of conservation of the different elements and the viability of reinforcing or renewing them. Based on the conclusions of this study, the interventions carried out at the top of the donjon during the second phase were as follows:
- Substitution of the framework because of the poor state of the joists, the signs of deterioration in the cement and the low safety factors found in the structural study.
- The main beam was maintained, after repairing it and applying a passivation treatment of the framework and replacing the concrete cladding, since the structural study showed adequate safety factors and removing it might damage the vault.
- It was also decided to maintain the layer of concrete on the vault, improving the connection between it and the resistant section of the vault with a drilled mesh filled with fibreglass rods injected with epoxy resin.
- The intrados of the vault was cleaned, the cracks and fissures were sewn with injections of a very fluid hydrated lime wash, the joints of the brick fabric were consolidated and filled and finally a layer of lime glaze cladding was applied, which leaves the repairs and joints of the vault visible.
- The existing roof was replaced with another lighter waterproofed roof with concrete slopes and gutters and a new gargoyle was added to increase the drainage of water.

*Interventions on the flat roof*
The flat roof was treated as a space of public use, as a vantage point over the Villa

district. To that end a level timber flooring was placed on the new roof. The coffer and closure of the stairwell was replaced with a lighter glass and metal one, eliminating the partitions that concealed the walls and loop windows of this part of the staircase. This new caisson cannot be seen from the street and allows visitors to see the different building stages of this area of the staircase. Furthermore, an illuminated wooden bench was designed to allow ventilation of the chamber. The battlements were only cleaned and there was no information about their initial configuration and no budget to repair them, so that refurbishment will need to be carried out in the future.

*Illumination*

In order to convey to visitors the value of the spaces, architectonic illumination was designed to highlight the walls, the vaults, the stairs and accentuate the most interesting elements. The artificial light is combined with the natural daylight that enters the interior of the building through the bays. The ashlar walls and the vaults are lit up from the floor or ceiling revealing their texture. The well, the gargoyle, the rocks and other remains have also been highlighted by the illumination, creating a scenographic effect.

The lights were located at strategic points: ceilings, flooring or windowsills, in order to go unnoticed. In some cases the illumination was designed to achieve the maximum integration with the architecture, such as, for example, the LEDs on the banisters and the emergency lights on the stone stairs where light profiles were used. Some elements with light were also designed for the roof, like the bench or banisters of the new caisson, which throw a gentle light down so as not to interfere with the view of the Villa at night. All the installations in the building were renovated to adapt them to the legislation in force and public use, passing the electrical and audiovisual installations under the technical flooring for the future use of the building as a museum.

**K. Kallamata**

English translation provided by the author

## THE CHURCH OF ST. GEORGE IN SHIPCKA (ALBANIA)

THE VILLAGE SHIPCKA

Shipcka is a poor village in a mountainous area in South-East Albania, about 25 km west of the town of Korça. The village is inhabited by vllahs, a special autochthonous Latin population very much spread on the area between Albania, Greece and FYROM (Former Yugoslavian Republic Of Macedonia). By the name “Shipiscka” and other indirect evidence it is supposed that the settlement dates back to the early Byzantine period of the Emperor Justinian. The origin of the name itself is an old Slavonic plant named Schipak = the red rose + the Latin local ending -isca> Schipakisca > Schipisca > (ar. Şipisca), (Alb. Shipskë), (Gr.Sipischa, Υπισχια). The “red rose” (a wild rose bush) was a prevalent local plant, and its flower was dried and used to produce a local drink.

Being a close neighbor of or Voskopoja, or Moschopoli (a center which was very famous in the Balkans for its development during 17th - 18th c.) Shipcka was an important center of cattle breeders as well as merchants. During the 17th c. the population grew up to 8000 inhabitants. Nevertheless, the very rapid growth of Moschopoli must have influenced later the migration of the population from Shipcka to the nearby town, as the records tell for a reduction of the population in Shipcka and abandonment of the old part of the village. With the passing years, the village became nearly empty, especially recent decades when most of them migrated to Greece for a better condition of life. Very few families continued to live there trying to survive and taking great care for the most valuable memory they had inherited from the past – the church of St. George.

THE TYPOLOGY OF THE CHURCH OF ST. GEORGE IN SHIPCKA AND ITS RELATION TO THE OTHER CHURCHES IN THE REGION

It is not for sure, but we think that the inhabitants of Shipcka must have built the church when they began to move from the old district of the village to the hill in front of it. The church is dedicated to Saint George, who together with Saint Demetrius are among the most venerated saints of the vllahs, which are characterized also as a sheep breeding population and as nomads in some parts. Their feast days, Saint George’s on April 25 and Saint Demetrio’s October 15, are connected with the sheep migration to the warm places. This very strong connection of the two saints is also shown in this church, where although the church is dedicated to Saint George, the representation painting over the main entrance door depicts also Saint Demetrius. They are depicted symmetrically on horsebacks of their respectively white and red horses.

The church of St. George in Shipcka is a three-aisled basilica with a roofing system made of arches, barrel vaults, vaults and cupolas. Its space consists in a naos (the main hall in an Orthodox church), a narthex, a porch and a bell-tower. Two rows of columns divide naos in three naves, which are covered by many vaults and cupolas. The central nave is larger and higher than the other two at the sides and since the plan resembles the type of the basilica church, this is why this type of building it is called - a basilica, although with many differences. This special type of basilica began to flourish in this region by the end of 17th c. Before that the most used types of churches all over the Balkans were the cross-in-square plans covered with vaults and cupolas (known also as the Athonite type, from the monasteries of the Holy Mount Athos) and the simple one chamber churches covered by wood roofs, or barrel vaults sometimes accompanied with one, or two cupolas. During the Post-Byzantine time (or the time during the Ottoman occupation of the Balkans), provinces retaining traditional architectural concepts began to develop regional forms, which sometimes were dictated by the currents that, in most of the cases, were placing the accents. Such is the case of Moschopoli and the area around it, which due to a high cultural standard and economic strength in 17th and 18th c.,

developed a fascinating architecture in both design and origin, and closely linked with local antecedents complementing architectural and liturgical demands. To this context belongs also the basilica of St. George in Shipcka.

This church of St. George belongs to the Moschopolitan basilica type group. There is no evidence up to now when this church is built, but considering the architecture and the technique, it can be dated by the end of 17th c. This instates it amongst the few earliest examples of this type of basilica in the area of Moschopoli. This type of basilicas spread in a short time all over the Balkans, becoming the most preferred architectural type of 18th – 19th c. churches.

SITUATION BEFORE STARTING THE WORKS

The statically conditions of the church were casting down from year to year. The reason was not only desolation, but also, as we will see later, a mistake made by the builders. During the winter of 2002, the main vault of the narthex fell down, seriously risking the demolition of the whole church and the disappearance of this monument. It was in this moment that Mr. Ioannis Averoff, a Greek from Metsovo, came for the first time in Shipcka. He saw the church and fell in love with it. He decided to save it and he did.

The Naos

*Stability of the construction*

The first restoration works began in the summer of 2004. The building had static problems. First, a specialized equip made by architects, civil engineers, topographers, art restorers and designers made a thorough examination of the monument. There were cracks in the cupolas, and both, the North and the South walls, had inclinations toward outside. The same had happened to the walls of the narthex, creating a situation that terminated to the demolition of the vault. First, it was thought the problem was in the foundations of these walls and there were made several examinations in different points of the walls. Surprised, it was found out that, except of the bell tower, all other foundations of the church were on rock, or hard soil, which never create problems. Excluding the cause of the foundations, we continued to uncover the roof. After removing the first layer of stone plates, we saw that the real problem was standing there. Instead of the wood construction, the builders of the church had build paralleled stone walls, nearly every 30-40 cm, resting on vaults and cupolas, culminating at their height in order to shape the slopes of roof. Over these walls, they had put the stone plate layers. This heavy construction was resting on the vaults and cupolas and together with them weighting down to the columns and the sidewalls. Besides this, the walls had not a technique of good quality. They had good carving and shape, but they had only mud mortar instead of lime mortar, as binding material. The great pressure had caused, first, a vertical sinking of the walls, which had caused also the cracks of the mural paintings and detachment of these parts from the walls. Secondly, the great weight had cracked the cupolas, pushing the thrusts on the top of the sidewalls and inclining them toward outside. We arrived at the conclusion that all this deformation of the building must have happened at a time soon after the building was finished, perhaps putting the builders in a difficult situation. To ensure the standing of the building, they had built later several heavy buttresses around the church to support its walls. These buttresses have the same technique as the walls, which mean that were built by the same masters, immediately, or soon after the church was finished.

*Provisions for the static stability of the building*

The first step for the consolidation of the naos was the removal of the whole stonewalls that were built on the top of the vaults and cupolas. The surface over them was cleaned and some reinforcements were made. The North and South walls of the naos, which had the inclinations toward outside, were tight by four metallic rails. Big metallic cross-shape heads were used at their ends, in order to tie up as much surface from the wall as it could. The vaults and cupolas that were cracked from the heavy weight were strengthened and consolidated. Some of the buttresses, which were demolished by the time, were rebuilt. This was made for several reasons: first, their presence was part of the history of the monument, a live document of a very early restoration; second, their function was still needed; and third, a drastic change of the church outside view will have happened by removing them. After all the surface over the vaults and cupolas was cleaned, the roof was reconstructed with wood construction to give less weight to the building. It saved the same slope and it was covered with stone plates, as before.

The Narthex

*Architectural changes on time*

The narthex had nearly the same statically problems. But it had also several changes during times. First, the whole narthex was built more as an open space covered by barrel vaults resting on arches and columns. It was quite opened to the North and the South and this type of an opened narthex, at both sides, proved to be a very rare case in the post-byzantine church architecture. The narthex had six columns at the beginning of its construction; two in each side and four in the middle. So the space was divided in three naves, which were connected by arches at the East-West direction and by barrel vaults over them at the North-South direction. The narthex has stayed opened for quite enough time. Then, perhaps having statically problems, the North and South arcades were destroyed and the builders had removed them off and had built stone walls instead, transforming the space of the narthex in a closed area, with only four columns in the center. Such evidences were found when the North and South walls of the narthex were removed. Parts of the fresco paintings, which were continuation of the scene of “The Last Judgment” painted in the narthex, were found after removing these walls. The carved stones of the first row of arches, serving for their support, were found also behind these walls. These stones were not removed from their place. They were consolidated and the discovered parts fresco paintings were restored, too.

*Restoration of the typology of the narthex*
The disappearance of columns and arches at its sides and their replacement by stonewalls had changed dramatically the architecture of the narthex. The decision for a complete restoration was essentially important for this unique typology. The walls, which were added later, were in a very bad condition and this was a great help for taking the decision to remove them. We had to rebuild the original shape of the narthex. Only a small part of the later walls was let at the South-West corner of the narthex, as a document for those interested in the history of the church.

*Restoration of architectural elements*
The four old original columns of the narthex were removed and their foundations were reinforced. Then they were put again at their original position. Two new columns were added at each North and South sides of the narthex. The stones were taken out from a carrier opened very close to the church just for this occasion. The aim was to make them from the same stone as the old ones. The new columns were also carved in the same size and shape as the originals.

The Exonarthex
*Restoration of the porch*
The porch also had a considerable inclination toward outside, due to the thrusts that had demolished the central vault of the narthex. Since the roof was removed and they were free of the weight, these small columns made by monolithic stones were easily brought to verticality one by one. They were cleaned and connected on the top by new wood girders, which had to support the eaves of the roof.

*Restoration of the west entrance wall*
A very delicate process was the stabilization of the West wall of the narthex, or the East wall of the exonarthex. This wall was inclined toward the porch, risking also its existence. The main problem here was a considerable surface of fresco painting made over the main entrance door. The painting depicted the donators, a couple, a man and his wife, donating the church to the Saints George and Demeter. The most interesting detail in this painting is a representation of the church, where it is shown the naos with its cupolas under the roof with stone plates and the narthex with its opened north side, giving access view to the columns inside. This representation is according to the original shape of the narthex and in accord with our conclusions after studying it. The situation of the fresco painting was in a very bad condition structurally as well as esthetically. The stones of the wall had mud for bounding and this material was deteriorated through the times.
A very careful work followed its consolidation. First, the works started with the consolidation of the structure of the painting. Then it continued by bringing the wall in verticality, pushing it by jets but without removing the painting from the wall. This was a very delicate process, which needed many preparations before acting. The consolidation of the wall was made by injecting a mixture of mud mortar inside its structure.

The Bell-tower
The bell tower was in very bad shape. A part of the foundation was sunk in the soil and this had given an inclination in two directions twisting it like a torso. It was nearly impossible to bring it in verticality. The only solution was dismounting the carved stones, rebuilding new foundations and the tower itself again. So it was done. The same stones and the same technique were used and exactly the same details were preserved.

*Mural paintings*
The situation of the mural paintings was not satisfactory. The movement of the structure had resulted in many cracks of the frescoes. Besides this there were many parts detached from the walls and some other parts were fractured. Some bad consolidations, which were made in previous decades, were removed and a professional restoration work followed. In some parts it was necessary to work in the same time for the restoration of the architecture and of the paintings as well. All the work was careful done, from consolidation to cleanings. This work not only saved these frescoes, but brought in evidence their quality, too.

*The restoration of the iconostasis, icons and wood elements in the naos*
The beautiful templon, or the iconostasis of this church is built after the typical style of 18th c. It is a half-flat carving, which has been painted with a gold-like color. It had been very dirty by time, smoked by candles used in church. Specialists and restorers from the Museum of Medieval Arts in Korça came at this church and worked for the restoration of this templon, restoring at the same time all the other wood elements of the interior. So were four beautifully carved wood candlesticks, two book holders and a fine carved prosqinitarios.
The original icons of this iconostasis were taken out two decades before in order to save them from rubbery and they were stored in the Museum of Medieval Arts in Korça. We were allowed to make copies of them and several icon painters were engaged for that. Now some excellent new art works, decorate the templon of the church of St. George in Shipcka.
Thrones and seats of the naos were restored, too. They had very interesting decorations, each one varying from the other. The restoration preserved the original elements and decoration.

*The Cross*
The big Cross, over the central part of the templon was damaged and made very dirty by the birds, which had found shelter inside the church. Some decorative parts in the arms of the Cross were missing. We dismounted and send it to the laboratory of the Museum of Medieval Arts in Korça. A careful work, made in a couple of months, brought in sight a wonderful 17th c. artwork. The missing parts were restored with the same materials and techniques.

*Lights and electrical installations*
Professional specialists were engaged for lighting the church interior and exterior. The electrical lines had to be invisible and

the lights, too. For this a good cooperation of electricians and painting restorers helped to satisfactory results.

*Chapel of St. Nahumus*
A small chapel dedicated to St. Nahumus was added to the South wall of the naos of St. George. Nahumus together with Clement were disciples of Cyril and Methodius, who in 10th c. invented the Glagolythic alphabet and made possible the old Slavonic writing. Nahumus and Clement translated many liturgical texts and opened many schools in this region living an unforgotten memory to its population. They were proclaimed as saints firstly by the independent Archbishopric of Ohrid in 18th c. at a time when this archbishopric was fighting for the preservation of its independence and authority from the Patriarchy of Constantinople and later they were proclaimed as saints by all Slavic churches.
The chapel of St. Nahumus at the church of St. George in Shipcka, although it is a later building, it has a very simple architecture, a rectangular chamber and is nearly without architectural decorations. But there is a wonderful fresco painting in the apse still preserved. The painter, who is anonymous, seems to be a great master of his time. I join Karin Kirchheiner's view that this painting is more likely to belong to painter Terpo, the son of Constantine from Korça, one of the nicknamed "Zographi Brothers". It belongs to the end of 18th c., or the very beginning of 19th c.
The chapel of St. Nahumus was in a very bad condition, too. Some considerable restorations were needed for the South wall, for the the roof, the ceiling, and the windows and besides these, for the paintings. A group of young restorers from the restoration school of TEI in Athens took over most of the processes for paintings restorations.

*Environment & fence walls*
During all the works for the restoration of the church we tried as much as possible to protect and preserve the existing environment. The courtyard of the church is considerably large and there are the cemeteries of the village. Many of the old graves have their old typical stones, in cross shape made of a porous lime stone, locally known as çmerç (or chmerch). The trees and the greens were preserved. Some of the fence walls were restored and also the small entrance door portico.

*Old barn in front of the church*
Outside the church territory, near the main road, there was an old barn. It was Mr. Averoff's idea to restore it and use it as a cafeteria, for the visitors of the church. The building was a simple construction with stone walls and a roof covered with straw. It had only two rooms. During the restoration, we tried to save its simplicity and especially the straw roof, which before was a very common feature in the landscape of the village.

EPILOG
The works for the restoration and conservation of the church of St. George in Shipcka were leaded by the strong requests to preserve as much as possible the unique artistic and architectural features of the monument very important for the history of art and architecture of the region; to preserve the great values of this monument, which were resting upon a vast simplicity; to preserve its very human aspect as well as its divine one; to preserve its nature in the midst of a wonderful, very close to a paradise landscape; to preserve the deep fillings and emotions it has given to the habitants, visitors and other people through the times since it was created.
The ever growing number of visitors and especially the coming back of the migrated inhabitants, who, as soon as they heard that their beloved village church was restored, began trying to reconstruct their houses, was the most significant sign of our success of work. A new life has begun in the village. There are visitors in the church every day. The cafeteria is humming, offering to them the natural food products of the village, like cheese, tasty meat and the famous raki of Shipcka.

**V. Vegas & C. Mileto**
English translation by Elisabeth Power

## RESTORATION OF PRE-INDUSTRIAL BUILDINGS IN ADEMUZ (VALENCIA)

Our small rural settlements usually lack important buildings that deserve to be considered monuments or sites of cultural interest, with the possible exception of village churches. The conservation of their built fabric and their vernacular architecture depends perilously on the sensibility of the inhabitants, the political authorities or the architects who are going to carry out the work. However, these settlements often possess vernacular constructions dating from pre-industrial economic times that can well be given the category of little local monuments. These are the bakeries, gypsum or lime kilns, roof tile kilns, forges, charcoal kilns, hydraulic irrigation infrastructures, fountains, drinking troughs, communal laundry spaces, fulling mills, oil mills, wine presses, wine cellars, distilleries, barns, corrals, dry stone huts, apiaries, etc. They are quite often the only public buildings in the village and, more than in any other case, they safeguard the memory of local culture and history.
The restoration and enhancement of these pre-industrial buildings is justified since they are repositories of the living memory of the area and transcendental monuments in the rural settlement where they are located. In most cases, these restored buildings are museums in their own right, either because they preserve the memory of a pre-industrial activity for nostalgic reasons or with a didactic purpose or because of the difficulty in finding a current use for buildings with a very particular shape, such as bakeries, fulling mills, aviaries, etc. In other cases, where the relevant fittings, referents or tools are missing, it is easier to rehabilitate these buildings for other uses, principally as dwellings.
The main problem arising in the restoration of this type of pre-industrial building and vernacular architecture in general, whose most important features reside in the use of barely transformed local materials and on

the naturalness, spontaneity and immediacy of their manufacture and enhancement, is how to go about the intervention while maintaining their original condition. The restoration is a deliberate, well-thought-out and conscious process whose main aim is to repair or recuperate a damaged building for a particular purpose. The application of this deliberate modern process on an architecture of an immediate nature, a skilful initiative on a building characterised by its faithfulness, a premeditated action on a spontaneous construction or a semi-industrial or, at the outside, semi-craftsmanlike operation on a manufactured object, involves myriad problems if the vernacular character of the building is to be maintained.

Francesco Giovanetti quite rightly said recently that it would require a serious effort to ruin the Palazzo Farnese in Rome, whereas the slightest act would be sufficient to spoil forever a little house in a village. At the beginning of the 20th century, the famous critic and architect Adolf Loos made a similar statement, pointing out how hard it was for architects of any time and place to work successfully on built vernacular contexts, precisely because of their lack of spontaneity. Indeed, restoring a vernacular construction is often a far more complex and delicate job than restoring a palace. In fact one must tread very carefully so as not to strip the essence from these vernacular rural constructions, so fragile and delicate, precisely because of their manufactured character. Francesco Doglioni has skilfully described the difficulty of adapting contemporary language to the restoration of vernacular architecture because of the possible distortion of the sense of traditional construction, thereby turning it into an ethnic museum piece. Indeed, the restoration of these architectures involves a great risk of turning the building into an exhibition piece not only due to the introduction of new languages that generate distance and alienation, but also due to the lack of the vernacular spontaneity mentioned above. Therefore, the restoration and adaptation as museums with a didactic purpose of this dozen humble little buildings related with pre-industrial architecture in the parish of Ademuz attempted not to perturb the aura of these constructions and keep the memory of their past alive with the same naturalness as though they were still in use, trying not to make them look artificial or petrify their memory. The main challenge to face up to in these works on a limited budget consisted in putting right the complex material and structural pathologies of these constructions and rehabilitating them so that they could be visited by the public, conserving at the same time the materiality of their patina and the uniqueness of their aura.

## THE PRE-INDUSTRIAL BUILDINGS IN ADEMUZ

Over a three-year period, the Plan de Dinamización Turística (Tourist Promotion Plan) for the parish if Rincón de Ademuz, 50% funded by the Ministry of Industry, Tourism & Commerce and 50% by the Commonwealth of Municipalities of the Rincón de Ademuz, invested a small sum of money mainly on the recuperation of a number of abandoned pre-industrial buildings in the area. The authors of this article, who are also the authors of the study entitled Homo faber, oversaw the choice of buildings to be rehabilitated in the whole parish and personally accepted the commission of restoring some of them in the area of Ademuz. The restored buildings were: two gypsum kilns, two tile kilns, a fountain, a drinking trough, a laundry room, a fulling mill, a bakery-cum-school-cum-barber's shop and a wine press and cellar. In general the buildings remained in their original state and had not been subjected to important repairs or restoration works, but presented serious problems of conservation or functional efficiency. The total budget for the restoration of this dozen buildings amounted to €200,000.

### *The gypsum kilns*

In a region where gypsum is the predominant building material, used for making large structural pillars, vault flags, pavements, walls, flagstone partition walls, adobe reinforcements, filling for cane roofs, renderings, nooks, shelving for pitchers and jars, olive bins and other interior elements, the gypsum kilns that have survived until the present day are of prime importance. In this case, two gypsum kilns conserved in the village of Sesga, one at each end of the town, which were abandoned and partly destroyed, were restored and enhanced. The restoration of the gypsum kilns consisted in merely repairing the fallen parts with dry masonry and crowning the actual kilns, but also conditioning the floors for grinding the gypsum which lay at their feet and placing two frusto-conical pieces of ground gypsum on the respective grinding floors, which were found where they had been placed to be used as milestones, taken up and put back in their original places. Besides, in one of the kilns, the existence of a batch of gypsum ready to be fired made it possible to complete the didactic character of the works along with the untreated gypsum stone stored there.

### *The tile kilns*

The large amount of stone to be found in this parish meant that brick had never been required for vernacular constructions, but the use of tile roofs since ancient times and ceramic-tiled wine presses since more recent times called for the need to have tile kilns in the area to meet the village demands. We were aware of the existence of at least three tile kilns in this place, one of which had recently been demolished. The second tile kiln, located in the village of Sesga, was not only all in one piece but during the restoration we found the old storeroom beside it, with all the tools and instruments necessary for making tiles still there: a cart for carrying clay, trowels for mixing, trowels for levelling, volume measures, moulds, half-burned logs for the fire, etc., all of which could be recuperated and added to the rest. However, the tile kiln, a stone masonry fabric lined on the inside with brick fabric to keep the heat in, with a base of fretwork arches over the combustion area and covered with a false slab and tile dome in successive layers, had a serious conservation problem. One of the internal layers of the brick fabric on the inside, about 2 m high, had an unbelievable bulge towards the inside of the kiln

of over 60 cm at the centre, and threatened collapse at any moment. In the first place, we proceeded to clean the interior, which was full of rubbish, and then placed several horizontal props on boards to distribute the pressure and tried to retrieve the vertical geometry of the bulging wall. After several days of progressive pressure, the original bulge was reduced 33 cm. In any case, the wall was no longer stable and as soon as the props were removed, the bulge returned, so it was necessary to contain it. After a trial consisting of injecting between the masonry wall and the brick wall lime mortars, PLM lime micro-mortars and acrylic resins, which turned out not to be effective due to the existence of a damp filling with no cohesion between them, it was decided to place contention braces there. The total thickness of the wall, which amounted to 1.4 m, and the extraordinary hardness of the lime masonries made it difficult to perforate it, taking into account the limited budget available. After several tests with a drill prolonged by a welded rod, we realised the internal brick wall was being damaged and that it was difficult to achieve a good result, so this solution was discarded also and a final alternative was sought consisting in permanent shoring with two planks inserted at the corners of the brick fabric that contain the central third of the bulge, which were stained with mud so that they would be better integrated in the context of the kiln. Furthermore, the oculus and extrados of the false dome were repaired, the thread of the entrance mouth was repaired and the lower grate of the kiln was mended.

The third tile kiln, located on a hill outside Ademuz on the road to the village of Sesga, was half collapsed due to the pressure of the earth from the hill on which it was leaning. A sapling had grown inside it and the original ceramic kiln could barely be distinguished. The intervention on a semi-demolished structure was not guaranteed to be as successful as the previous one, which was conserved with its site, character and tools intact. In the first place, we proceeded to clear away the soil and excavate the kiln carefully, saving the pieces that gradually appeared. Once the excavation was completed, we found that the corner and two interior brick walls had partially collapsed and that the rest of the masonry and brick fabric, the lower grate and the higher false dome, with a much wider oculus than the other kiln, were all intact. A first impression of disappointment at the state of ruin of a building to be restored provides a pleasant surprise if you find that it is better conserved than you initially believed, if you are careful to clean and study the remains with patience. We then considered the way to repair the remaining kiln and reconstruct the missing corner. To begin with, the masonry retaining wall was mostly rebuilt as a drywall construction, to allow water from the hill to keep seeping in without having to support the pressure of the damp earth afterwards. Furthermore, a drainage area was prepared to divert the water towards the sides of the kiln. Later, the inner layer of bricks was reconstructed using the pieces found when clearing the site. The lack of sufficient pieces to fill in the gap, the fact that many of them were broken and a desire to distinguish between the original part and the reconstructed part prompted us to reconstruct the interior part of the wall in a cut-header pattern, as opposed to the old fabric that was made in a stretcher bond. This partial reconstruction does not stand out much in the current restored building and only those who pay close attention to these details will notice the difference between the old walls and the reconstructed ones.

*The fountain, the drinking trough, the laundry room and the fulling mill*

This is a connected group of hydraulic infrastructures still partly used by the residents in general, sheep and the women who go there to wash clothes, respectively, except for the fulling mill, which was no longer watertight and had sprung a leak. The ensemble looked genuine and original, except for a few patches of cement mortar, concrete floors, metal posts, cables, anachronistic posters and a fairly good contemporary sculpture that was completely out of place. Furthermore, there were some pathologies in walls and roof, apart from a problem of contamination of the water from the source in the gully above that needed to be solved. The work in this case was limited to repairing the existing pathologies and eliminating or relocating the distorting elements to restore coherence to the whole site. As regards the pathologies, the leaking roof of the laundry room was retiled; the laundry room walls and the retaining walls were repaired; the pipes of the fulling room were repaired and watertightness was restored; flooring stained with earth from the gully above was laid down to prevent the water of the fountain from becoming contaminated; a rough set of table and benches of natural stone that had lain at the foot of the fountain since olden times were repaired also. And as regards the distortions, the cement mortar patches were chipped away and the gaps in the masonry fabric were grouted with earth similar to that originally used; a large amount of the unnecessary concrete flooring was removed so that grass could grow around the drinking trough as it had in the olden days; the superfluous metal posts were removed and the lighting fixtures were moved to a discreet position, beside a tree, and a new light was installed inside the laundry room; the anachronistic posters were taken down and replaced where necessary by more appropriate ones; and the contemporary sculpture was moved to a different site.

*The cellar-cum-wine press in Ademuz*

Commonly known as Tío Maroto's Tank (tank is the local name for a wine press), it is a three-storey building with the entrance from the front street on the ground floor and from the back street on the second floor, which had survived until the present day with all its tools and equipment in their original state, despite a few patches of cement mortar and a staircase of prefabricated concrete joists for access to a place to pour the grapes into the press to be trodden by feet. Its state of conservation was delicate in some places because the constant leaks from the roof had fairly seriously damaged the gypsum vaults. In the first place, we proceeded to catalogue and store all the tools and equipment inside in

order to restore the building. The restoration began with the roof, whose cane deck was repaired and completed with fresh cane; a layer of gypsum was laid on top as filling, a transpirable waterproof layer was laid on that and the tiles were put back in place on top. The interior flag floors were aired and dried so that the gypsum in the vaults could recuperate its structural resistance and reinforcement with a compression layer of gypsum was designed to guarantee the maximum compatibility with the existing floors.

It was not only a question of working with materials and systems of local tradition, but above all of avoiding the many shortcomings of the concrete in the usual compression layers: excessive weight even when arlite is used in the reinforcement; harmful construction damp passed on to the gypsum in the vaults and the timber; lack of transpirability in the concrete; incompatibility of the concrete pH with that of the cellulose in the wood; incompatibility of the iron in the mesh with the sulphates in the gypsum; possible concealed generation of expansive products like ettringite and thaumasite due to the combination of cement and gypsum; frequent inefficacy of the connectors because of the creation of loose patches in the timber as a result of the great difference between the elasticity of concrete and wood, etc.

On the contrary, gypsum, a material found everywhere, including in the structure of local architecture, weighs three times less than the more commonly used concrete with similar results regarding structural reinforcement, and is perfectly compatible with historic gypsum and timber since it has the same degree of hygroscopic, transpirable and elastic features. The electrically welded mesh in the compression layer of concrete required for constructive reasons to avoid cracks due to retraction and structural reasons to absorb shear loads would only be necessary for the latter function, given the slightly expansive character of gypsum while it is setting. In any case, due to the incompatibility of iron and gypsum, a vegetable reinforcement in the form of a knotted cane netting was conceived.

The cane (arundo donax), also known as "vegetable steel" in other contexts, is not only a material available in the area, but has extraordinary structural characteristics and, like any other vegetable, is perfectly compatible with gypsum.

Before pouring on and smoothing the gypsum of the compression layer, the knotted cane mesh was screwed on to the upper part of the joists to act at the same time as a connector, all the required electric cables were placed in the exact spots where the lights were to be installed on the floor below and in the vertical shafts between floors, and plate-shaped braces were anchored to the façade wall and screwed to the wooden joists parallel to it. In order to avoid undesirable reactions with gypsum, zinc-covered screws were used and the plates were coated with a protective resin.

Furthermore, two staircases were constructed to facilitate fluid movement between floors: one from the ground to the first floor, replacing the staircase of prefabricated concrete joists, where a spiral timbrel vault was used to permit access to the floor above and not to the wine press; and a previously inexistent linear staircase led from the first to the second floor, on timber joists, occupying an emptied vault next to the side wall.

The cement mortar patches were eliminated and the new lime mortar grouting was applied in a convex manner, without emphasising the grouting between the stones to prevent it from looking unnatural.

Finally, relatively concealed spotlights were installed to light up the space without being too prominent, connected with an independent power system located in the electricity panel in an outer wall of the building, concealed behind a wooden shutter, which also acted as emergency lights. Once the restoration of the building was finished, all the tools and equipment found there were put back in their original position, making sure at all costs that the building would not look like a museum.

*The bakery-cum-schoolroom-cum barber's shop in Sesga village*

This is an exceptional building in every sense, not because of its architecture, its construction or its structure, which are modest and would go unnoticed, but because of its extraordinary contents. Indeed, both the bakery on the ground floor and the barber's shop and the schoolroom on the upper floor have been perfectly preserved as they were originally and conserve all their furniture, equipment, tools, etc., to such an extent that they are capable of evoking strong feelings in those who visit the building. However, at the same time, the building was suffering from important pathologies that had to be resolved, such as the collapse of the main façade onto the street, the existence of leaks in the roof, dry rot at one end of a major girder and splitting in two major girders, as well as the collapse of two vaults in the barber's shop, which oozed damp, the partial collapse of the lavatory at the back, the cracks in the rendering of the façade and the damp in the retaining wall of the bakery against the land, along with a myriad of minor problems.

Despite the importance of the pathologies to be corrected, the aim of this intervention did not reside in simply repairing them, but in doing so without affecting the character, the human aura and the evocative power of the building. The first step was to classify, withdraw and carefully store all the movable objects in the building. Then the roof was dismantled to repair the layer of shingles on the purlins, add a reinforcement of gypsum and a transpirable waterproof layer and then put the same tiles back in place again. During this operation the tile eave resting on the side wall was repaired in situ, because it would have been impossible to reproduce its bonding with trowelfuls of mud mortar if it had been dismantled and because it would have become thicker due to the material added in repairing the roof. For that reason, the thickness of the roof reinforcement around the eave was reduced and the retiling was adjusted to the eave tiles repaired in situ, which acted as a guideline for the repairs. Before retiling the front part, plate-shaped braces were anchored to the façade wall and screwed to the wooden joists parallel to it, in a similar way to the procedure followed in the wine-cellar and press.

It would have been so difficult to replace the girder with one end rotten because it would have meant replacing at the same time the upper floor and it would have been very hard to find a similar one, that it was shored with a permanent transom placed axis-wise on the girder underneath. The ring shake was stapled with two pins and the fallen gypsum vaults were repaired with formwork similar to the historic one. The last third of the back lavatory was rebuilt archaeologically with the pieces found there, allowing the mortar to mark clearly the difference between the historic and the reconstructed parts. The gaps in the external layer of gypsum were filled in with lime mortar with a similar appearance and the cracked plaques were consolidated and sealed in situ. The internal damp in the retaining wall against the land on the bakery side was resolved by excavating on the outside, extracting the soil, mixing it with 10% lime and putting it back in place, so that it would be transpirable and yet waterproof to a certain extent thanks to its stabilising lime content. Besides, flagstones, pebble pavements and boarding were repaired; the furniture, woodwork and joists were treated with linseed oil; the windows were adjusted; some internal graffiti was consolidated with an image of the Virgin Mary, etc.
Two aspects of this intervention involved special risks because they might have affected the genuine character of these three rooms: the installations and restoring decorum to the interior. It was a building that had never had lighting (electricity first arrived in the village of Sesga in 2001), so it was not only necessary to deal with the course of the electric cables, which were run through the cracks in the walls before bonding and were distributed to the light points from the little attic above, but also the location of the lights, which had an important effect on the perception of the space and the building. In fact, we discovered that lighting from the sides made the objects and the whole setting more museum-like whereas functional central overhead lighting blended in better with the evocative atmosphere we wished to conserve. Finally, once the leaks that had damaged the interior of the barber's shop and the top of the schoolroom had been repaired, the affected parts had to be painted or whitewashed. But, especially in the schoolroom, the overall application of a coat of whitewash would have interfered with the human factor, because the little hands of the children had formed a natural dado by staining the walls at desk level. For that reason, the whitewash was thicker at the top than in the area of this natural dado so that it would not cover it completely, so as to restore decorum to the degraded parts but respect the patina caused by use, which had the power of evoking the lived space in a natural manner, our main aim in the restoration of this group of buildings.

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English translation provided by the authors

## DENDROCHRONOLOGICAL DATING FOR THE STUDY OF HISTORICAL BUILDINGS

*Definitions and principles*

Dendrochronology is the science that studies the growth rings of trees in relation to time. It is based on the principle that the annual ring width is largely influenced by the conditions under which the plant has grown, especially by the climate.
Although Leonardo da Vinci already identified the theoretical basis of this science in its Treatise on Painting, Book VI: "Trees and vegetables", dendrochronology in its present appearance was codified by the American astronomer Andrew Ellicott Douglass in the early decades of the past century.
Since then, this science is divided into several sub-disciplines, depending on the scope, the most important among them are the dendroecology that studies the dynamics of forest ecosystems and vegetation, the dendroclimatology, which has a key role in the reconstruction of climate past, dendroprovenancing, which deals with determining the most likely geographical origin of the timber. The list could go on and on (dendroglaciology, dendropyrochronology, dendrochemistry, ...) due to the large amount of applications. Suffice it to say that dendrochronology has also been used to analyse economic and social dynamics (Gil Montero and Villalba, 2005), periods of famine and pestilence, up to the study of the quality of the vintages of the past (Bourquin-Mignot and Girardclos, 2001 ). The dendrochronological dating, which in Anglo-Saxon countries is known as a dendroarchaeology, is just one of the articulations of dendrochronology.
Each sub-discipline has developed highly specialized methods and procedures. The lines that follow will deal exclusively with the dendrochronological dating, with some reference to the analysis of dendroprovenancing.
The dendrochronological dating is a technique that allows dating a wooden artefact, with a resolution to the single-year or less. In Italy, the rules for dendrochronological dating can be found in the standard UNI 11141, 2004.
As mentioned, the technique is based on the laws that regulate the formation of growth rings. In temperate climates, the seasons determine periods of intense growth in trees alternated with periods of reduced growth, which often end with the vegetative stasis. This rotation causes the formation of rings in trees, each of which consists of two slightly different wood tissues: the earlywood, which is formed in the most favourable season to growth (in spring and the summer), and latewood, which is generated before the winter stasis. The alternation of the two tissues allows us to distinguish a ring from the other: usually the light side of the ring is the earlywood, while the latewood is dark. The width of each ring is a function of environmental conditions, and climate in particular, where the plant lived. If these conditions act on a rather large region, the growing patterns of many plants are synchronized (Fritts, 1976).
In practice, the dating of an artefact is made by measuring the width of a sufficiently large number of consecutive rings, thus developing a "tree-ring series" which

is then compared with a long reference series, called master chronology, useful for the same species and the same geographical area (Figure 1). By comparing different tree-ring series (cross-dating), feasible both visually and through statistical tests, the chronologies are synchronized, i.e. that of the artefact in question is located in an area of the reference where the similarities in terms of growth ring are more evident. Once the synchronization is made, we are able to determine the year of the last ring measured on the artefact, which does not necessarily coincide with the year in which the artefact itself was made, as discussed below.

Evidently, the construction of long reference chronologies is a prerequisite in the dendrochronological dating. They must be as longer as possible and reliable, and they represent the basis of comparison for the dating of the series realized on individual wooden objects. For some species and geographic regions chronologies made in the various international laboratories now make it possible to go back in time for thousands of years. Irish oaks for over 9,000 years ago (Brown and Baillie, 1992), while for the German oak and pine now surpass 12,000 years (Friedrich et al., 2004). These chronologies have long proved to be essential, among other things, for the calibration of the radiocarbon analysis. The choice of the correct reference chronology is a crucial moment for the success of dating. Ideally, the reference chronologies should be long enough, refer to the same species and geographical area of the wood to be dated and sufficiently replicated, which consist of a large number of samples, such as to ensure a wide applicability. When you do not have access to chronologies of the same species may use different species for the same area, provided that the analogy between the growths in the two species is demonstrated. In Italy, this comparison is called etheroconnection. In contrast, when the species is the same, but the geographic area is changing, it is called teleconnection. In this case, however, relations between series should be demonstrated.

The extensive use of wooden structures in the past, the presence of large cross-section structural elements, so often rich of growth rings, and the use of species suitable for dendrochronological dating led to a series of favourable conditions which have caused that in the field of historic buildings the applications of dendrochronological dating are numerous. Since the birth of dendrochronology itself (Judd, 1930), there have been numerous dating of structural elements, the identification of phases of construction, restoration, re-use, tampering, so that is difficult to give a bibliographic reference due to the vastness of the material. Worth noting how, through the analysis of architectural structures it was possible to shed light on an entire civilization, the natives of North America known as the Anasazi (Dean, 1988 and many others), and Eckstein (2007), analysing the wooden elements in some buildings in the city of Lubeck, provides an overview of the retractable amount of information from this kind of studies, which are not limited to only dating, but also contain information on the amount of timber used, the identification of the woodland stand used to supply, the origin of the material, the forestry practices used in antiquity and much more.

*Requirements for the application of dendrochronological dating*

The dendrochronological dating is reliable, accurate and effective only on condition that certain requirements are taken into account. To ensure that potential users do not lose confidence in this important method of dating is critical that they are adhered to strictly.

These requirements are (Bernabei, 2010):

- The artefact to be submitted to date must show an adequate number of rings visible and measurable. Dendrochronology is a science that is based on statistical correlations: the higher the number of data compared, the greater the reliability of results. Although there is no universally accepted minimum value, a reliable series is made by reading at least 60 rings;
- The artefact must be made of a wood species suitable for dating. Riverine tree species (poplar, willow, alder, ...) or subject to heavy human disturbance (fruit, chestnut, walnut, ...) are not suitable for dendrochronological dating (Bernabei et al., 2007) because their growths are not primarily influenced by the climate;
- There must reference chronologies suitable for the species and geographical area considered.

In light of these observations, it is evident that there are cases where the dendrochronological dating encounters great difficulty or is even impossible. For example, 98% of panel paintings of the Italian Renaissance (Fioravanti, 1994) is made of wooden planks of poplar (requirement 2: species not suitable), which often have only few, but very large rings (requirement 1) and finally reliable reference chronologies are not available(requirement 3).

In the field of buildings of historical and architectural interest, very often these conditions are met: the species are the most suitable (oak, larch, fir, pine, ...), the number of rings measured using a targeted sampling (see below) is often sufficient and, most importantly, there are now many reliable reference chronologies, covering various periods in history for many areas and for many species, especially in Europe. An important reference in this sense is provided by the International Database, available on the U.S. government website http://www7.ncdc.noaa.gov, which provides a large number of chronologies reliable and dated from all around the world. For Spain alone it brings more than 60 chronologies.

*Sampling*

The aim of dendrochronological sampling is the measurement of the width of growth rings in the radial direction, the one that goes from the pith to the bark. This applies to both the cross section, for example, the head of a beam, and to the longitudinal radial.

The dendrochronological dating technique offers the possibility to calibrate the sampling according to the specific needs and thus depending on the conditions of work,

the importance of the artefact, and so on. We can distinguish sampling methods non-invasive or invasive and among them the destructive ones, semi-destructive and non-destructive .
Among the invasive and destructive methods we have the removal of portions of beams, a practice not uncommon in cases of restoration of degraded elements, especially in parts of contact between wood and masonry. For dendrochronological analysis it is enough to have a 4 – 5 cm thick section perpendicular to the length of the beam (Figure 3A), for the direct measurement of the rings in the laboratory using the appropriate instrumentation.
In an invasive, but non-destructive, way, sampling on the beams and other structural elements can be made with electric core drilling (Figure 2A and B). They are corer specifically designed for wood work, which should be applied to an electric drill. Usually these systems are considered semi-destructive, as they cause holes having a diameter of about 1 to 2.5 cm and would thus have a strong visual impact. The use of the electric drill, however, may cause problems of overheating, and the resulting deformation of the samples, and therefore it is sometimes prefer the hand corer.
This tool (also known as the Pressler corer, increment borer in English) is always invasive, but producing holes as small as 5 mm in diameter it is considered to be fully non-destructive. It allows the extraction of cores that can be very long (up to 30, 40 cm). Holes can be left open or closed with stucco or wood caps that make the sampling invisible.
Among the non-invasive techniques there is the photographic sampling, used in all cases in which the rings are clearly visible to the naked eye. The problem of parallax, or those due to deformation due to the shape of the lenses have proved more theoretical than practical. However, as a precaution, you should not use the sample photo in cases where the series is to be used for other purposes as dendrochronological reconstructions of climate or environment. Conversely, if the goal is the only dating, the photographic survey of the annual increments ring is very effective.
A recently developed system ties a portable dendrocronograph to a digital camera (Figure 2C). It finds optimal applications in museums where the objects are not easily removable (Bernabei et al., 2010), but it can also be useful on structural wood. This tool offers the advantage of being able to measure in situ the rings of the wood and immediately verifies the quality of sampling.
It's worth mentioning finally, a traditional technique still very effective in its simplicity and that is to restore the pattern of rings on a paper sheet, drawing a dash at the edge of the late wood. The distance between the marks is then measured in the laboratory and will provide a useful dendrochronological series, provided that the rings are not too thin.

*Statistical tests*

Statistical tests are of fundamental importance in the dendrochronological dating. However, when used uncritically, they show important limitations. In particular, they can cause the following errors (Sander and Levanic, 1997):
- you can sometimes obtain false datings for random high statistical values (type I error);
- you cannot recognise the true dating because of occasional low values (type II error).
To overcome these problems, you must compare each series with more visual and statistical reference chronologies. The dating is considered reliable only when it is confirmed by more reference chronologies. The most commonly used test in cross-dating are the followings:
- TBP: Student's t-adapted by Baillie and Pilcher (1973) to the analysis of time series. Generally a cross-dating is considered reliable when TBP is greater than 4 with corresponding high values of correlation coefficient and of the level of significance. To get an idea: a series of over 100 rings with a TBP of 3.5, the probability of having a random dating is one in a thousand (Baillie and Pilcher, 1973).
- Gleichläufigkeit (GLK) or coefficient of concordance: a percentage of the correspondence between the signs of growth of two chronologies in the transition from one ring to the next (Kaennel and Schweingruber, 1995).
- Significance of statistical Glk: can be 95.0%, 99.0% and 99.9% respectively, and is expressed by *, ** and ***.
- Number of compared rings, overlap, referred to statistical tests. As mentioned above dendrochronology is a science that is based on statistical correlations that, the greater the number of data compared, the greater the reliability of results.
Despite this, the visual comparison between the series is of basic importance. The human eye has the ability to succinctly capture the relationships between the chronologies, and statistical analysis alone can induce errors mentioned in the beginning of the paragraph. Consequently, in the operations of cross-dating is always good to use both visual and statistical comparison.

*What dating?*

The dating obtained by dendrochronology is located on the last ring visible on the artefact. This datum may be useful in the study of architectural structures, providing chronological reference points from which you can start building an historical analysis. These hinges are called terminus post quem or ante quem non. However, it should be noted that the date identified by dendrochronology may not coincide with the year of realization of the artefact, which may have been made in completely different periods: we have to think of possible cases of reuse, replacement, restoration.
Moreover, to date the last ring on the artefact means that the plant was still standing, alive and vegetating, as he formed the wood. After that date, the plant was cut, the wood transported elsewhere, seasoned, reduced to various assortments (boards, beams, poles, ...) that often require removal of part of the trunk and then the loss of a number of information that increasingly move us apart from the actual date of use of wood. As for the wooden structure, in the building phase normally the green

wood was used, felled recently, so the year of felling of the tree is often a reliable reference, unless reuse or restoration interventions.
Sometimes it may happen that on the artefact is present the last growth ring, just before the bark (Figure 3A). Depending on the amount and type of wood formed in a ring (earlywood / latewood) you can determine the season when the plant was felled. The date so found is the more precise (eg. Spring of 1412 AD), but always and only refers to the wood. To this date it must be added a period for the assembling, which includes cutting, preparation and seasoning, usually in wood structures is not very large, ranging between 1 and 6 years. This dating is defined terminus post quem.
In many species, such as oak or larch, the average number of sapwood rings at a certain age of the tree is known. When on the artefact is present a part of the sapwood (Figure 3B) or just a portion of it you can estimate the felling year from the number of missing rings on the section.
Finally, there is the possibility that the artefact in question lacks any reference of the sapwood (Figure 3C) and the last years have been removed by processing. In this case you can have the dating from the last measured ring, without the possibility of estimation of the felling year. The dating is then limited to determining the year before which the work could not have been realized. This type of dating is also called terminus ante quem non.

*The provenance of wood*

The theoretical basis of dendroprovenancing (Bonde et al., 1997) are on those of dendrochronology itself. As mentioned, the formation of growth rings in wood is a function of several environmental factors, including the very important climate, that act in a sufficiently uniform way on a more or less great region, and on a given species (Fritts, 1976). This determines the overall good level of cross-matching between the trees of the same species and the same area. The technique of dendrochronological dating is based on this principle.
Following the same line of reasoning, the comparison of a dated chronology of unknown origin with an adequate number of reference chronologies, scattered all over the territories, will produce a correlation that will be greater the more similar the environmental factors that have influenced the development of wood. In theory, therefore, the greater the agreement between sets, the smaller the distance between the sites where the plants are grown.
Unfortunately, the question is a bit more difficult than you can imagine reading these few lines. In fact, other factors intervene to influence the growth of a tree. For example, a key factor is the altitude, so far, but dendrochronological series conducted at the same altitude show more similarities to a series built on the same area but at different altitudes.
These and other considerations make the dendroprovenancing analysis complex. However, the information that it can provide is of great importance, sometimes allowing reconstructing trades or political conflicts.
Exemplary is the case of the wooden structures of the Church of the Nativity in Bethlehem (Bontadi and Bernabei 2011). The church (Figure 4) is one of the oldest in the entire Holy Land, and over time has been repeatedly restored and remodeled. The first building, built where tradition has it that Jesus Christ was born, was built under Constantine I in 339. This first building was completely destroyed by fire. The church was rebuilt after the 529 under Justinian. Over the centuries, while the walls remained largely unchanged, there have been on wooden structures a large number of maintenance and restoration at the hands of different workers, financed and guided by the various protectors and guardians of the Holy Land for the various Christian denominations.
Obviously, the reconstruction of the historical events of this building were exceptionally complex, particularly for the wooden structures, which, without a careful maintenance, were more perishable and therefore have a need for greater amounts of reconstruction and restoration.
The identification of wood species with which the roof structures were made has made it possible to determine mostly cedar of Lebanon, deciduous oak and larch, with a few scattered items of pine and cypress. This three main timber species identify interventions and additions over the centuries, in particular as regards the larch and oak, that could not be sourced locally.
The dendrochronological analysis has dated the last ring on the elements identified in the larch in 1412. The obtained series, 592 years long, showed very high values of correlation with the master of the eastern Alps, showing the origin of timber from that region. This allowed us to confirm what is shown on some documents about the time of the request that the Franciscans of the Holy Land made to Venice in 1479 to provide carpenters and timber for reconstruction of roof, with the financing of the King of England and of the Duke of Burgundy.
In contrast, the average series of oak, 315 years long and dated 1723, shows the origin of the timber from the Anatolian region. In particular, the growth rings of the Nativity Oak show strong similarities with those of the timber used for the construction of some structures of coverage of the Hagia Sophia complex in Istanbul, so as to indicate that the wood comes from the same forest.

*Conclusions*

The dendrochronological dating is nowadays considered among the principal techniques for the study of buildings having historical and architectural interest. When the traces left by the history make it impossible a correct reading of the context, the results given by dendrochronology are often the only certain data useful as a reference, even if they are referred to the material, not to the artefact. The power of dendrochronology is in the complete independence from other sciences or disciplines and it is particularly effective when is applied in large research context, in strict cooperation with several disciplines and competencies.

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English translation provided by the authors

# STRUCTURAL DIAGNOSIS OF HISTORIC TIMBER STRUCTURES: The Diplomatic Room of the of Royal Palace of Naples

*1. Introduction and objectives*

The Sala Diplomatica (the Diplomatic Room, Figure 1), anti-chamber of the Throne room, is one of the most relevant rooms in the Royal Palace, due to its dimensions and decorations; its location is in the centre of the historic building facade, facing Piazza del Plebiscito, which is considered the main square of Naples.

Interior surfaces are fully decorated by paintings and fabric, manufactured by the famous silk factory of S.Leucio in Caserta during the Borbons domination: the false-ceiling vault was painted in 1738 by F. De Mura (1696-1782) with the "Allegory of the virtues" of Carlo di Borbone and Maria di Sassonia On the walls, Gobelins tapestries depicting allegories of the Elements, Fire and Air, celebrate the power of the king of France, Louis XIV.

The dimensions of the room are 16,60 x 14,20 meters with a height of 12,00 meters. Few years ago the vault of the room was inspected due to the presence of several deformations on its surface.

Deformations and cracks were ascribed to the overload generated by late above constructed apartments (XIX century) which did modify the original structural scheme, causing deflection in the timber structure supporting the vault. Three apartments were built on the surface of 250 m2, with mezzanine floors and sanitary facilities integrated by plumbing systems of water inlet and drainage: we will see that the latter gave an important contribution to the degradation of the wooden material.

In order to protect the room and the frescoes it was then decided to close the room to the visitors, demolish the apartments and restore the timber structure; protection of the painted surfaces and specific scaffolding supporting systems to the vault have been provided in advance.

With respect to the international conventions, agreed for the conservation and protection of historical heritage, which requires attention for their peculiar characteristics including craftsmanship, techniques and materials, the objective of the intervention was to outline the less invasive systems to the structure.

To do that the first problem to be solved was a complete diagnosis of the state and of the residual performance of the timber structure supporting the vault, including a dendrochronological dating of some of the timber elements, done in order to evaluate the synchronicity of the different frames composing the overall structure and the presence of eventual substitution.

Paper will describe all the steps of the performed diagnosis, and the information that the diagnosis gave to the design of the intervention.

*2. Characteristics of the timber structure*

The timber structure is a slab made of 17 horizontal composed beams (each beam is made of two pieces) of sweet chestnut (Castanea sativa Mill.) wood, 14,5 m long; only one big beam (n° 11 in Table 1) is made of European fir (Abies alba Mill.) Dimensions and cross sections of each element are detailed in Table 1.

The chestnut timber is roundwood only slightly squared by axes (only the fir beam is squared), and simply leaning on the walls. The two portions of each beam are coupled, approximately for 5 m of length, on the middle part by big handmade ancient nails. Each beam has underneath a system of supporting inclined rafters that collaborates in load-bearing approximately at 1/3 of length and transferring the load to the side bearing walls and to a thin horizontal element which lies underneath (and parallel to) the central portion of each beam (Figure 3, left).

The three beams closer to the walls parallel to the beams are supported by a different series of rafters, which are perpendicular to the beams and transfer the loads to the lateral walls (Figure 3, right).

A 6 meters tall wooden truss, discovered during the demolition of the apartments, is located at mid span of the slab, perpendicular to the beams axes. Such system was deeming to support the charge of the beams at mid span, getting the entire construction exceptionally complex (Figure 4, left).

The structure was connected to the lathwork vault by a series of tension-rod made of low quality wood pieces, nailed to the arches of the vault, made of poplar wood boards (Figure 4, right).

*3. Diagnostic methods*

*3.1. Timber structure*

The aim of the diagnostic intervention was then the evaluation of mechanical properties of each member of the timber structure in order give to structural engineer the basic information to design the restoration.

The on-site diagnosis was made during 2004 winter, following the Italian standard "UNI 11119 Cultural Heritage – Wooden artifacts – On site inspections for the diagnosis of timber members", in order to evaluate for each timber member the original characteristics and the modification occurred during the service of the structure, taking into account the decay from the structural and biotic point of view, and to produce the structural visual grading.

Visual inspection and visual grading needs a contact as much good as possible with the element to be examined: before the inspection it was requested to have a perfect cleaning of the structure and the removal of the less important parts of the structure. All the tension-rods and the small horizontal elements simply leaning on the beams were carried away. The tension rods were temporarily removed because they became compression rods due to the weight of the flats and the deformations induced on the timber structure, while the small horizontal elements, typical of the Neapolitan floors, will be replaced at the end of the structural restoration works.

In order to improve the knowledge on the timber characteristics and to know the history of the structure, on many elements it was performed the dendrochronological dating.

*3.1.1. Diagnosis, the applied standard*

The UNI 11119 is an Italian standard that

establishes objectives, procedures and requirements for the state of conservation diagnosis and for the strength and durability evaluation of timber members in load-bearing structures, through the execution of onsite inspections and the use of non-destructive techniques and methods to estimate some characteristics of the timber elements (Macchioni and Piazza 2006).
This standard derives from an intense research activity on this field, carried out by several research institutions during last 10 – 15 years. Some information about the debates can be collected from the following papers: Bonamini et al. 1991, Bonamini 1995, Macchioni 1998, Tampone et al. 2003,
The objectives of the inspections are to obtain information about:
a) wood species;
b) wood moisture content;
c) class of biological risk of the timber members, according to EN 335-1/2: 1993;
d) geometry and morphology of the timber members indicating the position and extension of main defects, decay or possible damage;
e) position, shape and dimension of the critical zone and critical section;
f) strength grading of the timber member as a whole and/or in single critical zones.
The first point to consider in an inspection for the diagnosis in a wooden structure is the identification of the wood species composing it, because of the variability in wood characteristics from each wood species. Through wood identification is possible to collect a lot of information about that wood, as e. g. natural durability, physical-mechanical characteristics, geographical origin and typical employs. For the specific aims in a diagnosis procedure it is important to know the wood species because it is the first key essential to obtain the strength value with visual strength classification of every single beam.
The survey must then obtain information on: dimension and shape of each timber member, geometric features such as wane and deformation, growth peculiarities (position of the pith, growth irregularities such as forking and slashes), type, position and length of principles defects, shape of decay and/or eventual damage present, and position of the critical zones.
Critical zones are characterized by dimension and position of peculiar defects which may influence strength and stiffness characteristics as well as the mechanical performance of the timber member, with particular attention to those which are considered more stressed in the static analysis of the structure and/or the structural unit.
In case of alterations which are not visible on the surface of the timber member, but which are supposed to be present inside, the survey must proceed with the execution of non-destructive tests. Any time alterations are found, their position and extension in relation to the length of the timber member and if possible, in relation to its cross section shall be established; in this last case, the “efficient section” shall be determined, which is the cross section minus the decayed areas.
Finally, the visual strength classification must be carried out following:
a) Observation of all the visible faces and end of every member;
b) Application of the classification rules;
c) Allocation of the element in the worse category;
d) If the member it does not re-enter not even in the minimal category, must be defined “not suitable”.
Every single structural timber member must be graded according to strength. Generally strength grading on in situ wooden structures is based on visual inspection of the timber member, non-destructive estimation of one or more physical-mechanical properties, or else on an appropriate combination of both the above methods.
Timber grading must be carried out according to the criteria and rules following general criteria:
- Grade the entire timber member and, if necessary, identify each critical zone separately;
- Take into consideration the limitations that derive from the conditions of accessibility and visibility of the timber members’ surface; if the number of visible lateral faces of the timber member is less than three, it must be explicitly mentioned in the inspection report.
- If an alteration occurs due to mechanical damage or localized biological decay (rot, wood boring insect attacks), refer the classification only to the efficient section;
- If alteration occurs due to wood boring insect attacks which has spread throughout the whole section (widespread attack) consider the whole section when grading. In the structural analysis, the physical mechanical properties must be reduced in proportion to the surface occupied by insect galleries. The need for this reduction must be explicitly underlined in the inspection report which should indicate the reduction percentage to be applied.
- In order to assign a grade it is necessary that all the characteristics and/or defects enter in the specified limitations; the assignment of intermediate grades is not permitted.
In some cases, on-site inspection can be completed by supplementary tests through the use of one or more non-destructive methods with the aim of determining physical and/or mechanical parameters which can be clearly correlated with the strength of the critical section itself.
The instrument system employed in this case is based on a drilling resistance measuring method. A drilling needle with a diameter of 3,00 mm penetrates into the wooden object with a regular advancing speed, and the drilling resistance is measured. The data are instantly printed out by a printer at a scale of 1:1.
Special computer software serves for creating measuring profiles, on the basis of which the data collected may be rapidly and exactly analyzed and catalogued.
It is important to know the moisture content of wood in every wood element, and how the wood water content varies along the radial and longitudinal direction of the same element. Wood moisture content was determined through a portable resistance type electrical moisture meter.
The knowledge of wood moisture content is important because it is a limiting factor for the development of fungi and wood boring insects able to damaging wood.
It means that for every service situation,

there are some thermo-hygrometric conditions favorable or unfavorable for wood biological decay. In order to establish the hazard classes of biological attack, the standard EN 335, identifies five classes of biological attack, each class is defined by its service situation and the moisture condition of the wood in that situation.

*3.2. Dendrochronological dating*

For dendrochronological analysis the samples were taken from beams in the slab and from the large central truss. Pressler's corer was used to obtain a sample in a non-destructive (at least from the structural point of view) way, since this tool can perform core boring with a diameter of only 0.5 cm. In two cases, an electric drill was also used. At the end of the sampling process, many of the cores proved to be fragmented in a number of places despite the precautions taken. In a few cases, the sample was able to be completely reconstructed in the laboratory; in other cases, the rings were measured only in the area where the core was intact in order to exclude errors due to the loss of small fragments of wood. In any case, the remaining portions of the samples did allow an estimation to be made of the total number of rings (table 1), as measured with the LINTAB system.

The data was processed with the PAST4 and TSAPWIN programs. 18 samples in all were collected from 12 different beams, the samples were analyzed in the laboratory and a total of 12 individual chronologies were produced. In a few cases, the chronologies were averages calculated from a number of cores; this approach was taken to limit problems caused by the accidental sampling of wood with extraordinary annular trends (the presence of knots, injuries, reaction wood, etc.).

*4. Results*

87 structural elements were analyzed both visually and instrumentally, according to the standard UNI 11119.

*4.1. Original defects*

The visual analysis of the anomalies highly affecting the mechanical performances of the elements shows that the ancient carpenters made a good choice of the material to be used: the presence of knots is rather low and, mostly, their average dimensions are rather low.

Chestnut wood faced the carpenters with several problems to be solved.

Firstly the stems were typically small, with an important taper and not perfectly straight, and that's why they couldn't cover the whole span and had to make the coupling of two members. But that was the material available and the structure was not made to be visible.

Secondly, the most important structural defect in chestnut is the so called "ring shake", which is a tangential shake that follows the growth rings and that can make a single beam split in two when the shake follows entirely a growth ring (Fonti et al. 2002).

In this structure we could find only 9 elements affected by that defect (almost the 10%) and only in one case the defect makes the affected beam no more suitable for structural uses.

*4.2. Design defects*

The analysis of the heads of the beam showed a design defect of the structure, which is not due to timber problem, but to the fact that the bearing of the timber elements on one of the two supporting wall was not enough long, so that, due to the overload given by the apartments, the wall was suffering some important compression failures (Figure 5).

*4.3. Problems occurred during the service life of the structure.*

Two kinds of problems can arise during the service life of a timber structure:

biotic attack (insects and fungi) on wood, reducing the section of the elements proportionally to the intensity of the attack;

mechanical damages (breakages, disconnections, etc) caused by bad choice of timber elements, bad design, overloads, etc.

From the biotic attack point of view we have recorded the presence of ancient attacks, no more active, by insects from the Anobium genus and by termites. In both cases they destroyed only the sapwood of chestnut elements (less than one cm on the external surface), which in most cases was already removed by the squaring of timber. Insect attacks, even if visible, didn't cause any reduction of mechanical performances to the timber elements (Figure 6).

On the contrary, many important fungal attacks were recorded during the inspection. Fungi can destroy wood only when the wood moisture content is above 18 – 20%, so that in inner timber structures we can find fungi attack only when wood can absorb moisture from different kinds of moisture traps, like rain infiltration, presence of water into the supporting walls, steam condensation, etc. Typically the heads of timber beams inserted into the lateral walls are attacked by fungi due to the presence of moisture transported by the wall itself.

In the timber structure of the SalaDiplomatica we have discovered an important ancient fungal attack on many timber elements caused by rain infiltration close to the northern wall. The heads of tie beam (Figure 7) and of the northern rafter of the central truss were completely destroyed, causing the inefficiency of that frame as supporter of the mid span of the horizontal beams.

The two of the horizontal beams closer to the affected wall were almost completely destroyed and are at present no more suitable for structural uses.

Less serious attacks, but still working, were discovered in the portions of the beams that were directly underneath the kitchens and the bathrooms of the apartments. The water infiltrations were absorbed by wood and the fungal attack could start. Chestnut timber is nevertheless durable, so normally the attack could affect only partially the surface of the affected elements, without causing important reduction of the mechanical strength.

The moisture content of some heads of the beams supported by the western walls was quite high due to the presence of a bathroom on the opposite face of that wall: the problem must be solved in order to avoid future fungal attack on those elements (Figure 8).

From the mechanical point of view we could find one broken beam in next to an important overload that was acting on a

anomalous amount of knots and close to an important ring shake: beam defects were probably enough to stand the limited load of the vault, but not the overload of an apartment with mezzanine.
Still from the mechanical point of view, but about joints and connections, many of the hand made big nails were lost, making the doubling of the beam at mid span less effective. We cannot argue anything about how and when it happened during the past.

*4.4. Overall evaluation*
The previous sections allow two kind of overall evaluations: the structural grading of the elements and to underline some overall problems of the structure.

*4.4.1. Structural grading*
The evaluation of the structural defects, of the intensity of the biotic attacks and of the mechanical damages allowed the structural grading of each member of the timber structure, applying the grading table within the Italian Standard UNI 11119 (Table 2).
In fact the grading was made not only on each member, because each horizontal beam was considered as a single structural component, but divided in three different sectors (Figure 2, right) according to the imposed stresses and according to what is reported by the standard UNI 11119 that suggests to divide the structural elements into critical zones. So we graded the two sectors from each wall up to the rafters, separately from the mid-span central portion, between the two rafters.
We considered that the designer, who conceived the structure, took into account the weakness of the mid-span portion, where the sections were smaller, the defectiveness of timber is higher and where the coupling was ensured only by some nails. So he decided to support that weakness by way of a perpendicular truss many time sewed, with iron ties, by its tie-beam to the beams underneath.
Due to that from the original 87 elements, the grading was done on 124 portions of elements. Only 9 (7,3%) elements were considered no more suitable for structural uses. The summing up of the structural grading is detailed in Table 3.
The results of grading confirm that the choice of the stems suitable for the beam was well done, because the sum of I° and II° grades groups the 60% of the total. That means that the basic material for the restoration has a good quality and that the restoration could be really conservative.
From grading table of each element and from the strength profile for each species and for each grade (Table 4), the designer will collect all the data useful for the structural restoration.

*4.4.2. Overall problems*
The overall structure suffers for a very high deformation at mid-span of the beams which is due both to the overloading gave by the apartments and by the lack of support from the central truss.
From one point of view we could say that the structure, conceived only to support the vault in lathwork, was largely overstated, but for sure was not conceived to support two modern apartments with mezzanine. Moreover the fungal attack made the supporting role of the central big truss not only ineffective, but also an overload supported by the horizontal beam system. Looking at the fungal attack we can also say that it was antecedent the construction of the apartments.
The consequence was an important deformation of the mid-span portion of the beam system (Figure 9), where the bending stress is higher, where the beams are connected only by nails and where the support by the truss was later lacking.
The biggest problem for the restoration of the slab is then the recovery of that deformation in order to return horizontal the beam system.

*4.5. Dendrochronological dating*
For dendrochronological dating the job was rather difficult due to the very limited number of rings in the material, the species (chestnut) being poorly suited to this type of study, and the lack of an extended master chronology for central Italy and for the species being considered (Table 5).
Nevertheless, 11 out of the 12 chronologies involved beams made of chestnut; the chronology for the large beam made of European fir was constructed using the average of three samples. The investigations on the two species were carried out separately. There was no problem determining the chronology of the fir because the three cores used came from the same tree, and no particular anomalies (such as missing or false rings) were noted. This chronology extends over 167 rings.
The chronologies of the chestnut were also synchronized successfully, which enabled an average chronology of only 38 years to be produced.
The chestnut beams were obtained from trees of about the same age, with the possible exception of the trunk used to build a small reinforcement beam, whose chronology extends over only 12 years. Thus, the material probably came from a coppice with a rotation of around 12 years and was taken from 2-3 rotations, corresponding to 24-36 years. The poor statistical reliability deriving from the very small number of rings was counterbalanced by the general uniformity of the curves, which was confirmed also thanks to the good visual synchronicity observed in the material. All the material, including the elements in the truss, proved to be of concurrent origin.
In particular, the trend of the curve in the tie-beam of the truss is significant and well synchronized with the median chronology.
The chronology of the chestnut and the fir are surprisingly well synchronized(Table 6). Absolute dating of the structure (chestnut + fir) to 1708 is statistically significant when correlated with the chronology of beech in central Italy (Piovesan et al., 2003) and of European fir in the MontidellaLaga area (Schweingruber, 1980), in Southern Italy.
The close analogy between the chronologies of chestnut and fir leads to the presumption of an analogous ecological context for both species (Figure 10). Perhaps they were from the same forest. In fact, in the Apennines, fir tends to descend onto the base area of the mountain, where it mixes with Turkey oak and sweet chestnut (Bernetti, 1995). In particular, forests where European fir spontaneously takes hold in coppices of chestnut

are typical of Southern Italy.
Thus, the material could have come from any of the coppices of chestnut with fir that are located on the mountains in the inland regions around Naples, which would explain the strongly similar growth expressed in the two chronologies.
The most uncertain factor at this point is still the absolute date of the structure, given the lack of long lasting reference chronologies for the two species in the area being considered. A few years could be added to the presumed date (1708) to compensate for the few rings lost when the material was processed for construction or when the dendrochronological sample was taken. An aging period of 1-2 years must also be added to this date.
As a result, the timber elements of this structure could all be dated to the early decades of the 18th century. These results confirm that the different parts of the structure are synchronised and no important repairs were made later.
The dating results are also well synchronised with the recorded painting of the vault frescoes, done during 1738 by F. De Mura.

*5. Conclusions*
The described diagnosis allows specifically designing the restoration interventions. From one side it will be necessary to refit the few members no more suitable for structural uses: the broken beam and beams heavily attacked by fungi in order to make it possible to refer to the original characteristics of the structural material. Then the less effective connections must be strengthened. Another side is the restoration of the truss and its connection to the slab; the high deformation recorded on the horizontal beams will make this effort difficult.
The restoration design will also include a maintenance program through visual inspections at least twice a year and through tests of the efficaciousness of the interventions, to be repeated during the service life.
Visual inspections will control the eventual presence of xylophagous insects, with particular attention to the very dangerous termites, and the moisture content of wood close to the supporting walls, in order to control and minimize the fungal attack to wood.
The proposed example can confirm that the diagnosis is an effective prerequisite of the restoration; that the diagnosis can improve the quality of the design of the restoration and, mostly, the probability of its future success; that the diagnosis reduce unexpected events during the restoration works.

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English translation provided by the authors

## GEOGRAPHIC INFORMATION SYSTEMS: Concept, advantages and possibilities in the field of restoration

Restoration and conservation tasks in architecture require preliminary studies of the present state of a building or monument. Most of the times, there is a myriad of data from multiple sources such as historical documents, archaeological information, chemical analyses of the stone or the pigments, drawings and plans, black and white pictures, in colour or in infrared, thermograms, radargrams, etc. (fig. 1). A right management of these data is essential for planning and monitoring of the required works, namely for large and complex projects with particular stylistic periods and/or monuments with high historic and artistic value. The new software tools, more and more powerful and accessible, constitute at present necessary solutions in related projects. Among them GIS are highlighted, not only because they allow the optimum management of the data coming from a variety of different sources, but also because they interrelate them based on the true position, allowing users to generate new data, analysis, statistic and thematic reports, among others.
Although GIS offer a large number of benefits in architectural projects related with conservation and restoration, nowadays related works in archaeology make extensive usage of GIS. Researchers in this field are aware of the importance of incorporating modern technologies for documentation and measurement in their works, among others, photogrammetry and remote sensing, and definitely GIS as software packages used mainly for management, edition and generation of new data coming from multiples sources. For instance, archaeological and historical data with the transformations that occurred in the Roman road system in the Ayas Valley (Italy) between the Roman times and middle ages were managed in a GIS[1]. Different working groups collected data that yielded heterogeneous information, with different formats, types and aims, and were eventually managed in a GIS. In the archaeological site of Jerash (Jordan) a GIS was proposed to integrate data coming from modern surveying technologies such as GPS, remote sensing, photogrammetry and classical measuring devices. The urban expansion of the modern city around the ancient city was evaluated overlying layers created from both the aerial imagery and the satellite imagery; the acquisition time varied more than two decades[2]. In the ancient city of Sebaste Elaiussa (Turkey) a GIS was developed. The purpose of this system was to manage the information collected in the excavation, which was stored in a database. The system can discriminate the different phases of the buildings and the historical evolution of the city by studying and overlapping several thematic layers and its chronology[3].
In the following sections, a detailed study of GIS is presented. GIS tools have been developed and used since several decades ago, being currently systems very versatile, effective and robust. The knowledge of GIS capabilities and their benefits compared to other software packages will help to bet on this technology for the daily work of conservation and restoration.

GIS PRINCIPLES
*What is a GIS?*
Geographic Information Systems are computer-based software packages designed to capture, store, update, manipulate, analyze, manage and display geo-referenced data[4].
GIS emerged in the late 60s. They are based, on the one hand, on the modeling

and simulation systems of disciplines such as ecology, regional and urban planning, and on the other, on the large statistical and geographical information systems[5]. However, it was neither well-known nor widespread used until the massive introduction of computers in the 90s. The progressive evolution of GIS has been mainly marked by the advances introduced in the fields of computers and microprocessors[6].

The GIS term is generally used in territorial applications[7]. In fact, the "geographic" concept is linked to a recognized coordinate reference system, that is, global, with its corresponding geometric deformation. Because of that, other terms are sometimes used in the area of cultural heritage such as Spatial Information System (SIE), in which the "spatial" component is referred to a local coordinate system, or Architectural Information System (AIS), which customizes GIS applications in the field of architecture. In this article the GIS term will be generally conceived. Therefore, the tool can be adapted for each project.

GIS allows the identification of the spatial relationships among the different sources of information that contain their spatial data. A GIS does not save the map/plan data in a conventional way, but saves the data from which to create the appropriate representation for a specific purpose or build up new maps/plans using the powerful analysis tools of the system[8]. Thus, the definitions of GIS as either CAD systems or databases are rejected. Therefore, a GIS should have the following basic functions[9]:

- Graphical representation system to visualize spatial data, using preferably standard graphic libraries.
- Database that easily manages the alphanumeric and graphical data related to a physical space. In general, the database has to be relational, with multimedia storage capacity (images, sounds, etc.) and preferably object-oriented.
- Database that enables spatial and topological[10] relationships. The ability to create topological relationships between graphical entities is possibly the key feature of a GIS.
- Selective data access, for example, using SQL.
- Automatic mapping system from queries and simulations.
- Automatic alphanumeric documentation system from queries and simulations.
- High-level programming language that allows the development of customized applications.
- Data exchange system (import/export).

## GIS DATABASE STRUCTURE

GIS consists of both a database and a graphic representation system. GIS can be built on a database that has some kind of graphic representation system, or vice versa, a CAD system that is either associated with data tables or related to a database[11], fig 2. The information contained in the database is presented to the user via graphic plots, and can be created at the time of querying the database. These graphic plots can take the form of maps, histograms, bar charts, listings, tables, records, etc. In addition, the graphical entities can take different shapes and colors depending on the query made to the database, being this feature one of the major differences between GIS and CAD. Graphical entities in CAD take their own representation from their graphical attributes. It means that the CAD data are statically stored, in contrast to the dynamic data delivered by a GIS.

There exist two ways to encode spatial data in a GIS: vector format and raster format[12]. They differ in the way the information and the spatial location of objects is conceptualized, stored and represented. More details about the two types of data will be presented next.

All the vector data are defined by coordinates. This data model stores information using discrete forms, basically points, lines and polygons, is typically used for storing data with a well-defined spatial location. The attributes[13] belonging to the individual data are stored in an external alphanumeric database.

When dealing with vector data, an important concept is the topology[14], which expresses the spatial relationships between vector features. Topology is a very useful concept in GIS because many operations in spatial models do not require positions defined by coordinates, but simple topological relationships among different objects. For example, the optimal route between two points only requires a listing of the interconnected arcs and the costs to traverse each arc in each direction[15]. The coordinates are only required to draw the route after this is calculated. Topology is also useful for detecting and correcting digitising errors.

In the raster data, the spatial representation and the non-spatial attributes are mixed in a single data file. In practice, the study area is covered with a mesh or grid of cells (organized into rows and columns), where each central position of a cell stores its representing information value. Note that some raster models support the assignment of multiple attributes to each cell, while others assign strictly just one single attribute[16]. With this data model, a continuous data space is divided into discrete units where each cell is referenced by the position of its row and its column within the grid. To georeference or fix the spatial position of the whole grid, coordinates are assigned to the four corners. For that, an important concept is the spatial resolution of the raster, which sets the size of the grid cells on the ground. A higher resolution (smaller cell size) results in more level of detail and therefore the representation is closer to reality. However, keep in mind that a small cell size requires greater storage capacity and longer processing time.

Unlike the vector model, the raster model has no implicit topological relationships in the data: spatial elements are not recorded individually, but the behavior of the attributes in space (fig. 3).

## GIS FUNCTIONS

GIS have inherited many functions of the systems from which they have evolved. The general purpose GIS are those with more functions, in some cases of questionable value, because they are fitted to some specific needs but are not required for the common GIS applications that are currently in use[17]. Depending on the different software packages, GIS may contain different functions. However, most of the GIS available today cover a number of general functions:

- Capture functions and data organization: digitization, filtering lines, coordinate transformation, troubleshooting, geo-referencing, table management, selective deletion, creation of topologies, creation of raster maps from vector themes, conversion of raster thematic maps to vector, image processing, cutting and union of networks of polygons and arcs, etc.
- Alphanumeric table management functions: locating data by SQL queries, creating and modifying the structure of a table, indexing, relating and joining tables, add records from another table, etc.
- Documentation functions.
- Spatial analysis functions: buffers, intersection of polygons, creation of thematic maps, location and selection of entities (inclusion, proximity), clustering and classification, Thiessen polygons, etc.

## CRUCIAL FACTORS IN THE IMPLEMENTATION OF A GIS

Implementing a GIS is not always easy, as there are neither general solutions in terms of logical structures of data nor research tools. The data collection and its management depend heavily on the author's culture, the specific objectives of the intervention, the date of the project, etc.[18]. The final solution should be accessible to the highest number of people with different skills, culture and knowledge, which in the future may make use of this implementation. Similarly must reproduce the specialist's viewpoint about the job, satisfy the needs of the potential users, be well documented and ensure the security, the conservation and portability. There are a number of risks that have to be avoided in the implementation of a GIS, such as creating resources poorly documented or not comparable with similar projects, limiting the GIS for a single computing platform, or performing applications with the only purpose of serving as a database, not anticipating the eventual spatial analysis requirements. To avoid these problems the following guidelines should be considered[19], among others:

(1) The participation of the entire team of specialists in the definition and evaluation of the GIS conceptual and logical model.
(2) The proper administration of the spatial data.
(3) Programming of strategies for reuse and data exchange.
(4) The right acquisition planning and processing of data.

Therefore, a number of factors that enable the successful completion of these guidelines should be considered. Regarding guideline (1), the specialists who take part in the data capture, in the GIS implementation and in its subsequent use should find a common framework of understanding. A number of keywords should be adopted to avoid different interpretations, as well as a group of rules or priorities to be followed in case of multiple alternatives. It is also desirable to reach a common approach to "tag" the quality of the acquired data with adjectives such as good, excellent, doubtful, etc. Regarding guideline (2), it is convenient to consider and evaluate the used coordinate reference systems, the precision and the accuracy of the applied methods, the scale and data resolution, etc. In addition, the corresponding metadata should be ellaborated[20]. Guideline (3) is essential owing to the most expensive part of implementing a GIS associated with the project design, and in particular with the data acquisition, updating and maintenance. The redundancy of information should be avoided, and ensure the conservation and possible reuse of data, including integration with other GIS or with data coming from different projects. The project manager should ensure compliance of the guideline (4), developing schedules that cover all phases of the data management: acquisition, integration, processing, analysis, presentation and preservation.

## APPLICATIONS AND USES

The disciplines that traditionally more have benefited from GIS are geography, geology, archeology and surveying. Some tasks commonly supported by GIS are:

- Management of the urban and rural cadastre, registers of the property, land registry and farming, etc.
- Management of renewable natural resources: management of hydraulic resources, air pollution, landscape evaluation, etc.
- Management of infrastructures, not only in the phases of design and construction but also for exploitation and maintenance.
- Management of transportation: design of traffic plans, network evaluation, bus, train and underground management, etc.
- Management of statistics and electoral roll, and definition of electoral districts.
- Urban and regional planning: design and management of norms and by-laws in the use of soil, natural park management, management of planning permission, management of the street furniture, etc.

Although the SIG started its development several decades ago, its application in the field of conservation and architectural restoration is still reduced, despite the success achieved in other environments. However, it can be affirmed that in the last years the number of architectural applications is increasing, as in urban-related tasks as in documentation and restoration of architectural heritage, among others. For instance, a study of the urban growing of Tarrasa between the second half of the XXth century until our days has been carried out by means of processing and interpretation of aerial photograph and SIG[21]. Another GIS has been developed for architectural applications, allowing the management of any architectural data, either graphic or alphanumeric[22]. The system manages the architectural information of the city in relation with its urban shape, relating the block or the building, linking the graphic information that exists in the graphic system with the alphanumeric one that exists in the database. The acquired data can be added and updated gradually to the software, in a way that ones and others are easily linked. In the field of architectural heritage, GIS technology has been used in order to georeference a set of monuments, of such a way that a topological relationship is set between these and the characteristics of the geographic place (type of soil, risks, etc.)[23]. In St. Louis (in New Orleans) the GIS is used for management and planning of the restoration of an ancient cemetery that has a strong historical feeling[24]. Some areas were prioritized such as the ones requiring restoration, thanks to the effective

and analytical description and the mapping system. The GIS included historical aerial images, registers and maps, among others, that were digitized, georeferenced and classified in layers, creating a chronological sequence of the place.
The cases in which GIS is applied are very diverse, gaining steadily importance in architectural tasks, owing to the simplification of documentation and management processes, apart from establishing some links between the graphic and alphanumeric information. In addition, it is possible to register simultaneously the topological relations and the spatial entities. Without any doubt, all these tasks facilitate the works related with the restoration and conservation of buildings, where a relation between surfaces to restore, material, costs, has to be set up. Furthermore, the initiative in many cities of protecting the heritage step by step is foreseen, showing a uniform and homogeneous appearance of the buildings (in function of the style, period or colour, among others)[25]. In these cases, it would be desirable that the data were integrated in a GIS as to elaborate studies of visual impact as of maintenance, rehabilitation, conservation and restoration.

## EXAMPLE OF IMPLEMENTATION AND OPERATION

The phase of implementation of an information system can be considerably reduced if developed software packages are used or integrated. There exist many programs in the market, both commercial and freeware. There exist comparative studies between the distinct freeware SIG solutions available nowadays, which constitute a good option[26]. In the following lines are reported some aspects that should be consider when implementing and putting into operation a SIG.
- Preparation of the data: A GIS is nourished of geographic information, distinguishing between spatial data and thematic data. The spatial component can be produced importing the AutoCAD or the MicroStation files, making edition to get the shape file for each layer. The shape file is the data format of the data stored in ArcMap[27], one of the most extended GIS programs. Each shape file is characterized for a set of objects with the same geometry: points, polylines and polygons. The data can be classified in distinct groups and each group in different subgroups. A table with attributes on the available data can be created for each imported layer in AutoCAD. The basic unit of management can be a building, a monument or a complete site, but several subunits can be differentiated such as plants, façades, sections, floors, ceilings, etc. until reaching a level of detail which allows, for example, the study of alterations of a determined feature over time and in relation with nearby ones[28]. Once generated the database other operations will be carried out such as the establishment of the priority areas that need restoration, the calculation of the total areas and the costs related to the interventions, among others. All these new generated information will also be transferred to the database.
- Queries: The tables and graphics in a SIG are connected through a common identifier, so that each alphanumeric data is matched to a graphic and vice versa. Whenever an object in the graphic element is selected, the available information in the database (spatial query) will be displayed. Similarly, the spatial location of an element can be known from a register of the database (thematic query). This feature is particularly interesting in order to check all the attributes (or alphanumeric data) available for each entity. Furthermore, it is possible to access to external files from the GIS if the external contents are linked to the tables of attributes.
- Edition/data computation: To operate with a GIS ranges from data acquisition, management and presentation of thematic maps[29]. Afterwards, the crossing of the information, algebraic operations that generate new results that identify new units and that help to configure the simple or complex model of a building, depending on the relationships. The dimensions (surface or length) of the objects contained in the shape file can be automatically calculated. The surfaces of the rooms can be specifically determined, the floors, the façades, the areas of degradation, etc. Also topological relations can be extracted from the entities. The topologic relationships allow the selection of the elements with alterations particularized for each room, each wall and each façade (fig. 4).

## BENEFITS COMING FROM GIS

GIS offer plenty of advantages compared with other traditional tools. Without any doubt, this computer tool is a management and distribution device that can be used for all kind of information concerning a project. Some of the benefits coming from a SIG in the field of the conservation and restoration are presented, without exclusivity or generality.
- Data integration: It is possible to visualise, edit, interpret and manage in only one computer environment all the data collected for a building. This feature is more relevant on large projects handling a large variety of data about the building or monument to restore. The data can be either about the current state or about historical data, information about the materials or the original pigments, internal and external structures from plans, photographs, thermal images, geophysical surveys, etc.
- Questioning: It is possible to access to the alphanumeric data (or tables with related data) through simple operations of questioning, simply clicking on the spatial data or over the image in question. This characteristic can save time, especially in large projects of restoration and conservation with exhaustive associated data. For example, one image can display a façade that needs to be restored, but that has distinct materials, levels of deterioration and priorities of restoration, depending on the area of the façade where it is found, etc.
- Creation of thematic maps: It is possible to edit the maps of a building, choosing and combining the data of the different plants, sections and façades, in such a way that new thematic maps are generated from the input data. For example, it is possible to generate maps that show visually and quickly the period of the buildings, classifications about the alterations found, the priority zones to restore, their dimensions or locations.

- Spatial operations: the graphic data are stored with their corresponding spatial location (georeferenced data) as well as the topological relationships among the distinct elements, in order to solve spatial operations such as computation of distances and areas, connectivity and contiguity operations, inclusion, etc. In a restoration work, this characteristic allows, for example, the selection of adjacent ashlars, the number of altered or non-altered blocks and their visualisation in the plotting of the building, etc.[30].
- Avoid duplicity and/or loss of data: One of the unique characteristics of GIS that is not possible to find in other software packages is its capacity to store the information without repeating any data while establishing relations among all the graphic entities and their attributes[31]. This capacity is fundamental in tasks dealing with organization and data management of a building, avoiding loss of data and lack of control on diverse information, coming from different sources and with different formats.

## GIS ONLINE: MAP SERVERS

A map server is a software package able to interact directly with sources of GIS data and present them on the Internet thanks to a web server[32]. Map servers have a direct connection to the database. Therefore, the users can realise queries and generate new graphic information. The architecture of the map servers is client/server. The client – browser or navigator – requests the resources of the server which manages all the requests and answer in an ordered way. The net is the physical structure through which the client and the server are communicated. The client, when receiving the data of the server (for example, HTML code) interprets and presents them to the user. Fig. 5 shows a basic diagram of an online map server.
The increase of the capacity of transmission of information through the Internet is opening new roads of communication worldwide. From some years ago, the web is a standard platform for the GIS, and many commercial packages have already their own versions online. Some advantages of the online GIS can be highlighted[33]:
- Access from any part of the world.
- Interface standard through browsers, without any need to purchase additional software.
- More economic and effective maintenance, since the user can directly access to the source of information.

Nowadays, some map servers can be freely accessed to manage architectural information. For instance, the University of Alicante offers an online GIS of its campus[34]. Whatever user with internet connection can virtually visit the installations and retrieve interactively information from 2D and 3D plots. The GIS of urbanism of the city council of Madrid[35] offers the possibility of researching streets and postal numbers, cartography of the urban planning and plots up to scale. Through the URL of the University of Minnesota[36] it is possible to visit MARWP, an online GIS that contains a catalogue of geospatial information about the native Greek architecture. From interactive maps it is possible to select visual elements (such as ancestral buildings) by means of the mouse and access to some of the architectural features such as dimensions of the façades, orientations, type of roofs or constructive materials.
It is possible to find also references to specific projects on internet-based information systems related with urban and socio-economical development, for instance in Baalbek[37]. For this project many specialists from distinct disciplines and institutions are working together. A free distribution online GIS was adapted to the archaeological and architectural needs based on MySQL and PHP. Following this way, immediate access to the state of the art of the project was guaranteed to the different groups. Besides, it is also possible to combine the technology of virtual reality and GIS[38]. The aim is to elaborate an online multimedia GIS that allows users more interaction, increasing the degree of perception and the realism. The project is applied to the virtual reconstruction of two fortresses and a cemetery. There is also an online GIS for the preservation of cultural heritage[39] based on Map Objects Internet Map Server, which is not only an application to publish maps on the Internet but also a programming platform.

## CONCLUSIONS

This article reviews the state of the GIS technology at present, emphasising the add-ons, the applications and the benefits in daily activities of multidisciplinary teams working at distinct scales. Some factors to consider when implementing GIS are presented, as well as examples of use and international references related with successful applications of the GIS in distinct fields of knowledge, mainly related with architecture and archaeology.
The GISs answer perfectly to the basic requests of the architectural restoration, whereas those works require data acquisition, organised management and a continuous analyses that give immediate answers to the technicians' proposed applications, the managers and the users of the computing system during all the activity carried out on site, in the surroundings and/or monument. Questions like the optimisation of pipelines, the existence of clean data without duplicity, the establishment of topological relations, the edition of graphic data associated to alphanumeric data, or the access and fast analysis to large volumes of information, make GIS front-end packages compared to the traditional CAD systems. Moreover, online GIS yield new possibilities as regards all the information is available, accessible and securely updated at present through the web. Therefore, the project can be conceived not like a static question and be opened in a way that the society as a whole benefits from the control capacity, follow-up and advertising, without forgetting that the most benefitted personnel are namely the own technicians and managers of heritage. This article invites to the extensive use of the GIS technology in the field of the architectural conservation and restoration, in a similar way as other disciplines did several decades ago and did not doubt of both their benefits and their possibilities.

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