e-phc21

Guide to good practice in archaeological intervention in raw earth architecture

Junta de Andalucía

Consejería de Cultura y Deporte

Instituto Andaluz del Patrimonio Histórico

04

Before the intervention: prognosis and risk management for planning the excavation

María Arjonilla Álvarez
Dept. of Painting, University of Seville

Introduction

The archaeological method is based on scientific methodology. This involves drawing up a preliminary project, in which the excavation is demarcated in the environment, the expected objectives are outlined and the methodologies of action are adapted to the reality of the site. According to the Regulation on Archaeological Activities in Andalusia, this project, in addition to the preliminary documentation, includes a series of sections directly related to the organisation of the excavation.

Since the 1970s, international meetings have been held on the conservation of adobe and other raw earth materials, seeking how best to prolong the survival of these excavated structures, which are condemned by their extreme vulnerability to water, as discussed in previous chapters. And one of the key factors, as with much of the archaeological heritage, is proper planning of the excavation:

"The first key consideration when planning archaeological excavations is to prevent the deterioration of the cultural materials that are recovered through these excavations. These materials also include the site's structures. On this view, the Yazd resolutions (1976) recommended that no archaeological excavation should be undertaken at sites likely to have remains of adobe structures unless a policy of provisional conservation had been put in place and a budget approved by archaeologists and the competent authorities had been included in the excavation.

Even where no conservation policy has been adopted, the Ankara Resolutions (1980) include the following recommendation: newly excavated adobe material should be given immediate temporary protection until its significance is known and a permanent conservation plan is formulated. The aforementioned resolutions emphasise the importance of drawing up a conservation policy as a fundamental step in preventing the deterioration of archaeological sites as a result of exposure to environmental agents (Alva Balderrama and Chiari 1987, 114).

Based on current prevention policies (see, among others, Fernández, Levenfeld and Moreneo 2011; Herráez, Durán and García Martínez 2015) the effectiveness of risk management is included as an integral part of action planning. Threats will be identified from the survey of the site environment, and alerts will be added in each sequence of the excavation progress.

The planning itself must include this risk monitoring, comparing the initial schedule design and the work plan to determine whether they are suitable for the planned objectives. The following are external factors prior to excavation:

– The weather forecast and the excavation period.
– The study of geographical factors and site accessibility.
– The feasibility study, with the planned excavation methodologies.
– The provision of sufficient human, technical and financial resources, which should be in accordance with the scale and duration of the proposed excavation.
– The formation of an interdisciplinary work team, with a clear allocation of responsibilities and hierarchies for decision-making, setting the direction and coordination of teams.

The effectiveness of archaeological planning is closely related to a parallel risk management plan based on a prior prognosis. Risk management is conceived as a predictive tool, based on analysing how vulnerable the remains are and the degree of loss that may result from the impact of deterioration factors. Its main objective is to draw up a preventative plan to minimise unforeseen events, considering all the details of the project, to detect real or potential threats that may arise from it, as well as their degree of impact on the remains according to their type.

Prediction is based on the behaviour of materials in adverse circumstances. It is a mechanism that is already systematised, and which relates the indicators of alteration of archaeological remains to the agents that cause that deterioration.

The vulnerability of earthen architecture is directly related to what it is made of and how it was made. We relate forecasting to prior knowledge and accumulated field experience regarding the behaviour of materials (see chapter 1), according to the following parameters:

– Type of remains, nature and construction system.
– Function1 of their elements.
– Use made of buildings and material history.
– External conditions (mainly geographical and environmental).
– Available resources.

In order to identify the impact of possible risks, Guichen (Gómez

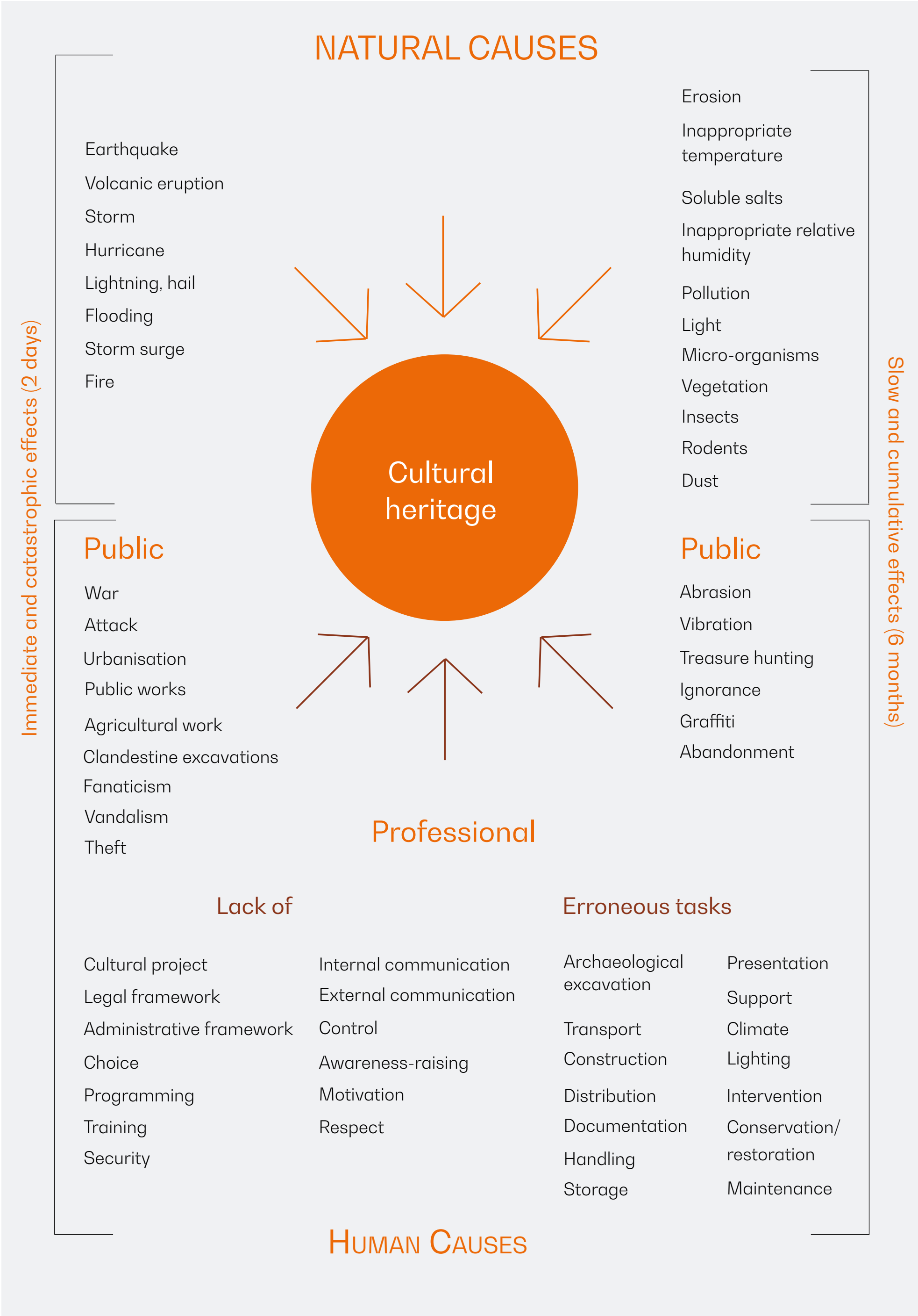
González and Tapol 2009) produced a graph showing up to 60 types, grouped according to their origin and effects on the artefacts, in the short or long term: this systematisation should be analysed in terms of the sum of adverse circumstances, since deterioration factors never occur as isolated phenomena, but always in combination.

Preliminary planning for risk management involves precise identification of the possible threats that could jeopardise the proper conduct of an excavation, before moving on to assess the impact they could have on the archaeological remains, all before starting work. This is the only way to make a sound prognosis in order to monitor the work and, ultimately, to ensure the conservation of the archaeological remains before the vestiges and their condition are discovered.

The identification of real and potential risks for the planning of the excavation

The administrative procedure of the Regulation on Archaeological Activities is in itself a guarantee, given the risk of losing the documentary value of the collections. We will consider ignorance of the regulations and their application as the first risk to be considered (see chapter 3). The complete absence of this procedure exposes the remains to one of the most frequent risks to our archaeological heritage, namely plundering or looting, which is characterised precisely by the speed of action, the impunity of actions that lead to a lack of documentation due to the immediate decontextualisation and, consequently, loss of the object's value.

To detect physical risks, we begin by surveying the archaeological site and its surroundings. After the first site inspections, using non-invasive or minimally invasive techniques if possible, the first data will have been obtained about the possible condition of the archaeological remains without the need to excavate them (see chapter 3). However, in general, if there are no resources available to employ survey techniques, a preliminary visual examination of the site can be conducted. The prognosis is made by predicting the consequences of the main deterioration agents identified and planning for the conservation of the remains must be done in advance in order to respond with an action plan should the predicted potential damage occur.



Deterioration factors based on the table by Gaël de Guichen. Source: Gómez and Tapol 2011

Data collection can be done by means of search protocols, which at this stage are only intended to identify the conditions prior to excavation. On the basis of the expected indicators of alteration, an alert will be raised for the second phase, in which the impact assessment will be conducted, during and after the excavation, on the remains themselves. These are two basic contexts, to which Guichen referred, which we are going to protocolise so as to identify the risks. Although any incident never usually occurs in isolation, we may classify the threats according to their causes.

– Natural factors: all the materials that make up archaeological remains are sensitive to the action of nature and to the local ecosystem.
+ External risks of an environmental origin —climatic, geographical, biotic, natural disasters (earthquakes, accidental fires or floods)— and specific factors related to the nature of the soil influence the mechanical or functional behaviour of the building elements.
+ The materials show chemical, physical and biological modifications in their internal structures, which causes natural degeneration and therefore a loss of their qualities. Most of the aforementioned factors cause gradual and progressive deterioration over time and with seasonal changes (plagues of lichens, fluctuating relative humidity, incidence of the sun or frost, etc.). Whereas, in the case of accidents, the aggression is rapid and devastating. This can be compared to the destabilisation caused by the change of environment, which is typical of post-excavation stress.
– Anthropic factors: here we must consider the critical evaluation of all human activities related to the intervention (study, documentation, planning, excavation, handling of remains, treatment, operation and custody), to consider the risks related to deficiencies in the action protocols that can lead to serious consequences, sometimes immediately. Inaction on the part of the relevant authorities should also be treated as a risk factor. The degree of incidence will determine the need to provide sufficient human and technical resources for the actions. Anthropogenic risk factors include:
+ Lack of recognition for protection by the authorities.
Failure to abide by the regulations governing the monitoring of archaeological activities.
+ Untargeted prior planning: lack of resources, of health and safety at work measures, etc.
+ Actions carried out without knowledge, negligence or poor practice,

Post-excavation constraints

Constraints	In burial	After excavation	Effects of accelerated deterioration
Relative humidity (RH)	Stable	Variable	High RH level: proliferation Of microorganisms and insects, rotting of organic elements due to the effect of hygroscopicity, dimensional changes
			Low RH level: desiccation of organic elements, retraction and dimensional changes
Temperature (Temp.)	Stable	Higher and fluctuating	It affects the RH levels: Proliferation, microbiotics, resistance to frost or drying out of soils and consequent fractures and fragmentation
Air	Limited entry of air	Exposure to oxygen, carbon dioxide, sulphur dioxide, acids…	Proliferation of biotic factors and degradation due to chemical effects
Light	Absence of light	Exposure to light	Proliferation of biotic factors, especially in organic materials: microorganisms and insects. Acceleration of oxidative processes
Contaminents	Presence of salts	Combination of salts and moisture	Soluble salts penetrate, channelled through the water, where they crystallise on the surface, causing deterioration. Insoluble salts form crusts on the surface
	Presence of Microorganisms	Combination of microorganisms, RH and Temp.	Metabolic processes are accelerated, which cause degradation due to the effect of acids

Summary of the impact of natural post-excavation constraints. Table: compiled by the author based on Leigh, in Porto, 2000, 14

lack of skills, abusive interventions.
+ Uncontrolled activity with regard to land use.
+ Any deliberate cause of destruction, plundering or vandalism.
+ Accidents or involuntary losses, such as disassociation or loss of information.
+ Insufficient prevention.
+ Lack of dissemination and maintenance or, on the contrary, abusive presentation.

In the case of the excavation of remains made of raw earth, as in the case of any of the manufactured or natural artefacts that bear witness to our past, the degree of vulnerability is a decisive factor and must be assessed with regard to the environment in which it has been preserved and, *a posteriori*, in relation to the methodologies applied in its excavation or post-excavation (handling, display, museumisation or storage).

The impact of post-excavation constraints leads to a series of modifications derived from the abrupt change in the conservation environment. Usually, they are almost immediately noticeable and their effect continues cumulatively. Remains that over time reached a degree of stabilisation in the burial environment are faced with immediate changes related to contact with light, oxygen, humidity, temperature, etc. (see table on previous page).

Tools for assessing the impact of risks on the conservation of archaeological remains

The previous knowledge accumulated by professionals, based on direct experience and on the application of scientific techniques, makes prediction the mechanism that initiates risk management, using tools that help us to prioritise them according to the degree of deterioration of the remains in response (impact).

The risk factor in the heritage spectrum is related to the degree of loss to which any asset is vulnerable, which is quantified according to the probability of its occurring and the consequences it would have. Undoubtedly, if there is a good prognosis based on planning adapted to the project's needs and objectives, the likelihood and impact of the risks will be minimised.

The assessment will consider a series of parameters that seek to determine the degree of loss related to the threat, in order to be watchful or to prioritise actions if necessary. Thus, the damage will be assessed by taking into account two crucial aspects, its location and its quantification (extent), according to the type of risk factors, both individually and in an integrated manner. In the case of risks of natural origin, there are aspects such as solar incidence, relative humidity, temperature, colonising pests, characteristics of the soil, etc. In the case of anthropic threats, we may cite, among others, the inaction of the authorities, failure to implement associated recommendations, the absence of a prevention plan, insufficient resources or poor practice at various stages of the intervention.

Each risk must be assessed with regard to the following parameters in order to make a preliminary appraisal of the construction material:
– Likelihood or exposure time: in the case of naturally occurring risks, this will depend upon the season, the orientation of the archaeological site and the level of exposure of the area being assessed.
– Consequences for the excavation (classification): this determines the type of damage to the affected area and is assessed according to the results of analyses or on the basis of appearance and diagnosis.
– Affected area (location): this data is essential for assessing the degree of alert, with priority being given for the purposes of the incidence to indicating whether the damage is located at the base of the wall, at the top, on the crown, on the cladding, etc., or inthe surrounding area, affecting the stability of the site as a whole.
- Degree of impact: the effect of these risk agents will be measured according to the severity of the damage observed and placed into one of four categories: catastrophic (risk of total disintegration or collapse), very serious (significant damage to the integrity of the building), serious (a specific need for intervention) and negligible (if it is stable although deteriorated and the damage does not affect the preservation of the site). This record will be used to prioritise the actions to be taken.
- To determine the level of damage to the architectural structures, a more exhaustive survey will be carried out, in which the function and dimensions of the walls must be ascertained by a specialist team. The research carried out in Ecuador through the World Heritage City Preservation Management project of the Faculty of Architecture and Town Planning of the University of Cuenca is noteworthy in this regard. Its conclusions classify the degree of severity of damaged walls according to the following parameters, which are also relat-

Tool for assessing the incidence of natural hazards

Hazard	Likelihood or exposure time	Consequence for the remains (classification)	Affected area (location)	Degree of incidence (damage)
Incident sun/light (assess according to geographic orientation)				
RH/ Temp (assess according to geographic orientation, incidence of rain, condensation, freezing, leaks…)				
Colonising pests (microorganisms, vegetations, insects, rodents…)				
Soil (hardness, resistance to digging, permeability, acidity, salts…)				
Orography and aquifers (slopes, ground movements, flooding…)				
Behaviour of building materials (nature, percentages and commissioning)				
Effectiveness of construction system and structural function				

Tool for assessing the impact of risks based on natural sources of deterioration related to earthen architecture. Table: produced by the authors

Tool for assessing the incidence of anthropogenic hazards

Hazard	Likelihood	Consequence for the remains (classification)	Affected area (location)	Degree of incidence (damage)
Lack of protection or inaction on the part of the authorities				
Non-compliance with recommendations for archaeological activities				
Lack of preventative plan				
Damage to soil-related operations				
Lack of resources (human, technical, financial)				
Poor practice during the excavation (abusive interventions, deficient methodologies...)				
Poor practice during conservation treatments (abusive interventions, deficient methodologies...)				
Poor practice during la custodia (negligence in documentation and record-keeping, dissociation, lack of oversight and maintenance...)				
Lack of dissemination or abusive presentation				
Accidents or involuntary losses				
Vandalism (intentional destruction, looting, plundering)				

Tool for assessing the impact of risks based on anthropogenic sources of deterioration related to earthen architecture. Table: produced by the authors ed to the level of alerts (Achig *et alii* 2013, 81):

- Very high - collapse: when the limit of the wall's physical stability has been exceeded.
- High-critical: the wall has a high level of damage but is amenable to intervention and recovery.
- Medium-conditional stability: the wall is damaged, but the condition of stability is maintained; therefore, interventions can be made to repair it.
- Low and undamaged-stable: no damage at all.

The risk plan would be addressed on the basis of the results obtained from these preliminary studies. The result of the information regarding the degree of impact and the assessment of the significance and impact of the damage, in the specific areas of damage, will be priorities in the intervention, setting a criterion of urgency from greater to lesser and ordering the actions according to resources.

Note

1. In the case of earthen architecture, the structural function of the excavated elements, be they walls, paving, plaster, rendering, paint, decorative elements, etc., should be assessed irrespective of the use of the constructions. Each of them will have a specific impact in the event of any hazard.