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# The Relevance of Maintenance and Monitoring in Architectural Conservation

**Abstract:** The Italian standards, formerly NORMAL, define Extraordinary Maintenance as those where a major intervention on the building is carried out, usually referred to as a conservation intervention. These receive much attention from the media thus prompting the interest of NGO and for non-profit organizations which take an interest in funding such projects. Conservation interventions are critical for the preservation of our architectural heritage; however, the trigger for their undertaking, as well as their timing, is mainly determined by political interests. Because of the lack of ordinary maintenance, conservation interventions have to address heightened material deterioration problems thus increasing the complexity and invasiveness of the required operations, as well as an overall higher cost. The most worrisome issue is that once the intervention is completed, the building or monument is considered as being in a stable condition and not requiring any further action. Only in few cases is the most ordinary maintenance regularly carried out but what is neglected is the monitoring, the early identification of those “symptoms” revealing that a problem is present and should be addressed before more damage occurs. The paper uses various examples to illustrate the above points.

**Keywords:** ordinary maintenance, monitoring, conservation, intervention, buildings

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## 1 Introduction

The notion of cultural heritage, as currently understood, was the consequence of changes in outlook (or viewpoint) introduced by the industrial revolution in the nineteenth century. Up to that time, buildings had a functional

value that had to be preserved for economic or social reasons, among others, and always clearly evident. With the introduction of the “heritage” concept based on intangible values, many buildings or structures, without any functional value were included in it. This transition, while interesting and necessary following the modern point of view, had some negative implications. While in the past, the requirement to conserve the functional value of objects was a practical need that followed routine operations regularly undertaken – as for example, the traditional application of lime-wash or oil-paints in Europe’s southern or northern regions, respectively – the new viewpoint simply considered that if an object had a cultural value it was important to preserve it. However, no suggestions were made as to how this “preservation” could be carried out in practice and in the long term. Furthermore, since in many cases these objects – as for example ruins of ancient buildings – did not have a practical function, maintenance operations were not planned for since they were not considered indispensable.

Simultaneously, advances in science and technology lead to the belief that the new methods and materials developed were far better than the traditional ones and, being better, required less maintenance. In turn, this led to the idea that once a conservation intervention was carried out the object in question would be safe and preserved for the foreseeable future, following man’s dream of “eternal youth” or the all-curing option. Thus, the traditional concept of regular and periodic interventions was replaced by the idea of a single intervention that could solve all problems. The present article discusses the practical issues that resulted from this change in philosophy.

## 2 Defining maintenance

The change in attitude towards the preservation of monuments generated a whole new approach that engendered a long controversy as to its implementation, either by the inertia in adopting the new ideas or by the different interpretations given to the term cultural heritage and its values. The most notorious being the one between

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John Ruskin (1819–1900) and Viollet le Duc (1814–1879). While Ruskin required that architecture be honest and avoid deceit [1] and considered “*practical laws... becoming the actual expression of some ultimate nerve or fibre of the mighty laws which govern the moral world*” [2], Viollet le Duc, being an architect, had a more pragmatic approach “*D’ailleurs, le meilleur moyen pour conserver un édifice, c’est de lui trouver une destination, et de satisfaire si bien à tous les besoins que commande cette destination, qu’il n’y ait pas lieu d’y faire des changements.*” [3]. It was probably William Morris (1854–1896) who first highlighted that maintenance was key for the preservation of monuments: “*... we plead, and call upon those who have to deal with them to put Protection in the place of Restoration, to stave off decay by daily care, to prop a perilous wall or mend a leaky roof by such means as are obviously meant for support or covering...*” [4].

No reference to the regular maintenance required for preservation appears in the reports from meetings such as the International Congress of Architects, Madrid (1904) [5], the 1931 Athens Charter [6], the Italian Carta del Restauro from 1932 [7]. However, the first article in the section on conservation of the 1964 Charter of Venice reads: “*It is essential to the conservation of monuments that they be maintained on a permanent basis.*” [8]. And reference to maintenance appears again in the 1976 Nairobi Recommendations, where “*“Safeguarding” shall be taken to mean the identification, protection, conservation, restoration, renovation, maintenance and revitalization of historic or traditional areas and their environment.*” [9]. One year later, Giovanni Urbani, Director of the Istituto Centrale per il Restauro, promoted the formation of the NORMAL (NORmalizzazione Materiali Lapidei) Commission in conjunction with the Consiglio Nazionale de la Ricerca. The aim of this Commission was to offer recommendations for standards to be used in the field of conservation. The objective of the NORMAL 20/85 [10] Recommendation was to provide guidelines for the implementation of the two types of maintenance, both extraordinary and ordinary, and where it is clearly indicated that after an extraordinary maintenance, ordinary maintenance is required based on periodic inspections, i.e. monitoring. Finally, the 2013 Burra Charter [11] improves the definition: “**Maintenance** means the continuous protective care of a place, and its **setting**”. Noteworthy is the slight change in wording from “*on a permanent basis*” in the Charter of Venice to “*continuous*”.

While there are relatively few publications that deal in depth on these issues, the books by Paolo Marconi *Arte e cultura della manutenzione dei monumenti* (1984) [12] and the far better known *Dal piccolo al grande restauro*

(1988) [13] stand out by the innovative approach introduced in these topics. The author analyzes the various types of maintenance interventions – which mostly fall into the extraordinary maintenance category – and highlights the need to correct current practices so as to remain within “the art and culture of maintenance”.

### 3 Maintenance implementation

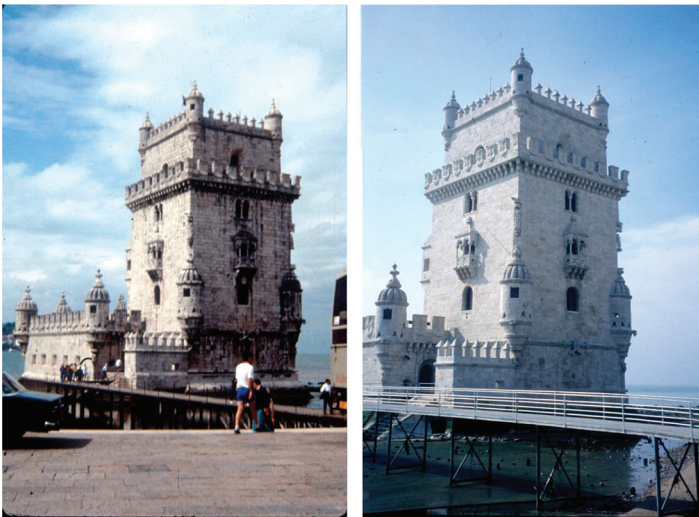
Extraordinary maintenance corresponds to what is generally referred to as a conservation intervention (although sometimes these may be denoted as restoration interventions due to linguistic differences), while ordinary maintenance is simply the regular maintenance that the building requires to keep it from excessive soiling and damage due to accidental breakdown of pipes, gutters, etc. What differentiates them is the time lapse between them and the cost. Extraordinary maintenance can be estimated as required every 25 or 30 years, though the frequency has much to do with political events. This can be exemplified by the case of the Torre de Belem in Lisbon, Portugal. The Tower, constructed as a fortress in the early sixteenth century underwent different modifications as its use changed over time to serve as a political prison, military barracks, lighthouse, and eventually as a space for exhibitions, meetings or concerts [14, 15], as summarized in Table 1.

It is evident that “extraordinary maintenance” was carried out prompted by the organization of international events when an increase in the number of tourists was expected and profits were anticipated from these events. On these occasions, those responsible for the city and its monuments actually remember that the monuments may require some care, a typical human characteristic that is found worldwide. Meanwhile, the authorities directly responsible for the normal upkeep of the monument have a specified budget, usually barely sufficient to cover the minimum needs, so that if a pipe breaks or a gutter is damaged, its repair may take years until it is undertaken.

This can again be illustrated by the example from the Tower of Belem. The 1997–1998 intervention was carefully documented and Recommendations for a Maintenance Plan had been drafted [16] (Figure 1). Since there was no documentation regarding the soiling rate, or the durability of the replacement mortars used in the joints, it was suggested that a close visual inspection be carried out annually, while for areas affected by humidity stains and salt efflorescence, the inspection should be every 6 months, once during a dry period in summer

**Table 1** Major interventions carried out on the Torre de Belem as of nineteenth century

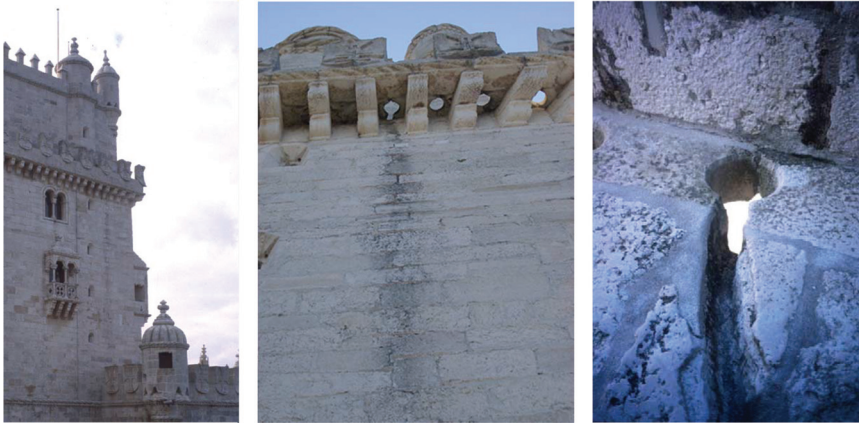
Year	Intervention	Remarks
1846	Restored to its original shape with addition of some decorations.	Removed extra constructions, such as rooms and the connection to Bom Sucesso fort. Around the central bulwark opening, the balcony and niche with the Virgin of the Grapes was added.
1940	Cleaning and some conservation works	Monument came under the jurisdiction of the Ministry of Finances and the Exposição do Mundo Português was held that year.
1983	Further conservation works were carried out. Cover over the central opening of the bulwark installed to allow exhibitions to be held in the bulwark. A dam was installed by the Tower to keep a water mirror around it on the land side even in low tide.	XVII Exposição Europeia de Arte, Ciência e Cultura was held in Lisbon. UNESCO includes it in the World's Heritage List.
1993–1994	Condition survey, documentation and cleaning tests.	1994: Lisbon served as the Cultural Capital for Europe.
1997–1998	Conservation intervention carried out.	1998: First world's fair held at Lisbon: Expo 98 on the occasion of the 500th anniversary of Vasco da Gamma finding the route to India. 1999: Received the Europa Nostra Prize.

**Figure 1** The Tower of Belem before (left, 1994) and after (right, 1998) the conservation intervention

and once during a damp period after severe rain in winter. A more detailed inspection, using fire-brigade ladders or equivalent equipment, was to be carried out every 5 years. Therefore, in 2003, a more detailed inspection was suggested; however, no funding was available to rent the required lift equipment and only a visual examination with binoculars could be carried out. It was found that overall the masonry was in good condition, and that only minor biocolonization had returned where once there were had been layers of lichen or mosses [17]. However, on the west façade a soiled strip had developed below the round-walk of the tower where the spout of the drain that collects the water had broken allowing water

to run down the façade promoting soiling and biocolonization (Figure 2). The solution to this broken spout is fairly straightforward requiring a mason to fix it, either by fashioning a simple spout with a cementitious mortar or by inserting a metal spout to prevent the water from running down the wall. A decade later, this simple operation has not yet been implemented and the soiling has increased.

The consequence of delays in taking care of minor problems in a timely fashion is that by the time the repair is actually carried out, far more damage has been induced to the monument's material than if it had been addressed immediately. And future conservation



**Figure 2** Partial view of the west side of the Torre de Belem (left) and detail of the soiling resulting from the broken spout (center), and view of the drain and missing spout from the round-walk in 2013 (right) (Center photo courtesy of J. Delgado Rodrigues)

interventions will have to address this material weakening so that a more complex and invasive approach will probably be required which in turn increases its cost. The accepted reason why ordinary maintenance is not properly implemented is generally attributed to a lack of funding, but this is not necessarily true. Studies carried out to evaluate these situations have shown that had regular maintenance been carried out, the subsequent conservation intervention would be simpler; and that furthermore, the cost of a cycle of regular maintenance plus that of the subsequent conservation intervention would be lower than if no regular maintenance was carried out and a more complex conservation intervention implemented [18]. Similar situations arise when dealing with public works, such as bridges, that require regular maintenance [19, 20].

## 4 Other examples

Ironically, some developing countries have a better maintenance policy for monuments. However, in certain cases

this may be a problem because they lack the knowledge, understanding, and training to apply the appropriate methodology required, as exemplified by the repairs undertaken in monasteries, caravanserais and related infrastructures along the Silk Road, currently under study to be included in the UNESCO World's Heritage List [21, 22]. There, in particular for the case of the Chor-Bakr Religious Complex, Uzbekistan (Figure 3) regular maintenance is carried out to replace renders at the base of the brick walls that are regularly deteriorated by rising damp and its salts. However, instead of using the traditional formulations, cement renders are applied increasing the amount of damage induced, even if the main cause of the problem is not addressed.

In part the problem may be attributed to the fact that when experts are called in, they do not speak the local language so that any suggestions and recommendations are translated by local people that while speaking both languages do not have the technical knowledge leading to misinterpretations. For example, in one World Heritage Site, repairs of cracks in a stone terrace were being undertaken with an epoxy resin-based mortar. When



**Figure 3** Chor-Bakr religious complex in Uzbekistan. Note the grey color of the cement renders applied at the base of the building. (Photo courtesy of Ona Vileikis)



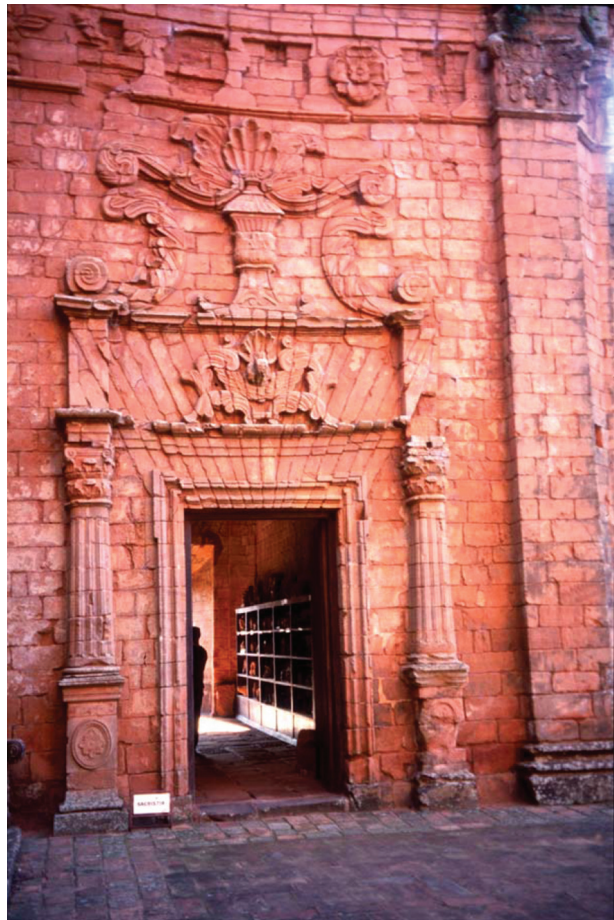
**Figure 4** A view of the church at the San Ignacio Miní, Jesuit-Guaraní mission (Argentina) that illustrates the layout model used for these missions

asked why this mortar was chosen the response was “*The last experts who came here told us not to use Portland cement*” the local staff being totally unaware that an epoxy resin-based mortar would be even worse than any Portland cement formulation.

Further examples of misguided regular maintenance were observed in some of the various Guaraní Jesuit Missions in the area of SE Brazil, E Paraguay and NE Argentina [23] (Figure 4). There employees responsible for the conservation of the ruins of the church at one of the Missions regularly cleaned the red sandstone masonry to eliminate soiling, such as biocolonization, using water and stiff plastic fiber brushes, eroding the stone surface by this repeated action (Figure 5). This and similar other observations resulted in the organization by World Monuments Fund of three workshops (held in Brazil 2003, Argentina, 2004 and Paraguay, 2007) to train the local staff responsible for site maintenance and to publish a basic conservation manual [24]. These actions proved to raise the consciousness of at least some of the local staff who have gained confidence in the work they are performing and, when they are not sure whether the intervention they are planning is correct, to seek advice (Myriam Ayala, personal communication, 2014). This positive result was also observed in other countries after well-implemented extraordinary maintenance interventions [25].

## 5 Monitoring

One of the critical points when undertaking the “ordinary” maintenance corresponds to the timing at which these should be carried out. There is no rule to be



**Figure 5** Portal of the sacristy in the church at the Santísima Trinidad Jesuit-Guaraní mission in Paraguay, showing the friable condition of the stone so that repeated brush-cleaning may induce surface loss

followed because each object or building is unique. The materials are not the same, neither is their location, use and past history. Therefore, after an extraordinary maintenance, besides the regular cleaning maintenance it is fundamental that regular monitoring be carried out. Again, the timing of this monitoring will depend on the object and, while some guidelines can be given, as discussed in the example of the Tower of Belem project, these have to be established on a case to case basis [26]. Furthermore, it is important that the “ordinary” maintenance should follow the objective of the previously executed “extraordinary” maintenance.

For example, during the intervention of the Gardens of the National Palace of Queluz, which are decorated with over 100 marble statues/busts, over 180 stone bases/pedestals, plus 100 vases, some in marble, some in glazed terracotta, and marble or limestone balustrades, the aim was to improve the maintenance approach and present these elements, particularly the statues/busts, in keeping with their age and environment, that is, slightly weathered but without allowing the development of heavy biocolonization [27–30] (Figure 6). Therefore, the frequency of the regular maintenance has to be developed in accordance to the specific location of the object in question, for example, whether they are in the shade of trees or whether they are located in full sunlight. For this purpose, regular monitoring is necessary to determine the frequency of the ordinary maintenance required. This also applies to buildings, especially if roof or gutters are not properly maintained, so that monitoring should be incremented in years with more rainfall to ensure that no damage develops.

Monitoring requires that those in charge of it have an understanding of the types of problems that can develop

and be capable of recognizing their initial symptoms thus implementing an “early detection”. This in turn allows addressing the issue promptly avoiding significant damage to the structure. It does not require a specialist but a person trained to be observant and attentive to changes and with the common sense of alerting and consulting with those in charge when in doubt.

## 6 Conclusions

Buildings, like any other equipment, require periodic maintenance to keep them in good condition. The change in the “heritage” concept and of its “value” from a purely pragmatic one to an abstract and subjective one, such as historic or artistic, resulted in the loss of the traditional regular interventions in favor of a single, unique and exceptional one that would resolve all problems for the foreseeable future. Unfortunately, this approach has proven unsuccessful because conservation interventions are usually carried out when the various problems besieging the object have become so obvious and have reached such a degree that even the untrained eye realizes that something should be done to preserve this heritage. At this point, the fabric of the object has suffered major irreversible changes and losses, to the detriment of its preservation potential and requiring far more complex and invasive conservation interventions. This in turn, will jeopardize the success of the intervention and the long-term durability of the object. Finally, the overall cost will be far higher than if maintenance was implemented as soon as problems are identified by early detection via regular monitoring.

It should not be forgotten that although the deterioration of our architectural heritage continues at a



**Figure 6** Extremes in appearance found in marble statues in the gardens of the National Palace of Queluz, Portugal at the beginning of the project. Left: a statue totally disfigured by lichen colonization. Center: a recently cleaned statue that stands out by its whiteness. The drastic cleaning used wears away the stone surface. Right: an acceptable “intermediate” appearance that shows the weathering without diminishing the aesthetic value

slow pace beyond our human life span, it will be cumulative and increasing in deterioration rate with the passage of time so that future generations will have to deal with the consequences of our actions.

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