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Restoration of monumental rammed earth buildings in Spain between 1980 and 2011 according to the Archives of the IPCE

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ABSTRACT: This study has been carried out as part of the research project called "Restoration of Rammed Earth Architecture in the Iberian Peninsula. Technical criteria, results and perspectives" (ref. BIA 2010-18921), funded by the Spanish Ministry of Science & Innovation. The research presented here consisted in reviewing the collection of the archives of the Cultural Heritage Institute of Spain (IPCE), with a view to providing an initial approach to the interventions on buildings made of rammed earth in the last thirty years (from 1980 until the present day) and funded by the Ministry of Culture of the Spanish Government. The paper strives to provide a preliminary global analysis that will make it possible to draw certain more specific conclusions about intervention criteria and the construction solutions adopted in the different interventions.

1 FOREWORD

1.1 *Aims of the study*

This research strives to provide an analysis of the restoration works carried out on rammed earth architecture in Spain funded by the Ministry of Culture of the Spanish Government during the period going from 1980 to 2011. The documentation about the interventions on Spanish cultural heritage is kept in the institution created in 1985 with the name Instituto de Conservación y Restauración de Bienes Culturales (Institute for the Conservation and Restoration of Cultural Assets), and whose name was changed to Instituto del Patrimonio Cultural de España (Cultural Heritage Institute of Spain, IPCE) in 2008. Therefore the research comprised a first phase of pursuit and compilation of information from the archives and a second phase of revision and analysis.

1.2 *Metodología de investigación*

To carry out the study in the first place we worked with the complete collection of the Cultural Heritage Institute of Spain regarding projects for intervention on buildings from 1980 to the present day. From all the documentation in the archives during this period, those related with buildings made partly or entirely out of rammed earth were selected, and constitute the totality of the study cases.

1.3 *Selection of the study cases*

The first step in the research consisted in selecting from among the 2,779 files in the IPCE belonging to the period 1980–2011 the interventions on rammed earth buildings, which yielded a total study sample of 147 files.

An initial analysis of the chronological evolution of the interventions showed that, of all the records in the archives in the period studied, approximately 73% (2,029 cases) dated from the eighties, that is, almost three quarters of the total; the rest comprised 427 files from the nineties and 323 from the two thousands (Fig. 1).

This situation is very similar if we take only the dossiers selected. Of the 147 records of interventions on rammed earth buildings, a total of 128 were performed in the eighties, which means about 87%; in the nineties there were only 10 dossiers, and 9 in the two thousands.

Due to this irregular disposition of the study cases, as a second step it is necessary to analyse the temporal distribution of the cases that arose in the

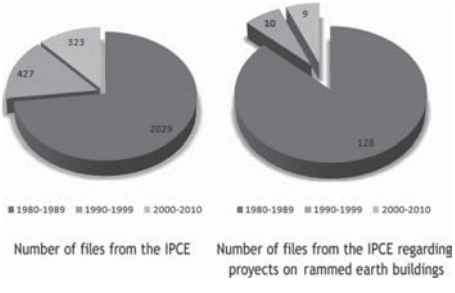

Figure 1. Diagrams of the temporal distribution of the records.

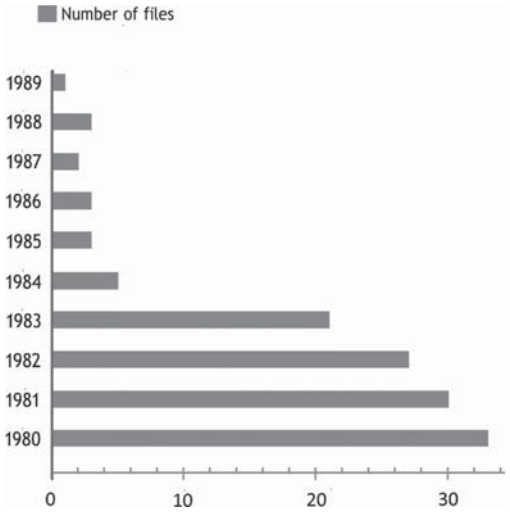

Figure 2. Diagram of the temporal disposition of the cases that arose between 1980 and 1989.

eighties year by year, since this is the most numerous group within the period studied (Fig. 2).

We observe that of the 128 files registered in the eighties, over 86% (111 cases) were lodged in the first four years. This may have been due to the fact that in this period of time great changes came about in the Ministry of Culture, such as those arising as a result of the transfer of powers related to culture to the different Autonomous Communities (Royal Decree 565/1985, of 24 April). With this transfer of powers to the Autonomous Communities, the budget assigned to the IPCE decreased according as the different communities made their own investments in different restoration areas.

Therefore, in these first steps for selecting the sample the records of intervention on rammed earth buildings over the last thirty years could be identified, but it must be taken into account that in all these cases the intervention was not necessarily on the rammed earth walls, but some are of another type, such as works to rearrange the exterior of the buildings or works on the pavements, roofs, etc.

So taking this aspect into account and looking over the 147 files that comprise the sample, we can extract a study made up of 99 files where the works were performed on rammed earth walls and 48 files related to other types of intervention.

2 GEOGRAPHIC MAP OF THE STUDY CASES

When the study sample is analysed, we find that of the 99 files where rammed earth walls were intervened on, a total of 60 different buildings underwent one or several interventions during this period.

From the point of view of geographic analysis of these buildings, three autonomous communities had the largest number of files: Andalucía, with 17 different buildings; Castilla y León, with 13 interventions and the Comunidad Valenciana, with 12 buildings (Figs. 3 and 4).

Of course, this is not a random occurrence, because as we can see on the map showing a scheme of the geographic disposition of the different buildings worked on, there is a fairly uniform distribution, taking into account the territories in Spain where there are larger numbers of monuments made with this building technique. The remaining interventions, in order, were in the communities of Castilla y La Mancha, Murcia, Aragón, Extremadura and Madrid.

It is also interesting to review these buildings according to their typology. In order to draw up this analysis, the buildings have been classi-

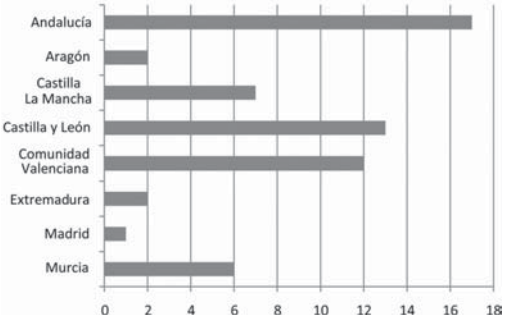

Figure 3. Diagram of the distribution of interventions in each autonomous community.

Figure 4. Map of the interventions studied.

fied in three large groups: military architecture (castles, towers, bulwarks…), religious architecture (churches, convents, monasteries…) and civil architecture (palaces, hospitals, dwellings…).

If we compare all the dossiers of intervention on rammed earth buildings and the 99 files where the interventions were on the walls, we can see that in both cases there is a majority of military buildings, since rammed earth was a very typical construction technique in this type of monumental building (Fig. 5).

If we examine the number of files according to construction typology and year, we find that, as we pointed out above, the vast majority of cases date from the first half of the eighties, but there have also been a series of more recent interventions, because in 1997 a subproject called "Programme of Military Architecture" was included in the budgets assigned to the IPCE in the general State Budget. Thanks to this fact, interventions were carried out on this type of building, which were, moreover, State property. The dossiers from this period are not very numerous, for in many cases the works were performed jointly with the different autonomous communities and provincial and city councils, etc., and also with the Ministry of Defence when the interventions were on buildings belonging to it, so a great deal of this documentation is filed in the relevant archives.

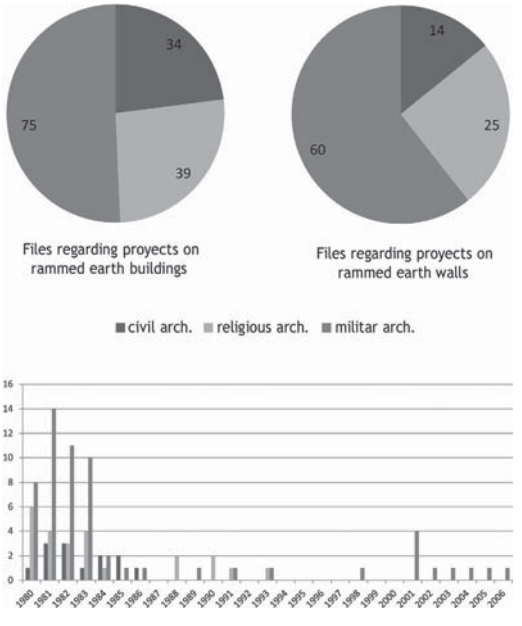

Figure 5. Graphs of the distribution according to typology.

3 ANALYSIS OF THE CASE STUDIES

3.1 *Analysis of the intervention criteria*

The study of the criteria followed in these interventions requires a detailed analysis, because the most contemporary dossiers must be examined in order to find explicit reference to these criteria in the project reports.

On the other hand, in the files from the eighties, which comprise the majority of our sample, the report tends to be a fairly brief text, just a few pages long, which usually contains two basic sections: a historical-artistic description of the monument and a section explaining the works planned. In some cases, the report of the project is a little longer and contains a few more sections, such as a description of the construction system of the building and its current state of repair (before the intervention). Therefore, in most of the files the intervention criteria are not included, or only a few specific ideas are put forward. For example, an idea that appears repeatedly is the desire to differentiate between the new elements and the old, often using new materials but the same building methods. This option can be found in the report of the intervention on the Castillo de Tabernas (Almería) in 1983, in which the author, Roberto Puig Álvarez, proposes that "as the walls of this castle are made of rammed earth, we shall use the same construction system, replacing the mortar of the rammed earth with a mortar of lime and cement mixed with sand and dyed to obtain the same shade as the original wall, using formwork and placing holes with boards the same size as the original ones as deduced from the remains of the wall and the layout of the putlogs. These concrete walls will be reinforced with concrete tie beams with 4ø 16 mm diameter concealed in the rammed earth with the same materials and colours" (File PI 0009.02 of the IPCE archives).

In other cases, we find the opposite idea: using the same materials as the original ones, as in the case of the intervention on Jumilla Castle (Murcia) in 1982, where Ignacio Mendaro Corsini states that "coffered walls (lime concrete) will be used in the areas where the existing parts indicate it." (File PI 0926.07 of the IPCE archives).

It is also a fundamental point in the analysis of the intervention criteria, especially in military architecture, to address the issue of reconstruction. In many cases, the reports speak of "consolidation" as a synonym of "reconstruction". But, as far as reconstruction is concerned, there are several different tendencies. In some cases only some parts are reconstructed, such as the coping of the walls of the Albaicín in 1982, where the architect Ana Iglesias Gonzales said, "Once the floors partly concealed by the outer walls are removed,

we may find traces of the apron and merlons of the battlements, which will allow us to recompose the profile of the top of the monument, that is, its modulation and dimensions, after which we can proceed to re-execute the original apron." (File PI 0077.03 of the IPCE archives).

In some interventions reconstructions are seen as partial volumetric restitution, as Ismael Guarner González writes when speaking about his intervention on the walls of Niebla in 1980 (Fig. 6). "Restore the monument while striving to endow it with a more defined image more like what it once used to be, without having to reproduce the original volume" (File PI 0102.09 of the IPCE archives).

This criterion can also be seen in the intervention on the Castillo de la Mola (Novelda) in 1983 (Fig. 7), where Ramón Valls Navascués stated, "This project is aimed at consolidating the existing ruins, arranging the current volumes in such a way that by completing the shapes which can be deduced from the existing parts, the appearance, the colour, the well-known romantic character of this type of building and this one in particular will not be substantially altered" (File PI 0987.02 of the IPCE archives).

Some of the interventions mentioned attempt to use reconstruction to restore the building to its original appearance, whereas other interventions aim at just the opposite, like in the Alcázar of Jerez de la Frontera (Cádiz) in the intervention performed by Fernando Villanueva Sandino: "When planning the restoration, we tried to be faithful to this historic constant, so we do not wish to restore the site of the Alcázar to the splendour of a given historic moment, but, critically assuming all the interventions that characterise it, provide it with a new appearance…" (File PI 0024.01 of the IPCE archives).

In some dossiers they go as far as to claim that the intervention must be limited to the strictly necessary, as Mariano Bayón Álvarez says in his report on the intervention on the Palacio de Juan II (Madrigal de las Altas Torres) in 1981 (Fig. 8), affirming that "the overall restoration works try to adjust to contingent, really direct, compulsory and necessary principles, without making any concessions to rhetoric" (File PI 0482.01 of the IPCE archives).

On the other hand, in other contemporary interventions they contemplate the complete reconstruction of the walls and even of the coping (battlements…), as is the case, for example, of the intervention made on the Castillo de la Judería in Córdoba in 1983 by the architect Carlos Luca de Tena y Alvear, where "the intention is to reconstruct a wall with the rammed earth method that will make it conserve its primitive character, treating the rammed earth adequately, and on the other hand protecting the upper area so as to avoid loss of height in relation with the original structure." On the other hand, this intervention strives to be an example of intervention criteria in its own right, for as the report says, "we aim to provide an example of the criterion of the ministry that the council can follow. This solution is adopted because the criterion put into practice by the council in the first phase did

Figure 6. General view of the Niebla city walls after restoration (Huelva, Spain) (Vegas & Mileto).

Figure 7. Part of the external wall of the castle of La Mola (Novelda, Alicante, Spain) with the regularization of the volumes (Vegas & Mileto).

Figure 8. Restored building at the first patio of the Palace of Juan II at Madrigal de las Altas Torres (Ávila, Spain) (Vegas & Mileto).

not comply with the criteria of the Córdoba Delegation, confirmed by the technicians of the Ministry of Culture" (File PI 0042.04 of the IPCE archives).

Therefore, we see that the intervention criteria are very diverse in the different study cases, even in buildings of the same construction typology, as is the case of military architecture.

If we analyse civil and religious buildings, the criteria for intervention on the walls are not so diverse, since the very building method (in many cases, rammed earth placed between bricks) has different pathologies that, in many cases, require interventions not so much on the volume of the walls as on their surfaces.

3.2 *Analysis of the construction techniques proposed*

To make an analysis of the construction techniques proposed in the different case studies, it was decided to group the records according to the construction typology of the building, since the construction techniques for the intervention respond to the pathologies usually found.

In the interventions on buildings of the "military architecture" group, such as ramparts, castles, towers…, the construction solutions proposed can be classified broadly into three groups according to the material used on them: restoration with concrete or cement, restoration with masonry and one last group of restoration with newly-applied rammed earth.

In the first group we find, for example, the intervention on the Castillo de Orce in 1980, where José Antonio Llopis Solves explains that the works proposed contemplate the "demolition of the buildings attached. Once the surfaces of the walls and the middle tower have been bared, it will be necessary to proceed to underpin the walls and fill in the gaps that have appeared over the years. All this operation will be performed with mass concrete, making sure to use yellow and reddish sand in the outer layers to blend in with the rest of the wall, differentiating the texture by the way the planks are set out" (File PI 0089.07 of the IPCE archives).

The connection between the original material, rammed earth, and the new material, concrete, depends on the construction detail proposed in each case, but the detail proposed for the Castillo de Petrel in 1982 is common: "Restoration of the surface of the wall with mixed cement and lime concrete, with timber planks fixed with wire, which will be cut off when the planks are removed and the putlog holes will be left visible. Dovetail profiles will be used to attach the rammed earth wall to the existing fabric" (File PI 0988.03 of the IPCE archives) (Fig. 9).

As regards restoration with masonry, we can mention the statement made for the intervention on the Alcazaba in Almería in 1981, where Roberto

Figure 9. Restored wall of the castle of Petrel (Alicante, Spain) (Vegas & Mileto).

Figure 10. South wall of the Islamic castle at Almería (Spain) (Vegas & Mileto).

Puig Álvarez suggests "consolidating with masonry in the existing gaps, first proceeding to clear away the rubble at the base of the wall, to which will be added the rubble from chipping off all the false rendering and plaster in order to restore a stony appearance to the wall, which, even if it is not quite the original Arabic rammed earth, would be more appropriate than all the Christian reconstructions" (Fig. 10) (File PI 0001.01 of the IPCE archives).

In other cases, the interventions use traditional methods although, as we pointed out above, the intervention criterion is usually to make sure the new construction will not be confused with the original one.

In civil and religious architecture, the interventions proposed are different, because, as we suggested above, the pathologies that affect these buildings are usually different too. Interventions on these buildings are usually on the surfaces, as we can see in the intervention on the Iglesia de la Merced (Murcia, 1981), where they proposed "the recuperation of the rammed earth fabrics, to which end an average of 5 cm will be removed from all the damaged surfaces, which will then be rebuilt with lime mortar and the old surfaces will be duly treated" (File PI 0938.04 of the IPCE archives).

When the intervention is to be on structural pathologies, mainly cracks, the intervention methods

Figure 11. South façade of the Church of La Merced (Murcia) (Vegas & Mileto).

Figure 12. Restored wall of Jorquera (Albacete, Spain) (Vegas & Mileto).

chosen also depend on the original building techniques. For example, in the intervention on the walls of Jorquera in 1982 (Fig. 12), they said "as the building material is not stone but mortar, we do not think the solution is to clamp the cracks. Therefore we prefer to fill them in with lime mortar, stone and local soil, to which formwork will be applied in the places where it is deemed necessary and a finish similar to the original will be applied" (File PI 0363.03 of the IPCE archives). In other cases, such as the intervention on the church in Écija in 1983, since it is rammed earth confined between brick buttresses, the solution proposed is completely different: "the surface is cracked just between the two vertical joints that define the rammed earth walls. We propose to consolidate this wall by clamping these cracks by means of toothers or brick repointing" (File PI 0157.04 of the IPCE archives).

4 CONCLUSION

After making this first analysis regarding the intervention criteria and building techniques proposed in the case studies, we can draw some initial conclusions. It is necessary to point out that since the vast majority of records of the study cases date from the first half of the eighties, the ideas put forward below must be seen as pertaining to that period.

With regard to the construction techniques, it is interesting to note that although modern materials like concrete are used, they are applied by traditional methods, since the aim sought is to achieve an exterior appearance similar to that of the traditional material. It is important to underscore also the fact that some interventions serve as models or examples for ensuing interventions, as is the case mentioned by Carlos Luca de Tena y Alvear regarding the intervention on the Judería in Córdoba in 1985: "The study and the solution put forward are based on similar solutions to those adopted under the sponsorship of the Dirección General on the wall of Palma del Río (Córdoba) and on the Castillo de Obejo (Córdoba), under the orders of the architect of that ministry, Eduardo Barceló, and the technique used by my colleague Guarner for the walls of Niebla" (File PI 0042.05 of the IPCE archives). The reference to Ismael Guarner's intervention on the walls of Niebla in 1980 would still be found in future interventions, like the intervention on the walled centre of Cáceres in 1989: "Consolidation with new rammed earth enriched with lime mortar and 5% cement, a system that gave a good result in the consolidation of the walls of Niebla, performed by the architect Ismael Guarner" (File PI 0735.06 of the IPCE archives).

With all this, we can affirm that the first half of the eighties was a fruitful period in interventions on rammed earth constructions from the point of view of the actions supervised by the Ministry of Culture. This first research and analysis has provided information about the situation during a short period of time, and for that reason it must be seen as a first step in broader research that will be carried out in future and that will address different cases.

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