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INDICE

GUIDELINES FOR THE PLANNED CONSERVATION AND RESTORATION OF THE RUINS OF NINFA: A TOOL FOR THE PROPER MANAGEMENT OF THE FRAGILE BALANCE BETWEEN ARCHITECTURE AND VEGETATION

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Abstract.
In a complex site as the Garden of Ninfa, the conservation practices of the ruins, carried out through both circumscribed and wide-ranging interventions, represent an essential means for the maintenance of the aesthetical value of the site.
The recent series of interventions, promoted by the Roffredo Caetani Foundation over the last two decades, show a changed approach, which has also highlighted the importance of developing an integrated management method, based on the principles of planned conservation and environmental and economic sustainability.
This methodological development constitutes the basis for the proposal of 'Guidelines for the Planned Conservation and Restoration of the Ruins of the Garden of Ninfa', a programmatic document in the process of being completed, that outlines the conservation methods to be applied to these structures.
The methodological framework of the Guidelines summarises a logical process that, starting from the analysis of the characteristics of existing structures and the general assessment of risk factors and levels, intends to determine the most urgent interventions and the possible coherent processing methods.
It is a process aimed at a less time-consuming and economically more sustainable management, as it rationalises the programming and determines, over a medium-long period of time, a much lower cost and greater protection of the site, producing a beneficial return for the community and in terms of environmental sustainability.

Keywords: *guidelines, ruins, planned conservation, historic garden, architectural conservation*

Introduction

The bucolic image that is revealed to the eyes of the inexpert visitor walking along the paths of the Garden of Ninfa, devoid of historical conditioning or specific botanical interests, conceals a complex management model and conservation practice, dictated by the peculiar symbiosis between vegetation and medieval ruins. Although intrinsic to the history of the site, this relation took on a picturesque character following its conversion into a garden from the 1920s onwards. The aesthetics of the sublime, which inspired artists and intellectuals to visit the vestiges of the ancient city covered in ivy and surrounded by the waters of the Pontine Marshes during the 19th century, survives today only in historical accounts and iconography. Nevertheless, it allows us to understand the indissoluble bond that has been established over the centuries between ruins and vegetation, a source of inspiration for the modern romantic aesthetics of Ninfa (MATHEUS 2022, p. 38).

The site has gone through numerous historical vicissitudes, the most remarkable of which was the destruction and failed reconstruction of the settlement at the end of the 14th century, followed by a rapid and constant decline of the already partly abandoned city (MARCHETTI-LONGHI 1964, p. 24). Successive centuries in which nature took possession of the site have led to numerous conservation problems in the ruins, such as widespread material decay and structural instability phenomena. Even though most of these phenomena are part of the picturesque aesthetics of the current garden and do not necessarily affect the structural capabilities of the ruins, indeed representing an essential part of them, over the last hundred years there has been a wide range of interventions on structures with serious conservation issues undermining their stability.

The Roffredo Caetani Foundation, committed to the protection and enhancement of Ninfa since 1972, has recently implemented a very active intervention policy, which is also the result of an increased recognition of the garden's cultural value among the public and institutions: this has enabled resources to be obtained for both major and minor interventions, also enhancing areas of considerable historical importance distant from the common visitor paths. The wide frequency of conservation projects over the last twenty years has thus highlighted the need for a more articulated management policy, which would allow more carefully weighted project choices, intervention modalities and techniques.

In this regard, the Guidelines for the Planned Conservation and Restoration of the Ruins of the Garden of Ninfa («*Linee Guida per la Conservazione programmata e il Restauro dei Ruderi del Giardino di Ninfa*»), hereinafter referred to as the Guidelines, intend to be a tool for a more rational and planned management of the site's conservation processes, to be implemented in close collaboration between managing body, supervisory bodies, and proactive citizenship. Currently nearing completion, the guidelines have been developed in collaboration with Sapienza University of Rome as part of a doctoral research aimed at defining sustainable management methods for the garden.

Aims and Method of the Guidelines for a Planned Conservation

Within the framework of the conservation processes on Italian cultural sites, a widespread awareness of the importance of planning and programming tools for the interventions has been observed in recent years. This realisation is linked to several factor, namely the increasing recognition of the importance of historical evidence previously considered as less valuable and the awareness of the actual advantages, not only qualitative but also economic, of such strategies. Furthermore, the large public subsidies granted in recent years for large-scale cultural heritage projects have emphasized the need for more planned conservation programmes, also envisioning the environmental sustainability, which is assuming a key role in the policy guidelines and management processes of these sites.

Aware of Ninfa's cultural value and of its responsibilities as managing body, the Roffredo Caetani Foundation has promoted several projects towards climate change mitigation and adaptation in recent years, the last of which thanks to Italy's Recovery and Resilience Plan funds for historic gardens, aimed at the sustainable restoration of the *Hortus Conclusus* and the ancient hydroelectric power station. Specifically addressing the ruins, the Foundation's objective is to implement a coherent and coordinated management of conservation processes, guided by a programmatic document such as the above-mentioned Guidelines.

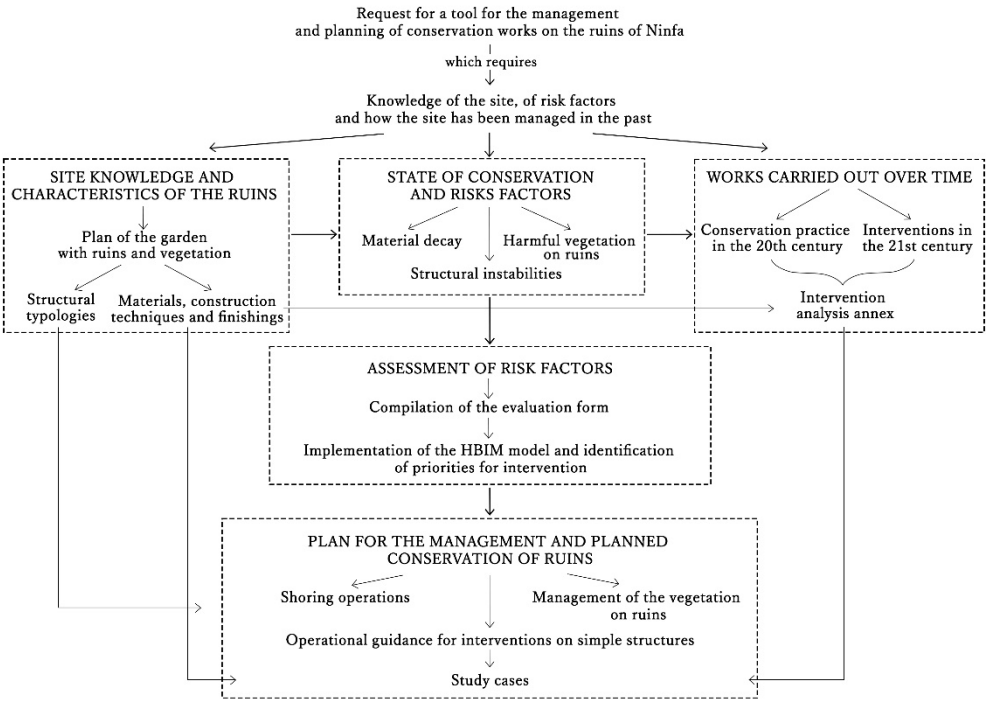

Fig. 1. Flow chart of the Guidelines (diagram by the Authors)

The Guidelines therefore define the methods and operational aims of a long-term strategy, based on an in-depth knowledge of the state-of-the-art and intended to establish the appropriate criteria for the planned conservation of the ruins of the garden. They are structured according to a methodological pathway (fig.1) that starting from the knowledge of the structural and constructive characteristics of the ruins, through the study of risk factors and past interventions, leads to the assessment of criticalities and intervention priorities, and finally to operational indications.
Structured in three parts propaedeutically related (Knowledge, Assessment and Operational Indications), the Guidelines give great importance to the practical aspect of the interventions, the in-depth study of which is essential to maintain the uniqueness of the site and comprehend the conservation practice that will be implemented in it. To this end, they highlight how the recourse to restoration work must be anticipated (and to a large extent substantially replaced) by constant maintenance, carried out in the logic of preventive and planned conservation, in keeping with the romantic aesthetics of the site: very often, maintenance activities alone are in fact sufficient, in order to prevent environmental factors and growth of harmful vegetation from making structures more vulnerable, forcing more complex interventions later on.
It is also interesting to note how the strategy of planned conservation has often been related, over the last twenty years, precisely to archaeological sites. In them, in fact, the issues of prevention and maintenance assume a prominent role, and the definition of maintenance plans with an analytical and design character are the instrument through which they can be implemented (GASPAROLI, CECCHI 2010, p. 20).
In archaeological contexts, however, there is often a strongly preventive and protective approach to the heritage, which does not consider restoration work proper; the latter, although limited, may indeed become necessary over time. The narrowness of the exclusively preventive and maintenance-oriented approach of such plans therefore leads back to the usual problem of restoration intervention not infrequently detached from the organic vision of conservation processes.
Thus, the Guidelines for the Planned Conservation and Restoration of the Ruins of Ninfa attempt to address these issues, in the awareness that the now recognised specificities of restoration in the archaeological context can offer a valid source of reference for interventions coherent with the characteristics of the site.

The Knowledge Phase

The practical approach required of the Guidelines is revealed, right from the document's opening chapters, by the analysis of the characteristics of the ruins, fundamental for the subsequent determination of risks and compatible interventions.
The knowledge analysis is specifically structured into three analytical phases:
1) site knowledge and structural and constructive characteristics of the ruins;
2) analysis of degradation, instabilities and harmful vegetation on the ruins;

3) previous interventions.
The in-depth study of these themes within a document that establishes principles and methods for the conservation of the ruins intends to provide an overall knowledge of the object of study to those involved in the process: by understanding the formal and constructive characteristics, as well as the causes of degradation and instability, the motivations behind the numerous interventions that the Caetani family first, and then the Foundation, have implemented over the last century to ensure the preservation of Ninfa's picturesque character will become clear.

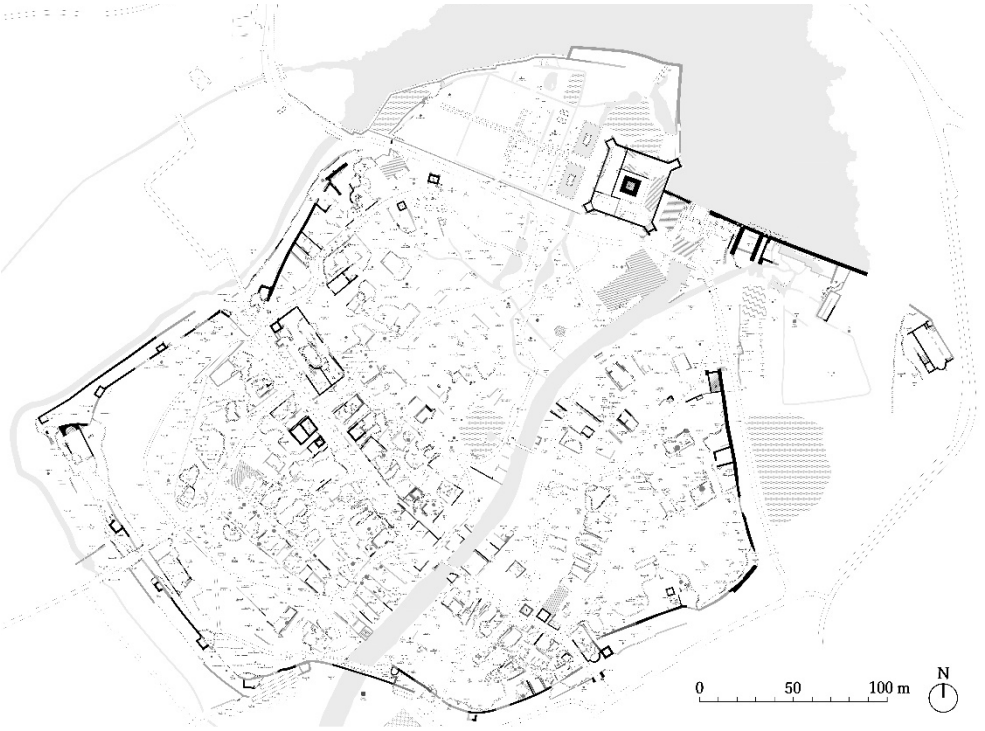

Fig. 2. Planimetric map of the Garden of Ninfa (scheme G. Tedesco)

The study began with the reworking of the site's planimetric map (fig.2), where the ruins were graphically identified one by one; they were, in turn, catalogued using a code identifying their sector, height, thickness and construction technique. The planimetry also identifies the tree and shrub species present and the relevant size of their trunks, thus also constituting an important source of knowledge that can be drawn on in the future to study the evolution of the vegetation over time.
The ruins of Ninfa constitute a very rare example of an abandoned medieval urban palimpsest, and among them numerous building types typical of 11th to 14th century architecture can be found. The Guidelines therefore identify on the one hand simple structures, i.e. single or connected walls (from 0.40 m up to more than 9 m in height),

and on the other hand complex structures, i.e. vaulted roofs, apsidal semi-domes, towers and bell towers. This distinction was done to highlight how the Guidelines only delve into the study of simple structures, the conservation and restoration of which follows unitary principles and methods.
The structures were analysed in relation to the masonry construction technique found. Constructed during a rather limited time span, using exclusively tuff, limestone and seldom travertine (MANCINI 2019, p. 57), the building techniques of Ninfa are rather homogeneous. However, a detailed analysis of the walls has allowed as many as sixteen different construction techniques to be identified, being them all with a concrete core (DOGLIONI 1993, p. 140). Among these, it is worth noting the ample presence of the so-called "tufelli" masonry type, of which Ninfa represents one of the most interesting case studies (ESPOSITO 1998, p. 171).
The analysis of the historical mortars carried out at AStReLab, the materials analysis laboratory of the DSDRA Department of Sapienza University of Rome, then made it possible to ascertain their good quality (due to the abundant use of pozzolan and quarry aggregates), also in consideration of the adverse environmental conditions to which the ruins have been subjected over the centuries. Still referring to the characteristics of the ruins, the types of finishing plasters, and in particular the frescoes that still characterise, albeit only in limited portions, some of the ruins of Ninfa, were finally analysed: more than fifty years after the studies, restorations and detachments carried out by Paolo Mora and Laura Sbordoni, often in collaboration with the chemist Giorgio Torraca, in the main churches of the garden (PHILIPPOT 1990, p. 281), it seems appropriate to pay renewed attention to the surviving frescoes in order to avoid their definitive disappearance.
The study of the characteristics of the ruins was followed by the cataloguing of the risk factors. Specifically, the Guidelines focus on the types of losses, from mortar joints to entire portions of masonry (of the face alone or of the core too) and on the phenomena of instability (including in-plane, out-of-plane and angular overturning, as well as foundation failure and masonry buckling), as well as on plant species whose root growth may pose a risk to masonry conservation.
Having defined the potential critical aspects for the conservation of the ruins, it was possible to analyse the past interventions, both by means of reading the project documentation in the Foundation's archive and by *in situ* study (fig.3).
Visual identification was also essential for understanding how the twentieth-century interventions were carried out, as no written documentation has survived.
The understanding of these interventions is an essential issue for the definition of a future conservation plan: they represent the outcome of a precise project policy in line with the aesthetics of the garden, adopted and defined by the Caetani family and then carried forward by the Foundation, in the wake of which the Guidelines are to be implemented.

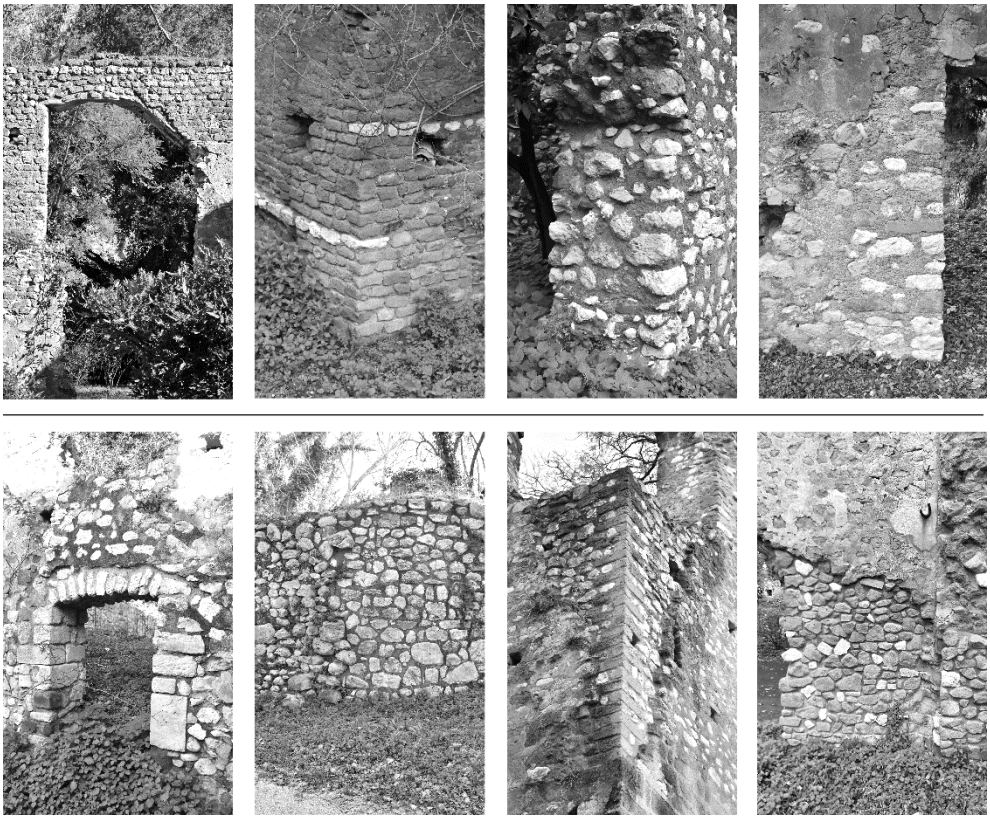

Fig. 3. Examples of restoration works on the ruins of Ninfa, carried out respectively during the 20th century (upper strip) and from 2004 to 2023 (lower strip) (photos G. Tedesco, 2023)

Criticality Assessment and Digitised Data Management

An essential part of a programmatic document such as the Guidelines, through which a conservation plan structured over time is to be defined, is the assessment of the site's conservation status.

In the case of the Garden of Ninfa the analysis focuses on the simple structures, which make up approximately 90% of the ruins within the city walls. Indeed, the complex structures, especially those with apses or vaulted roofs, as well as the double defensive walls surrounding the city, require a specific, more complex and precise method to assess the state of conservation.

The peculiarities of Ninfa draw attention to the need for a procedure based on the overall quantification of characteristics for each wall. The difficulty in implementing a systematic and scientifically rigorous assessment of the critical factors, also in view of the large number of elements to be analysed, determines the choice of an empirical approach, nevertheless based on in-depth knowledge of the site. In addition to the numerousness of ruins, the multiplicity of the forms of degradation (often difficult

to quantify) and the different historical and architectural value of each element, in fact compel an operational approach that cannot be based exclusively on the use of digital instrumentation for structural or environmental monitoring, which is in any case desirable in specific cases requiring prolonged monitoring over time. The high costs, the operational commitment and, moreover, the interference of these instruments in a natural site such as Ninfa, consequently, highlight the need to implement an assessment through the visual survey of the critical conditions of each wall, possibly repeated every two years.

Considering mainly the factors that can lead to the deterioration of structures and endanger the safety of visitors, the tool through which their gravity is defined is the evaluation scoresheet, filled in manually for each wall. Organised in ten macro-areas, in which there are several analysis factors, this form determines a final value out of a potential thousand points.

The macro-areas include both intrinsic and extrinsic factors such as morphological and constructive characteristics of the ruin, connections with other elements, monumental significance, and the presence of vegetation, but the focus remains the assessment of decay phenomena and structural instabilities. The latter constitute the factors of greatest interest, as they are the main cause of potential collapse (of individual stone elements, wall portions or even the entire structure), and are divided, within the sheet, into losses, deformations and instabilities, and cracks. Each of the forty-three total entries consists of three or four options to choose from, depending on the absence or the presence (and so its significance) of the phenomenon or characteristic.

The objective of this analysis is to obtain an overall picture of the state of conservation of the garden's ruins, and consequently a classification of the structures that need to be worked on most urgently.

To this effect, with a view to a management process of conservation practices that can be shared among the operators and updated over time, an HBIM model has been developed following the result of previous studies carried out at Sapienza University of Rome (D'ANGELO et al. 2019, p. 238). The model was developed starting from the new planimetric map of the garden, and it represents each single wall as a parallelepiped element, characterised on thickness and height.

The usefulness of this system lies in the link that is established between Revit (the HBIM software of the model) and the data obtained by filling the scoresheet for each ruin: these data are transcribed on an Excel spreadsheet, where each line refers to a single wall. The link between the data on Excel and the model is made through Dynamo, a visual programming software available with Revit. Dynamo works by means of a string of nodes, where the spreadsheet information is exported, categorised, elaborated and then imported into the Revit model, finally representing an information included in the parameters of each element. It means that a real-time link is obtained between the two programmes, with the values resulting from the risk assessment flowing directly into the parameters of each element on the model. Once

the link is established, every single modification of the Excel spreadsheet is directly updated on the model.
Through a chromatic characterisation of the elements based on the values of the parameters, it is hence possible to highlight the structures based on their characteristics: it means that an operator, accessing the shared model, could easily check the instabilities of a wall, as well as its previous interventions information, or even understand the areas of the garden with a more urgent need of conservation works. Thus, the HBIM model represents a support for the management the conservation strategy of Ninfa, also considering that all information on past and future interventions can be entered and managed there.
The framework of this method can easily be implemented on other sites characterised by a wide range of elements. Nonetheless, it is important to emphasize the uniqueness of Ninfa, exemplified by the bespoke scoresheet strictly related to the characteristics of the ruins and the principles of its conservation. These are clearly different from those of other archaeological sites, where more conservative attention is required, e.g. Roman cities. Therefore, the method can be considered as a reference for data and conservation work management, but data collection and intervention planning must be considered on a case-by-case basis.

Operational Indications, from Maintenance to Conservative Interventions
A critical issue frequently found in broad archaeological sites is the difficulty in regulating the methods of intervention over time, due to factors such as cultural or management changes or, even more simply, the use of different workers. Although these represent inevitable and, to some extent, even positive aspects, since they are generally accompanied by gradually more mature reflections, there is no doubt that in sites characterised by a vast heritage, the coherence of the operative methods remains an objective to be pursued.
As the third and final part of the document, the Guidelines deal with the planned conservation strategy and with the operational methods, specifically with maintenance practices and types of conservation work consistent with the characteristics of the Ninfa specificities. The document is not intended to be coercive, but rather to guide and direct operators towards appropriate types of intervention and working methods.
As a first theme of analysis, the Guidelines identify the principles on which to base preventive and maintenance activities. The latter are therefore identified in the practical activities aimed at limiting the occurrence of degradation phenomena. Particular attention is given to the complex relationship between ruins and vegetation, identifying a method for the removal of plants whose growth on the masonry may cause significant damage to the structure, and the retention of unharming species: a practical approach, hence, with an instrumental character as appropriate for activities falling within the scope of planned maintenance (DELLA TORRE 2014, p. 12).

The definition of shoring operations, although apparently an ordinary issue, is of extreme importance in the context of Ninfa and requires an approach that goes beyond the sphere of mere prevention, falling rather into the sphere of design. It is therefore hoped that the practice of intervening to secure structures at risk of collapse through provisional works of an architectural nature, aesthetically and structurally consistent with the characteristics of the garden, will gain ground in the coming years.

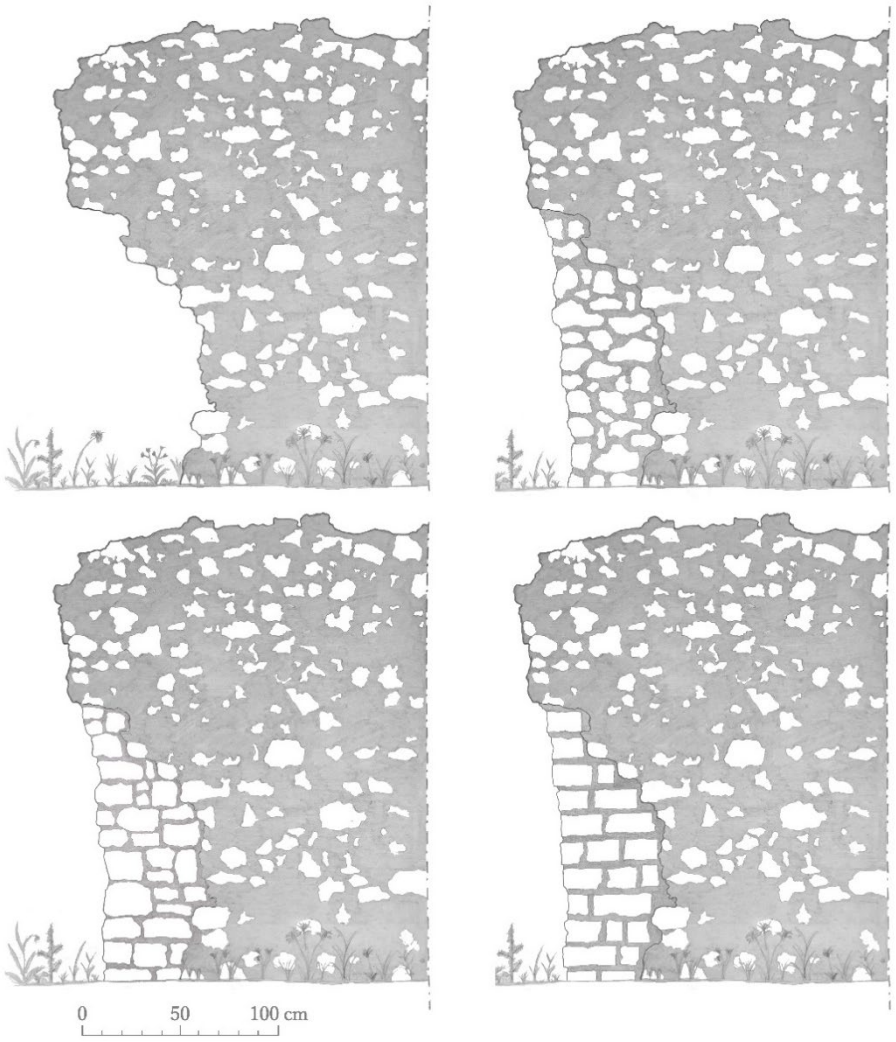

Fig. 4. Graphic representation of different possible intervention modalities for the masonry reintegration of a ruin without termination. Depending on the characteristics of the ruin, the solution must be weighed up on a case-by-case basis, while maintaining some constant and identifiable guidelines for all interventions on the site (scheme G. Tedesco)

As far as restoration operations are concerned, the Guidelines outline the forms of intervention that are most consistent with the structural and material characteristics of the ruins. Several types of intervention have been selected, some of which are subdivided into sub-items in relation to the scope of the intervention: this is the case, among many others, of the restoration of masonry losses (that can be carried out, depending on the state of conservation of the masonry, by means of total or partial reintegration, or by simple plastering).
Finally, the intervention typologies were analysed with regard to the working methods. Starting from a reflection on the principles of archaeological and architectural restoration and on the historical-cultural values of the garden, the guidelines define the methodological criteria and methods underlying the conservation practice of the ruins. To this end, following the model proposed by Guglielmo de Angelis d'Ossat to represent the modalities in which masonry lacunae can be reintegrated (DE ANGELIS D'OSSAT 1995, p. 87), a schematisation of the various possible modes of intervention is being carried out, also through the graphic rendering of some case studies (fig. 4). Moreover, masonry reintegrations have constituted the prevailing type of intervention in the conservation history of the ruins of Ninfa; as a result, a careful analysis of restoration techniques is hoped for, to avoid imitative interventions that disguise the historical value of the original masonry, as well as reintegrations that disfigure it in the name of recognisability of the intervention.

Conclusions

The Roffredo Caetani Foundation has recently promoted the definition of a management model for Ninfa that is framed within the principles of planned conservation. It is based on a critical process that from the analysis of the state-of-the-art leads to the proposal of possible design solutions to be adopted according to the conservation status of each ruin. Thus, the acknowledgement of the complexity of conservation practices in the Garden of Ninfa, where there are many variants that underlie management and design decisions, not least the close, constant and changing relationship with the vegetation, originated the drafting of a programmatic document that illustrates this methodology, namely the Guidelines for the Planned Conservation and Restoration of the Ruins.
The adoption of the computerised HBIM model of the garden also makes it possible to share information regarding past interventions, the current state of conservation and indications on future projects, speeding up the process and guaranteeing greater quality and economic sustainability of the interventions. Not to be overlooked in this regard is the possibility of in-process procedural corrections based on the evaluation of the effectiveness of the computerised process, which can be managed directly by users.
In the wake of the maintenance plans recently defined for other archaeological sites, this management model intends to guarantee greater procedural slenderness and

rationality of operational choices, but with specific attention also paid to the types of restoration work: the precarious state of conservation of numerous ruins, together with the awareness of the importance of working methods coherent with the construction characteristics of historic masonry and with the spirit of the place, in fact induces a very operative approach, also linked to the assessment of the conservation issues found on the ruins.
Among the advantages of the Guidelines is the potential simplification of the process through a more coordinated analysis and control activity by the supervision authorities. Indeed, sharing the criteria of the Guidelines among all those involved in the conservation process, also through the adoption of continuously updatable computerised methodologies, is an essential part of this operational strategy.

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