



## TRADITIONAL TECHNIQUES IN MASONRY BUILDINGS AT RINCÓN DE ADEMUZ (VALENCIA)

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### ABSTRACT

A comprehensive study of the traditional construction techniques of the Rincón de Ademuz area (Valencia, Spain) has been developed during the last ten years by the authors. This mountainous area has been isolated from the outside world in a way for centuries. This situation has helped create a very peculiar vernacular construction. Walls, slabs, roofing and constructive details have been thoroughly researched and very peculiar masonry techniques have been identified. They consist of a combination of masonry and gypsum pillars that support the wood structure of the slabs. The walls that fill the spaces between pillars are made of masonry with mud mortar on the ground floor and vertical flat stones with the same gypsum mortar on the upper floors. The strength of this apparently fragile structure has been deeply researched and yielded incredibly positive and unexpected results. These constructive studies have been applied to the real case of an almost completely dilapidated house located in a little hamlet in the area. A very detailed restoration project has been conducted with a view to recover these traditional techniques. This restoration project was conceived as a pilot project for the recovery of the traditional techniques and local crafts of the area to help to restore a great number of buildings of the same type. In addition, a restoration guide for the traditional masonry buildings of the area is being prepared. This pilot project received the 1st Prize of the European Union for Cultural Heritage (Europa Nostra Award 2003).

**KEYWORDS:** Vernacular, Techniques, Gypsum, Restoration, Strengthening, Wood

### INTRODUCTION

Traditional architecture in Rincón de Ademuz, an inland community in the province of Valencia situated between Teruel and Cuenca, is an example of built rural heritage in danger of disappearing. The isolation of the community, surrounded by mountains, has created a very peculiar architectural style closely linked to its surroundings (see Figure 1), and has also led to massive emigration of the inhabitants to large cities [1]. However, thanks to this circumstance, this vernacular architecture has undergone few alterations and, in spite of its precarious state at the present time, conserves most of the characteristics of its particular traditional building style.



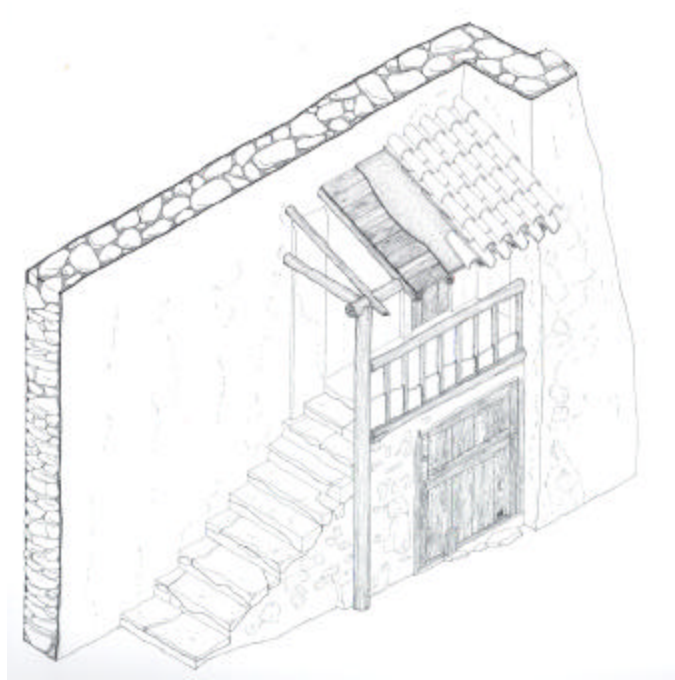
**Figure 1 - View of the Town of Ademuz**

### **INTERNATIONAL WORKSHOPS ON TRADITIONAL ARCHITECTURE**

In view of this situation, traditional architecture has been under examination since 1996 in nine international workshops with the participation of students and lecturers from some twenty universities from all over the world, where composition, morphology, construction, costs, etc. have been studied. Most of the participants have been architecture students, although some researchers from other disciplines have also participated, for example, geology, anthropology, construction engineering, structures. These workshops were mainly funded by the Leader II Programme of the Economic European Union, the Polytechnic University of Valencia and the local group ADIRA (Association for the Integral Development of Rincón de Ademuz), made up of local residents who refuse to resign themselves to the dilapidation of their community.

Part of this research has been published in a book titled *Memoria construida. La arquitectura tradicional del Rincón de Ademuz* (Built Memory. Traditional Architecture of Rincón de Ademuz), with illustrations by the student participants and text by Fernando Vegas, Camilla Mileto and Marina Zucolotto [2].

The drawings (for example, see Figure 2) and texts in this book describe the valuable building techniques of the area in order to facilitate the conservation and restoration of traditional architecture in Rincón de Ademuz. The distribution of this book among the local people has served to enhance the respect they feel for these vernacular constructions.



**Figure 2 - Typical Building Features of Rincón de Ademuz**

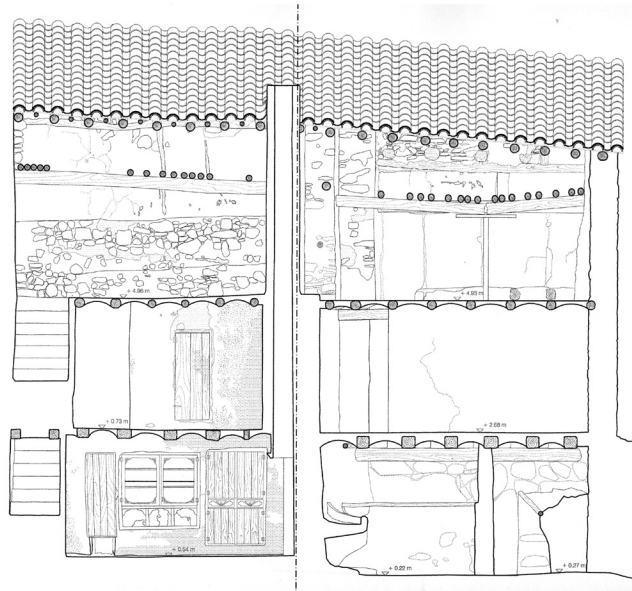
### **CHARACTERISTICS OF TRADITIONAL LOCAL ARCHITECTURE**

Although there are slight variations, the configuration of the houses in Rincón de Ademuz has certain building features that are common to the whole area. The load-bearing structure is not based, as one might think at first glance, on masonry walls. The outer stone wall clad in mud and straw mortar on the ground floor nearly always responds only to the settling, protection and isolation of the ground. The skeleton of the building is made of gypsum pillars the same thickness as the masonry wall (about 40 cm) and embedded in it. This system made it possible to reduce the amount of gypsum used to a minimum.

These pillars are usually erected at a 6 m distance from each other at the most, so that the width of the facade contains one pillar at each end and the depth of the house has three pillars at an equal distance from each other, the central one coinciding with the axis of the ridge piece. There are large timber beams between the pillars to hold up the frame of the house, made of timber joists and shallow gypsum vaulting poured *in situ*. The building system is based on shallow vaulting between joists and is adapted to the specific characteristics of the material and uses it to the greatest advantage. The gypsum set so fast that a single plank form was sufficient. The form, consisting of wooden slats, was placed between two of the joists in the frame and underpinned. The gypsum mortar mixed with medium-sized gravel was poured on from the top and levelled with the ridge of the joists. Shortly afterwards the underpinning was removed, the form was taken down and slipped on to the adjacent joists to form the next shallow vault (see Figure 3).

What we can gather from a photograph dating from the early 20<sup>th</sup> century is that the building process involved making the pillar, frame and roof structure at the same time, even before the facades were erected or the interior layout was marked. The immediacy of this basic structure, with which each owner laid out the interior of the house according to his needs, is reminiscent of

Le Corbusier's Maison Domino, originally conceived as a flexible, instant structure to house refugees from the Battle of Verdun in 1914.

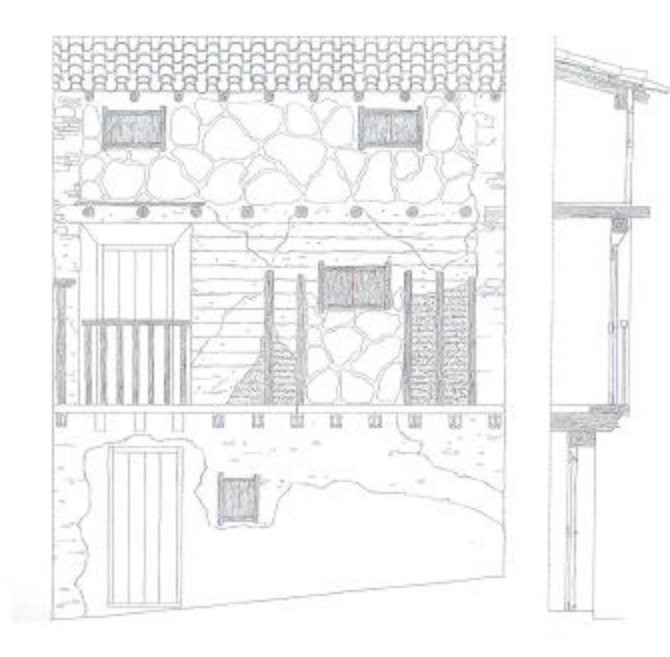


**Figure 3 - Typical Building Features of Rincón de Ademuz**

The facades of the upper floors consist of gypsum-clad partition walls made of stone slabs placed vertically and reinforced with vertical posts at the back. This auxiliary post structure also serves as a support and marked the jambs and lintels of the windows. The process was as follows: first, the gypsum mortar was placed on a vertical formwork and the slabs were pressed against it, then when the planks were removed the marks remained on this gypsum mortar cladding. In spite of its apparent fragility, gypsum mortar has a long tradition of excellent performance when exposed to the elements in this area.

On the other hand, the facade of the attic is usually made of an unclad partition wall of vertical stone slabs built without any sort of form. The ventilation openings in the lofts tend to use the upper facade beam that serves as a support for the roof gable as a lintel, and the auxiliary posts for the building of the partition walls as jambs. On occasion, windows consist of the mere absence of a stone slab in a correctly clad wall without any need for wooden window posts, sills or lintels.

The house is covered with a one- or two-hipped tiled roof. The slopes are usually set perpendicular to the street. Outside the towns, there are very humble primitive examples of single-hipped roofs covered with stone slabs. The construction of the roof rests on rafters supported at the gable end by posts and struts. The spaces between the rafters are covered with wattle or wooden slats. A layer of mud and straw is placed on top of this sloping plane, and on top of this the tiles are laid and bonded with the same mortar (see Figure 4).



**Figure 4 - Typical Building Features of Rincón de Ademuz**

The layout of the interior is marked with partition walls made of stone slabs placed vertically, shored by vertical posts at the corners and the jambs of the doors and clad with gypsum mortar. These walls were originally plastered with gypsum mortar and, more recently, whitewashed. These interior gypsum plasters were periodically given a coat of gypsum wash, which ensured their maintenance and revived their natural local soil colour.

The results of a recent campaign of diagnosis research verified the enormous resistance of these gypsum masonry fabrics, provided they were sheltered from atmospheric and ground dampness. In the case of the savin wood (*Juniperus Thurifera*) habitually used for building in the area, the results of this research were even more surprising. Its knotted appearance and the axial slant of its fibres conceal an extraordinary density and tenacity, exceptional resistance to factors of environmental degradation, and enormous resistance to woodworm, even when it is near other species seriously affected by these agents [4].

#### **A PILOT PROJECT FOR THE RESTORATION OF TRADITIONAL HOUSES**

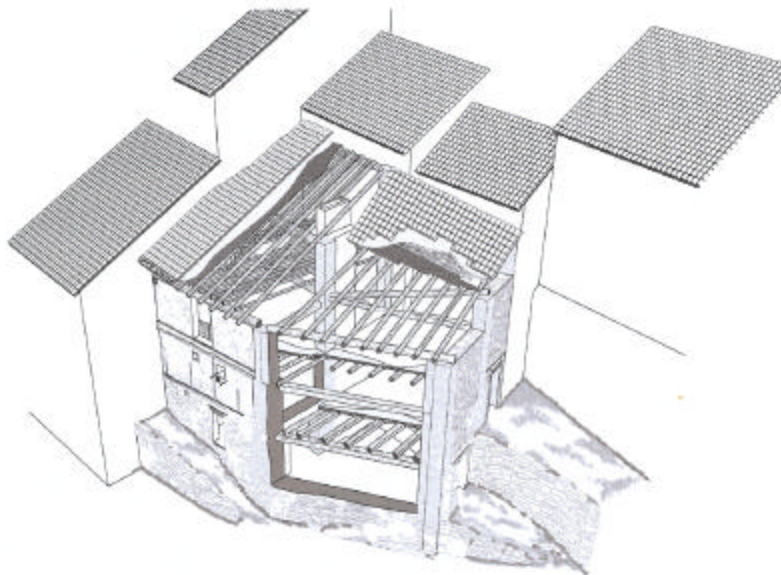
Until recently, the abandonment of traditional techniques, ignorance of the real behaviour of the structure of these buildings and reluctance to spend an unwarranted amount of money in having the houses properly restored have all discouraged owners from restoring their houses so that many of them were demolished and replaced by modern buildings. This research attempted to solve this situation. In the first place, the traditional building techniques of the area were investigated and the drawings resulting from this research were published as a guide for local residents. Then a restoration project was drawn up as carefully as possible for an anonymous house with a view to studying the possibilities of a new application of the old techniques or at least of the same constructional logic, in order to demonstrate that the recovery of traditional dwellings is both possible and economically viable today.

For this reason, a pilot project was drawn up for the restoration of traditional houses in Rincón de Ademuz: an anonymous, humble, rural dwelling was selected, with many of the characteristics shared by other houses, ordinary building features, the morphology, layout and, without a shadow of a doubt, the usual list of pathologies suffered by these constructions [5] (see Figure 5).



**Figure 5 - View of the House Chosen for the Pilot Restoration Project**

This pilot project attempts to apply all the knowledge gleaned by this research group at Valencia Polytechnic University over the years to one particular case. The idea was to perform restoration works that would respect not only the existing building but the history of vernacular building techniques in the region, as seen in Figure 6. Techniques both physically and conceptually compatible with existing building tradition were investigated and the technology concealed within the vernacular solutions were reinterpreted to carry out modern restoration works. These points were borne in mind for both the graphic information and the preparation of the report and budget.



**Figure 6 - Axonometric Projection of the House with a Volumetric-Constructive Analysis**

## **STEPS ENVISAGED IN THE PROJECT**

In order to achieve the objectives of the project, the following steps are to be taken:

1. Application of newly reinterpreted local traditional restoration techniques, some examples of which are listed below:
  - Dry light consolidation of frameworks especially conceived for the joists and shallow vaulting typical of Rincón de Ademuz
  - Possible insertion of tie beams between the gypsum structural piers to provide stability
  - Use of traditional gypsum mortars or transpiring lime mortars
  - Use of mud, straw and lime mortar for the joints of the roof tiles, the best system to avoid bursting as a result of freezing
  - Rebonding of the loose mortar fabrics and rejointing with hydraulic lime mortars
  - Recovery of the woven reed roofs
  - Recovery of wooden carpentry by sanding, stripping and applying woodworm repellents
  - Recovery of beams and joists by immersion, painting and injection of woodworm repellents
  - Recomposition of the missing vaulting in the framework using the traditional plank forms
  - Use of natural traditional parges and cladding of local mortar composed of gypsum, clayey sand and slag
  - Respectful treatment of the existing facades, carefully inserting contemporary wirings
  - Restoration of furniture and utensils found in the house
2. Preparation of a detailed work diary containing all the observations of these experiences and the techniques applied, assessing the performance of the different units, describing the composition of the different mortars and their results.
3. The information gleaned from the work experience and the analysis of the samples of traditional mortars extracted will be gathered to form a guide book about architectural restoration in the area for local residents.
4. Plans will also be drawn up after the works to show their final state and the variations with regard to the initial project.
5. This document and all the surveys and photographic information of the progress of the works process and the finished product will be published as a restoration manual for local residents, masons and builders.
6. According to the project, a large section of the restored house has been reserved as an cultural museum to exhibit the furnishings and utensils, with graphic panels documenting the restoration process.

7. The intention is to present the book entitled *Restoration Guide for Rincón de Ademuz* in the surrounding towns and villages at an event including the exhibition of the panels depicting the restoration of the vernacular house, lectures and talks addressed to residents.
8. Finally, this experience could lead to the creation of an office to provide information and technical advice for the refurbishment of vernacular houses in the area, with a view to orienting residents about the way to restore their houses.

### COMPARATIVE DIAGRAMS NEW BUILDING/RESTORATION

The study carried out for this pilot restoration project made it possible to establish an economic comparison with newly-built houses, in order to reach conclusions about the wisdom of conserving these traditional houses suitably modernised, not only from a personal, cultural, sentimental or romantic viewpoint, but also for the economic development of the community.

In Figures 7 & 8, we can see not only the difference between the prices of new and restored buildings, but the economic consequences in the area where the restoration is carried out. Two types of charts have been drawn up: one reflecting the percentages of the elements in the total cost (labour, machinery, materials, indirect and other costs) and another showing the total works in Euro.

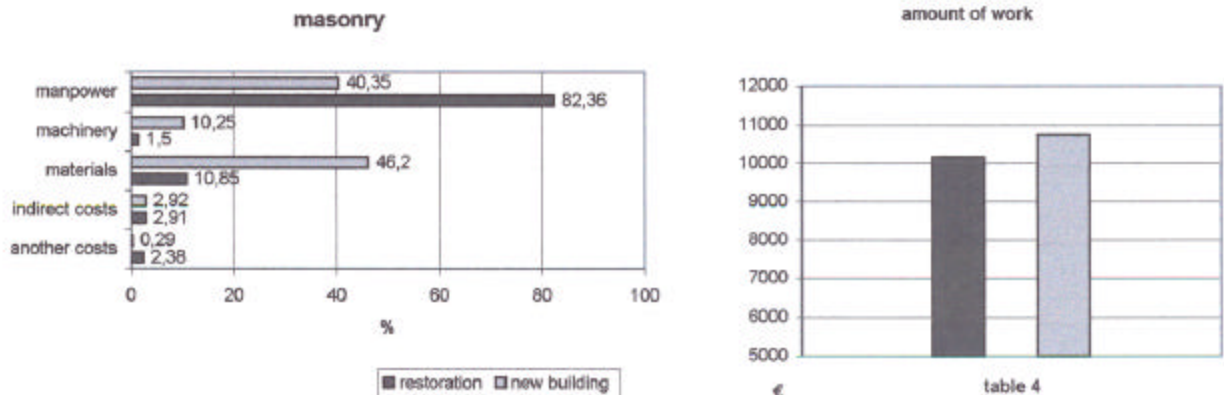


Figure 7 - Comparative Diagrams of Restoration and New Building Prices for Masonry

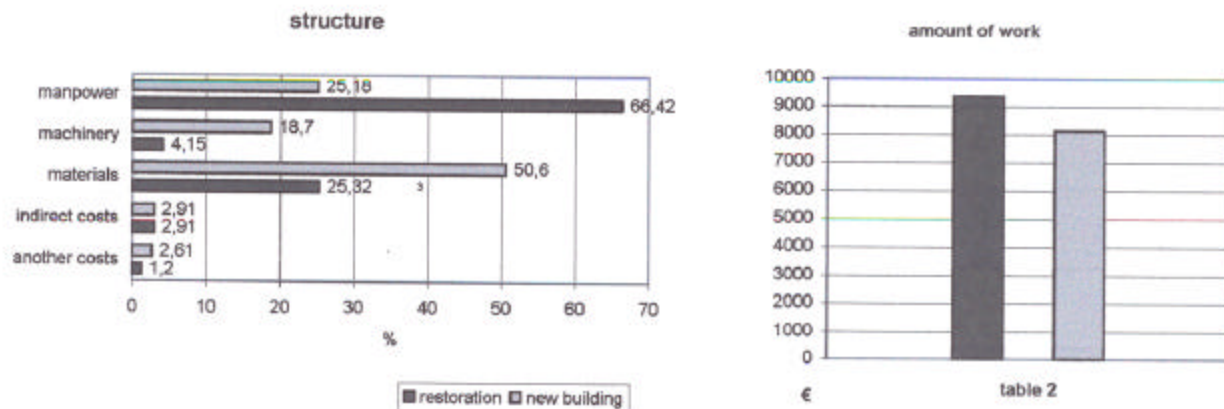


Figure 8 - Comparative Diagrams of Restoration and New Building Prices for Structure



The lack of any sort of industrial production is an indication of the poverty and isolation of Rincón de Ademuz. Only the money spent on labour and local materials will remain in the community. Any other money will go to the place the machinery or already produced materials come from. From the charts on the left one can see how much of the money spent on the building process will remain in the area. We can see that most of the money spent in the restoration of a house is for labour, whereas for a new house a great deal of machinery and ready-made materials are brought in from outside, which involves money that will not remain in the area. That means that restoring a house of this kind in a poor, out-of-the-way community involves investing most of the money required in that community, apart from promoting local crafts and traditional building techniques.

The charts on the right also show the total amount of work in Euro for both a new building and a refurbished one. In refurbishment works, the house already exists, so that most of the work required for a new building is already present, regardless of the state of repair (fair, poor or in ruins). In fact, in the case of refurbishment, hardly any excavation, foundations, cladding or flooring will be necessary. For the structure, roof, masonry and joinery, a similar amount of money/effort will be required, but, as we can see in the diagrams on the left, this investment will stay mainly in the neighbourhood (labour) in the case of restoration and, on the contrary, will be exported from the area (machinery and materials) in the case of a new building.

### **FIRST STEPS IN THE RESTORATION WORKS**

Before this pilot project received the award, the first stage of restoration had been performed on the functional rehabilitation of the walls, beams and roof of the house under study. Lack of maintenance of the building, abandoned over fifty years ago, had led to leakage, the cause of most of the problems in this kind of humble architecture, with the ensuing wetting of gypsum structural piers and shallow vaulting frames, rotting and woodworm in beams and joists and weakening of the masonry walls on the ground floor, whose mortar grouting was a simple mixture of mud and straw [6].

The masonry walls on the ground floor of the house, the backbone of the building's whole structural system, were in a very poor state of repair. The wall in the east side of the south façade was badly built with two layers of rubble, because, before the extension, the east part of the house had originally been a wall around an open stockyard and not a load-bearing wall. This wall was swollen and misshapen. At the same time, one of the three walls perpendicular to this facade, which give the house stability against the thrust of the buildings attached to the floor above, specifically the central one, had crumbled and collapsed on the ground floor, weakening it. For this reason, the house had deflected several centimetres towards the street, as could be seen in the partition walls and the jambs of the doors in the east facade.

First, all the south facade was underpinned from the ground floor to the roof. Later, the downstairs wall was dismantled and rebonded in alternate strips, the fallen wall perpendicular to the facade was rebuilt and the jambs of the east facade were straightened by remaking them from the foundations to the lintels. Furthermore, the three walls perpendicular to the south facade were regouted with sunken joints all the way up, to guarantee stability and inertia against the thrust of the adjacent houses. A mixture of hydraulic lime and sand in 1:3 proportion was used for all these tasks to provide the fabric with structural consistency.

The idea was to recover the structural and waterproof function of the roof, which was in a very poor state of repair, while applying thermal insulation and the same additional waterproof protection as a contemporary tiled roof that would not require constant maintenance. To this end, the roof was dismantled, the damaged beams and rafters were replaced, the layer of wattle was replaced or reinforced with a second layer where necessary, a layer of gypsum was spread over it, a coat of transpirable waterproof fabric and a layer of expanded polystyrene was placed on top, and finally the recovered tiles were set in place with a mixture of mud, straw and lime.

## **CONCLUSION**

The traditional architecture in Rincón de Ademuz, stands as a built reminder of its culture. A study of this architecture led to the discovery of unique apparently fragile building solutions whose great solidity and resistance was verified during a recent campaign of diagnosis research.

The desire to experiment with the conscientious, respectful recovery of these rural buildings gave rise to research of one particular case and the drawing up of a pilot project to restore similar buildings in the area. This project attempted to take into account all the aspects of the buildings in the area, from their actual construction to their most common pathologies.

The first building phase, on walls and roof, was therefore based on an interpretation of the philosophy of the techniques traditionally used in the district and respect for the logic of its building system. This first step has already generated a very positive reaction and interest in other cases of restoration of houses in the area, which have shown the same respect for these buildings that form part of their cultural identity and the built landscape of the district.

## **ACKNOWLEDGEMENTS**

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