RehabiMed Method
Traditional Mediterranean Architecture

II. Rehabilitation
Buildings
RehabiMed
Method
Traditional
Mediterranean
Architecture
II. Rehabilitation
Buildings

THIS PROGRAMME IS FINANCED
BY THE EUROPEAN UNION

EUROMED

EUROMED HERITAGE

AGENCIA ESPAÑOLA
DE COOPERACIÓN INTERNACIONAL

COL·LEGI D’APARELLADORS
I ARQUITECTES TÈCNICS DE BARCELONA
**Consortium RehabiMed:**

**Project Manager:**
Xavier CASANOVAS

**Members:**

**Ministry of Communications and Works**
Department of Antiquities of Cyprus
Person in charge: Evi FIOURI

**Bureau Culturel de l’Ambassade de la République Arabe d’Égypte en France**
Supreme Council of Antiquities, Egypt
Persons in charge: Mahmoud ISMAIL et Wahid MOHAMED EL-BARBARY

**Col-legi d’Aparelladors i Arquitectes Tècnics de Barcelona, Espagne**

**Ecole d’Aviron, France**

**Centre Méditerranéen de l’Environnement**

**Institut National du Patrimoine, Tunisie**

**Director:**
Xavier CASANOVAS

**Coordination of the volumes:**
Oriol CUSIDO
Ramon GRAUS
Amelie MARGAL

**Development and drafting of the method:**
Oriol CUSIDO
Ramon GRAUS

**Network of experts of the RehabiMed Consortium:**

**Cyprus**
Persons in charge: Evi FIOURI et Irene HADJISAVVA
Constantinos ALKIDES
Athina ARISTOTELOS-CLERIDOU
Michael COSMAS
Elina GEORGIOU
Kyriakos KOUNDOUROS
Yiota KOUROU
Athina PAPADOPOULOU
Agapi PETRIDOU
Eleftheria PETROPOLOU
Maria PHIKOPOULOU
Eleni PISSARIDOU
Socrates STRATIS

**Egypt**
Persons in charge: Mahmoud ISMAIL et Wahid MOHAMED EL-BARBARY
Mahmoud ABD EL MAGED
Mahmoud EL-ALFY
Mohamed ELBARIBY
Philippe HEARINGER
Hany HELAL
Bernard MAURY
Mohamed SIEF AL-YAZEL

**Spain**
Persons in charge: Oriol CUSIDO et Ramon GRAUS
Marti ABELLÀ
Josep ARMENGOL
Santiago CANOSA
César DIAZ GOMEZ

**France**
Persons in charge: René GUERIN et Patrice MOROT-SIR
Xavier BENOIST
Christophe GRAZ
Maria LÓPEZ DÍAZ
Michel POLGE
Jean-Alexandre SIRI
Christian THIRROT
Veronique WOOD

**Morocco**
Persons in charge: Abderrahim KASSOU et Quentin WILBAUX
Karim ACHAK
Mohamed BOUJAZZAOUI
Hicham ECHERAA
Jamal-Eddine EL-GHORAFI
Ameziane HASSANANI
Oum-Kaltoum KOBITE
Said LOQMANE
Abdelatif MAROU
Ahmed OURARZAZI

**Tunisia**
Persons in charge: Radhia BEN M’BAREK et Abdellatif GHIHLENE
Mourad RAMMAH
Mohamed KERROU

**Collaborating experts in other Mediterranean countries:**

- Nur AKIN (Turkey)
- Nazmi AL-JUBEH (Palestine)
- Mustafa AL-NADDIF (Jordan)
- Ziad AL-SA’AD (Lebanon)
- Suad AMIRFY (Palestine)
- Koksal ANADOL (Turkey)
- Carlo ATZENI (Italy)
- Abdelaziz BADJADJA (Algeria)
- Kurtel BELMA (Turkey)
- Demet BINAN (Turkey)
- Can BINAN (Turkey)
- Andreas BRUNO (Italy)
- Khalidn BSHARA (Palestine)
- Yotam CARMEL (Israel)
- Baru CELEBIKCI (Turkey)
- Vito CENTRONE (Italy)
- Nathalie CHAHINE (Lebanon)
- Ofer COHEN (Israel)
- Michel DADOUR (Lebanon)
- Habib DEBS (Lebanon)
- Michelangelo DRAGONE (Italy)
- Reuven ELBERGER (Israel)
- Tal EYAL (Israel)
- Fabio FATIGUSO (Italy)
- Antoine FISCHFISCH (Lebanon)
- Yael FUHRMANN-NAAMAN (Israel)
- Giovanni FRIFRIF (Italy)
- Sinan GENIM (Turkey)
- Feyhan INKAYA (Turkey)
- Mohther JAMHAWI (Jordan)
- Oussama KALLAB (Lebanon)
- Nikolaos KALOGIROU (Greece)
- Vito LAUDADIO (Italy)
- Yasmine MAKAROU (Greece)
- Moshe MAMON (Israel)
- Hitesh MARAOA (Palestine)
- Filippo MARIO LOPES (Portugal)
- Nikolaos MOUTSOPoulos (Greece)
- Farhat MUNAWAR (Palestine)
- Yassine OUAGENI (Algeria)
- Alkmini PAPA (Greece)
- Rubi PELED (Israel)
- Avi PERETS (Israel)
- Simona PORCELLI (Italy)
- Bouguenrira-Hajd QUENZA (Algeria)
- Cristina SARNOPOLU (Italy)
- Sinan SENIL (Turkey)
- Haluk SEZGIN (Turkey)
- Mai SHAER (Jordan)
- Yaaqov SHAFFT (Israel)
- Ram SHOF (Israel)
- Giambattista DE TOMMASI (Italy)
- Shah TSAY (Jordan)
- Fandi WADE (Jordan)
- Eyal ZIV (Israel)

**Scientific Committee of the RehabiMed Project:**
Brigitte COLIN (UNESCO)
Josep GIRALT (IEMed)
Paul OLIVER (Oxford Brookes University)

**French translation:**
Michel LEVAILLANT

**English translation:**
Elaine FRADLEY
ADDENDA

**Spanish translation:**
Inma DAVILA, Amelie MARZAL

**Arabian translation:**
Mahmoud ISMAIL

**Illustrations:**
Joan CUSIDÓ

**Cover Illustration:**
Fernando VEGAS, Camilla MILETO

**Photographic material:**
RehabiMed, CORPUS and CORPUS Levant teams.
Other sources are indicated with the photo.

**Graphic design:**
LM, DG: Lluis MESTRES

**Website:**
www.rehabimed.net

© 2007 Col·legi d’Aparelladors i Arquitectes Tècnics de Barcelona pour le consortium RehabiMed
Bon Pastor, 5 – 08021 Barcelona, Espagne
rehabimed@apabcn.cat

ISBN : 84-87104-75-4

RehabiMed wish to encourage the reproduction of this work and the diffusion of its contents, with due mention of its source.

This project is financed by the Euromed Heritage programme of the European Union and by the Agencia Española de Cooperación Internacional (AECI).

The opinions expressed in this document do not necessarily reflect the position of the European Union or its member states.
The first Euromediterranean Conference of heads of state in 1995 saw the launch of the Barcelona process, an ambitious initiative ratified in 2005 at the Barcelona +10 Summit. The priority objectives are intended to seek sociopolitical, economic, cultural and environmental synergies from a regional and mutual development viewpoint. It was within this context that the Euromed Heritage Programme emerged in 1998, to contribute towards the improvement and protection of the diverse heritage shared by the different Mediterranean countries.

Traditional architecture, as an essential part of the cultural legacy generated by the collective imagination of the Mediterranean, plays an important part in the actions carried out by Euromed Heritage. In their first years, CORPUS and CORPUS Levant carried out an enormous task cataloguing and analysing the characteristics and typologies of traditional Mediterranean architecture, identifying the problems presented and suggesting the best alternatives for preserving it. RehabiMed wanted to continue this stage of analytical study to develop the essential ideas arising from the needs and urgent requirements detected by these projects – promoting effective, respectful rehabilitation.

Today, in a globalised world, where economic and cultural uniformity mark the development criteria to be followed based on standard patterns, RehabiMed’s proposal is even more meaningful. Rehabilitation counters the idea of globalisation, and regional wealth, cultural diversity, different ways of life and particular local features become essential elements to be preserved.

There are many public and private initiatives aimed at recovering constructed heritage; some are oriented towards singular, monumental heritage, which we call Restoration, and others, as is the case with RehabiMed, are directed towards more modest, more abundant heritage with a greater presence in the territory, such as traditional architecture in historic town centres, rural villages and dispersed throughout the territory. This is what we call Rehabilitation, always carried out to provide buildings – the majority of them without any kind of heritage protection – with a use. This activity involving action on what has been built presents a wide diversity of situations, if we look at the Mediterranean sphere. In European countries, rehabilitation activity represents almost 50% of total activity in the sector, while in the countries of the south and east of the Mediterranean basin, this activity does not amount even to 10% of activity in the sector, despite its importance concerning economic development and the social cohesion of the population.

RehabiMed’s aim is to reinforce rehabilitation activity and maintaining traditional Mediterranean architecture as a factor in sustainable (social, economic and environmental) development. Achieving this objective will allow us to move forward with two historical challenges that may appear contradictory but from our point of view are perfectly compatible and complementary: firstly, contributing towards improving the living conditions of residents, who are the people who give meaning and life to this heritage; and, secondly, contributing to preserving the historical and cultural identity of Mediterranean peoples.

To achieve this aim, RehabiMed’s approach has been to work in three directions. Firstly, we have developed some strategic and methodological tools orientated towards rehabilitation; alongside these, we have carried out various publicity actions and training for professionals in the spirit of the content of the tools developed; and, finally, we have launched four pilot operations with real rehabilitation work to test, experiment and demonstrate the importance, possibilities and positive effects represented by good rehabilitation policy.
They have been three years of hard work, constructive debates and experiences shared with experts, with students and, above all, with the population directly linked to our actions, which has allowed us to meet the objective we initially set. We believe that the results are excellent and that we have created a good starting point for rehabilitation to get off on the right foot, giving meaning to the tools created, the training given and the experiments carried out.

I am delighted to present the first volume of our methodological work, the result of the effort of more than 150 experts from different professional spheres in 15 countries. The texts in this publication contain the RehabiMed Method for rehabilitation of Traditional Mediterranean Architecture, which have been considered and drawn up at length to respond to the concerns of our collaborators and experts. In addition, the publication develops the different points put forward by the RehabiMed Method to provide guidelines on specific proposals, to facilitate their application and to show different situations sharing very similar forms of action in the rehabilitation of the regional and urban heritage of traditional architecture. All this should serve politicians and officers of the different administrations to make it easier for them to generate and develop their initiatives to promote rehabilitation from a very broad frame of reference, raising the awareness of the population and getting it to take an active part in decision-making.

Xavier Casanovas
RehabiMed Project Manager

Barcelona, 30 June 2007
Traditional Mediterranean Architecture

RehabiMed uses the term traditional architecture to refer to everyday architecture that is alive because it is inhabited, essentially civilian, domestic and of pre-industrial construction. It is a form of architecture built using local resources, which covers materials, techniques and the skills of its constructors, and it is the fundamental expression of the culture of the different communities and their relation with nature and the landscape. It is an architecture that covers different forms of grouping and the scattered habitat with all its auxiliary constructions, not forgetting the more modest elements (fountains, paths, etc.), which, altogether, form the traditional Mediterranean landscape. RehabiMed focuses broadly on this architecture, including both the rural habitat, fundamental to the humanization and structuring of the territory, and the city, the clear expression of life in community and the optimization of resources and human relations, going beyond the filters of highbrow architecture to incorporate all the values of more modest forms of architecture.

Rural architecture is primarily linked to systems of agricultural and livestock production, which, beyond a simple presence in a bygone landscape, plays a vital role in understanding the processes that have produced today’s landscape, the result of a social and a natural history. Rural architecture has always played a salient role as an element that structures the landscape in which buildings, crops and nature are in perfect balance, the result of a continuous process of change and transformation, a socio-environmental reality generated jointly by biophysical and socioeconomic factors throughout history. The traditional rural habitat takes the form of a heterogeneous variety of built typologies which may be scattered or form small settlements. It is also accompanied by a large variety of auxiliary elements and constructions that are vital to the domestication of the territory (cabins, dry-stone walls, ovens and kilns, caravanserais, fountains, wells, mills, stables, granaries, etc.), and infrastructures (canals, paths, irrigation channels, etc.) which are the result of the historical interaction between natural resources and human ways of appropriating them that bear witness to the coherent hybridization of the biophysical factors of a region and the socioeconomic factors of the community that inhabit it.

Urban architecture, on the other hand, is built in the context of a city or urban settlement, being the expression of a more complex form of community dwelling, in which artisans and traders predominate over the land-related trades and where ‘the new needs and forms of society find their place’ (Mumford, 1961). The urban settlement, though also originally linked to the rural space and to the need to commercialize farming surplus, appeared as a structure to dominate the territory, defined by Braudel (1968) ‘more than by its walls or the number of its population, by the way in which it concentrates its activities on the most limited surface area possible’. The urban habitat covers a large typological range, derived to a large extent from geographical differentiation and from its origin and historical evolution. This historical and morphological diversity not only translates as buildings, construction procedures or materials used, it is also the configuration of the urban form, expressed in the way of structuring and considering collective space (streets, squares, etc.), of organizing constructions and uses which, in the rural world, are scattered (sanctuary, fountain, fortress, etc.), of relating private architecture and public space, developing a greater variety of residential typologies that reflects more complex social structures, in the uses of buildings, in the singularity of its infrastructures (market, school, etc.), and so on. These settlements, which in days gone by exclusively configured the city as a consequence of its growth and transformation, now form an integral part of the contemporary city, where they play the role of historical nucleuses. It is, then, the form of traditional architecture that humankind used to settle and construct its habitat in the territory around the Mediterranean Sea, a palimpsest permanently rewritten by the relations between people and their surroundings, and which has today become cultural landscape and collective imaginary.
Introduction

Qalaat al Manika, Syria

Hacienda Algarrobo, Málaga, Spain

Rovinj, Croatia

Lurca, Italy
A changing world. Architecture under threat

The inventories drawn up as part of the CORPUS and CORPUS Levant (EUROMED Heritage I) projects showed in 2002 the far-reaching transformations and pressures to which architecture, landscape and traditional territory are subject. Today, traditional surroundings are in a dramatic situation throughout the Mediterranean Basin, reduced to a continuing loss of their social and cultural character, threatened by intense degradation and constantly on the retreat. Likewise, the breakdown of the traditional world and the tendency to cultural homogenization as a result of globalization have brought about disregard for much of this architecture, often considered to be a symbol of poverty with values and qualities that are far removed from the mediatized concept of modernity.

Pressure on the traditional habitat began with the process of industrialization, though it was much accentuated by the modern movement and urbanism in the early 20th century, seeking new models of dwelling and building cities that could overcome the deficiencies of traditional settlements; it went as far as denying all functional, social and even aesthetic values, and radically placed ‘the new’ before ‘the old’. This process emerged at different times according to the country in question and whether we refer to the urban or the rural space.

Today, in the era of the ‘global village’, when the metropolitan industrial city is turning into a diffuse metapolis and the borders between country and city are becoming increasingly hazy, the pressure on this architecture and the population that it houses is even greater.

In the rural environment, many villages are becoming depopulated due to the lack of alternatives for development, and others are subject to violent transformation under the pressures of property or tourism-related speculation without the necessary urban planning. This contemporary urbanism is upsetting the historical balance between humankind and nature, and converting the rural landscape into a landscape without activity, where traditional architecture loses its meaning and original function, and is reused and transformed.

In urban environments, the ‘historical nucleuses’ are affected by different problems according to each historical and regional circumstance, which we could summarise according to four main vectors of pressure, sometimes complementary or simultaneous, and with differing degrees of influence: nucleuses in the process of overpopulation due to migration (south-north or country-city) with the subsequent physical (over-occupation and modification of dwelling), social (constitution of ghettos, insecurity, etc.) and environmental (insalubrity, lack of comfort, pollution) deterioration of the urban environment; nucleuses in the process of depopulation due to the abandonment of the historic fabric for the city, with the subsequent loss of social values and the deterioration of buildings and architectural heritage; nucleuses affected by heavy-handed urban renovation work (demolition of heritage, destruction of the historic fabric with the creation of new expressways, incoherent insertion of new architectures), and, finally, nucleuses affected by processes of urban reinvestment, in which we can distinguish three main processes: the development of tourism, tertiarization (especially in historic centres) with the possible loss of the residential function, and gentrification (the installation in a run-down neighbourhood of residents from a
Introduction

high-income bracket), all processes that can have a counterproductive effect in social terms. Institutions such as the UNESCO and ICOMOS have issued repeated alerts about the loss of this heritage. In this respect, mention should be made of the recommendations of the International Charter for the Conservation of Historic Towns and Urban Areas (Washington Charter) of 1987 and the Charter on Built Vernacular Heritage (1999). Both charters, in addition to providing criteria for intervention, stress the need for long-term action in the form of education and sensitization measures, involving the promotion of training and specialization programmes in areas of preservation of traditional architecture, aimed at technical professionals and politicians, who should head policies for the assessment and rehabilitation of this heritage, and seeking the complicity of the population, an active protagonist and participant in this shared legacy.
It is in this context that the RehabiMed project proposes a series of measures to encourage the rehabilitation of this architecture on the basis of sensitization and training.
Rehabilitating Traditional Mediterranean Architecture

In its global dimension, traditional habitat has a great deal to contribute to a context of sudden changes and urbanization that is neither sustainable nor environmentally friendly, and is marked by a need for the reorientation of urban policies in order to reduce conflicts between humankind and nature, improve quality of life, encourage basic values of community life and call for the recovery of the existing territory and recognition of cultural diversity.

For RehabiMed, the concept of rehabilitation covers a broad range of action with a view to recovering and updating a lost or damaged function—in this case, dwelling. On the basis of present-day concerns, rehabilitation means improving the action of dwelling by seeking a point of balance between technical aspects, the preservation of heritage values and criteria of social justice, economic efficiency and preservation of the environment (the three mainstays of sustainability).

RehabiMed continues the task begun by the European Charter of Architectural Heritage and the complementary Amsterdam Declaration, both dated 1975 and promoted by the European Council. These documents put forward the concept of “integrated conservation” for the recovery of run-down historic centres, based not just on the restoration of monuments but also on the promotion of actions to rehabilitate the fabric of dwellings and social measures.

RehabiMed therefore proposes a methodology that addresses the rehabilitation process on the basis of integrating traditional space into a wider territorial context; from the global viewpoint of a multisectorial, economic, social and environmental approach; that is driven by a desire for coordination and calls for consensus of action between the various agents; that is flexible, due to the need for continual adaptation to changing realities; and, essentially, non-dogmatic, not claiming to produce single solutions to the problems of the traditional habitat in the Mediterranean, seeking instead solutions that adapt to the conditioning factors and specificity of each local context.
The RehabiMed Method on the scale of the building. The Guide and its constituent tools

Whereas the first volume of this publication is devoted to the RehabiMed Method and its intervention on the scale of villages, towns, cities and the territory, volume two is its complement, focusing on the scale of the building. It is, then, a text aimed at the architects, engineers and builders who design, direct and carry out rehabilitation work on traditional buildings in the Mediterranean.

Rehabilitation of a building calls for an overview of the territory in which it is set and an understanding of its relation with the territorial and urban context. This is why the RehabiMed Project insists on the need to apply this Guide in the framework of the overall rehabilitation method outlined in the first volume of this publication, which sets out a series of shared, coherent criteria for intervention in order to address the complex problems involved in these situations.

This second volume is also divided into two different parts: a methodology, which we refer to as the Guide, establishing procedures for the successful undertaking of rehabilitation work, and a practical part containing specific tools for concrete problems.

The first part is the product of the joint work of a network of Mediterranean experts who, in the first year of the RehabiMed Project, drafted the basic principles and procedures of the Guide. The texts in the Guide have been debated at length after presentation at the 2005 RehabiMed Symposium in Marseilles, and constituted the conceptual bases for various training seminars in 2006 and 2007 (Nicosia, Cairo, Kairouan, Marrakech).

The second part, comprising practical tools, was written by individual specialists in a variety of fields with a view to providing elements of support for the various phases of rehabilitation work. It aims to cover a broad range of problems and sensibilities which, in our opinion, characterize the Mediterranean basin.

It is true that strict compliance with a guide of this nature calls for a high degree of commitment and may raise issues that are difficult to address according to the reality of a given country and place, but we are convinced that setting high standards will, in the long term, stimulate the quality of the rehabilitation of our traditional architecture and contribute to its preservation.
Second part

The RehabiMed tools

An aid
to the rehabilitation
of traditional buildings
I. Knowledge
Tool 3
Overall knowledge of the building
Tool 3
Overall knowledge of the building
I. Knowledge

The programme of studies

This is the starting point: a traditional construction needs fitting out, repairing or restoring. This construction may be a traditional dwelling (private or collective, isolated or clustered), premises linked to the pre-industrial economy (a windmill, tile works, press, olive-oil mill, stables), a modest religious construction (chapel, small sanctuary) or a functional structure associated with farming, stock-keeping or hunting (terrace, wall, cobbles, canal, waterwheel, dike). There are two possibilities: either the vernacular techniques that produced these constructions are still alive in the place or they now form part of the past and the place no longer conserves the knowledge of the master builders from days gone by.

In the first case, supposing the techniques are still truly alive in the area, the fitting out, repair or restoration can be easily undertaken employing the same construction systems used to build the traditional architecture. The second case requires a detailed study of the existing construction to discover these construction techniques and carry out the best possible intervention.

In both cases, prior to any study and by way of a general recommendation, the scrupulous conservation of pre-existing elements is urged as opposed to the oft-considered alternative of demolition and complete rebuilding, even when vernacular construction techniques are still active. In these cases, it is often discovered after demolition that reconstruction is not so easy after all, or that the necessary processes are not actually known, despite having thought the contrary. Furthermore, the presence of pre-existing elements is always an open book that provides reference to the knowledge required to draft and construct a project.

The preliminary study

Before the restoration project is carried out, a preliminary study of the building is necessary to acquaint us with the architecture in question and allow us to produce a project in keeping with its reality and its real needs. If few means are available, the preliminary study can be limited to a detailed inspection in order to interpret the point of departure, before intervention, with the help of the experience of similar cases. If means are available, then the preliminary study can be as detailed as you like, as there are no bounds to knowledge, even in the case of simple traditional constructions.

As we will see further on, an exhaustive preliminary study does not guarantee correct restoration, which ultimately depends on the attitude or criteria of the designer or actor. It is also true that fuller knowledge of the built reality often allows a more sensitive approach to restoration, as sensibility increases with greater contact with the building.

Ultimately, however, the strict conservation of traditional architecture depends not on the profusion of multidisciplinary studies—which can often not be undertaken due to their proportional cost in relation to the intervention—but on the criteria, respect and sensibility displayed by the actor or actors in the project.
the intervention. For this reason, it is advisable that universities and research centres undertake multidisciplinary studies to give various ideas about the traditional architecture of each place or types of vernacular techniques, facilitating the work of the architects and owners who, due to lack of training, knowledge or means, cannot undertake a complete study of these buildings.

A comprehensive programme of preparatory studies for a restoration project might include the following: historical study, metric and descriptive plan, photographic plan, plan of construction and materials, stratigraphic study, study of pathologies, study of fissures and deformation, functional study and other, more specific complementary studies. It is up to each actor to decide which studies are necessary in each case, according to the needs and means available.

**Historical study**

However difficult it may initially seem, it is important never to leave out a historical study, albeit simple, of the traditional building requiring rehabilitation or, in its stead, of the surroundings, area, village or town in which it is located. This historical study may be a simple recompilation of old photos of the building, the documentation of oral sources gathered with due precaution as regards possible partiality or subjectivity, the study of buildings of similar morphology, the consultation of previous cases of restoration, and so on.

**Metric and descriptive plan**

This is the most exact graphic reproduction of the built reality. It must faithfully reflect the object represented, since it will provide the basis for the rest of the preliminary studies and the project itself. Discontinuities, irregularities and deformations must be precisely drawn, with no attempt to simplify or impose a geometric order, as they usually conceal clues to understanding the building’s growth, historical evolution and pathologies.

There are many ways of measuring and describing buildings, from manual means, using a tape measure and triangulation, to recent 3D scanning systems, to the laser distance metre, the theodolite and photogrammetry. The most natural in the case of traditional architecture is the use of manual means, which, if carried out efficiently in these simple constructions, does not compare unfavourably in precision with more technological means.

It is necessary to draw out as many floor plans as there are levels in the building and as many cross- and longitudinal sections as there are different situations in the layout. The projection of the interior elevations in these sections will subsequently help to locate the project in the interior of each room.

When drawing up these plans, it is advisable not to take any relation in a vertical direction as read, as walls often decrease in height or slope away from the vertical. For this reason, it is a good idea to fix at least three external or internal points of connection.
between the various floors to facilitate the subsequent location of the floors with reference to them. Similarly, it is important not to take as read the existence of horizontal planes, as both ground and upper floors often have deliberate slopes, pathological inclines or structural deflection that may be very useful to understanding the building and drawing up the restoration project.

The mapping of arches, vaults and domes has to faithfully reproduce their trajectory in space, producing at least one section for each curve, and a series of sections in the case of a longer vault. These curves in section, compared to the theoretical line of pressure, allow us to analyse the state of health of the construction element.

Photographic plan
This is basically for the building's external and internal façades. It involves producing a map with the help of photographs superimposed with data (photomaps) and put together like a puzzle. This requires the use of a computer, as it involves taking digital photographs (or photos that are then scanned), rectifying them using one of the many computer programs currently on the market, manipulating them and printing them to a certain scale.

A photographic plan of a building's façades or a photomap is far more powerful in terms of expression and communication than the information offered by a metric and descriptive plan. A photomap represents the object with its exact measurements, but it also provides information about the colour, material, texture, state of conservation, etc. A scale photomap offers the same information as the metric and descriptive plan, plus a great deal of added data that the drawing is unable to reflect, to the extent that it can replace the first mapping.

In fact, if you have a photographic map, you can produce the metric and descriptive plan by tracing the information provided by the photomap in line form. This might initially seem a pointless task. However, the manual exercise of reproducing the lines provided by the photograph reveals to the hand things that go unnoticed to the eye.

However, it is not important if the means to draw up a photographic map are not available. Simple photographic documentation to accompany the metric and descriptive plan allows the same type of real approach to the architectural object and provides the same amount of information as a photomap, with the difference that the measurements can only be obtained from the metric and descriptive plan.

Plan of construction and materials
This plan is drafted on the physical support of the metric and descriptive plan or the photographic map. Its purpose is to identify and name all the types of materials used: the types of masonry and their respective bonding, the bricks, the rammed-earth walls, the mortars, the interior plasters, the exterior renderings, the timber used for the beams, joists, door and window frames, the partition walls, the uprights, the glass, types of floors, roofs, tiles, flooring, and so on. And not only the materials, but also the way they are grouped and combined to form the constructional details of the building that have two aspects to be considered: function and mutual physical compatibility.

What is the objective of this task? The precise identification of the various construction materials and techniques used in the building firstly facilitates the drafting of the stratigraphic study but secondly, and most importantly, it represents a step further in knowledge of the built object, allowing us to choose and design the best processes of consolidation, treatment and repair of the individual elements that form part of the whole.

By way of example, a wall of bonded masonry or plaster made with earth or lime mortar are different things, and each element requires different attention. Various types of timber behave differently in the event of damp and the attacks of wood-boring insects and fungi. Precise knowledge of a constructional section can provide explanations for a building's pathologies, and this is just one example.
Stratigraphic study
This is a study of the evolution of growth, and the extensions and modifications made to the building. It does not require written historical documentation or information that can be found in libraries or archives. If such documentation does exist, it should not be disregarded, but this very rarely is the case with traditional architecture.

The stratigraphic study is written directly by reading the signs contained in the built fabric. The objective of the stratigraphic study is to produce a chronology that tells of the phases in the life of a building, with all the cases of extension, transformation and demolition, etc.

This reading calls for some practice and the adoption of a code that allows us to record on the plans the information about the structure as we obtain it. In this case, the photographic map or simple photographs without scale are preferable to the metric and descriptive plan, due to the importance of the added documentation that the photograph provides.

If you have drawn up a plan of construction and materials, you will be better placed to draft the stratigraphic study, since you will have refined your knowledge of the various changes of stonework that appear in the building, which, on occasion, correspond to the different phases of construction. Likewise, irregularities and discontinuities found in the walls during the drafting of the floor plan will be possible points of information for the stratigraphic study.

It is also interesting to cross-reference the information obtained from the stratigraphic study with the building pathologies, as the building’s healed-over wounds, listed within its overall chronology, contribute information about the active or inactive presence of the factor causing the pathologies. For example, a small crack in a plastered wall may correspond to a large crack that has been repeatedly repaired during the life of the building and successively covered up by multiple layers of plasters of differing ages.

Study of material pathologies
The detection, identification and study of the building’s pathologies are the necessary preliminary to drawing up a restoration project that will ensure the building’s return to overall health. Pathologies are normally manifested in the surface of built elements, though there are also cases, such as a possible termite attack, when the affected material—in this case timber—does not
present any signs on its surface, and it will be necessary to look for other signs of its existence. Before starting, it is important to distinguish between two types of phenomena: alterations and degradations. Alterations are modifications in the material that do not necessarily involve a worsening of its characteristics from the viewpoint of conservation. Degradations, conversely, are transformations in the material that do represent a worsening that endangers its integrity and permanency. Alterations do not compromise the existence of the building and are therefore not the object of concern or intervention—on the contrary, they mark the effects of the passing of time on the building and, within reason, form the patina that allows the observer to identify the value of its age. Degradation, conversely, should receive attention, as ignoring it could compromise the existence of the building in the short, medium or long term, depending on the gravity of the case. It is important to reflect on the plans all the observations made about the stonework with regard to the phenomena of degradation present in the surfaces of the materials. In mineral materials, such as masonry, rammed earth, mortar or plaster, these phenomena may be superficial or deep-seated erosion, air pockets, disintegration, flaking, pockmarking, spalling, subflorescence, etc. Of the materials of animal origin occasionally used in construction, such as leather, bone (horn), animal fibres (wool) or the various additives used to make mortar in different parts of the world (eggs, glues, fibres, hair, honey, etc.), it is animal fibres that are most subject to attack by moth and similar insects. In plant materials such as timber, reed, wicker or straw, the phenomena of degradation may be the various types of biological attack by fungi or wood-boring insects (anobids, curculionids, termites, etc.). Study of fissures and deformations The overall symptomatology of the cracks and deformations in the traditional construction as a whole provides valuable data about the building’s structural pathologies. Often, the simple observation of an isolated crack, without the context of fissuring and deformation of the whole building, may be deceptive. Likewise, sometimes the confluence of various phenomena can cloud a hasty initial examination lacking in thorough analysis. The record of fissuring should be made on the metric and
I. Knowledge

Overall knowledge of the building

The programme of studies

The recording of pathologies on the metric plan is another step towards the restoration project. Old waggons’ inn in Torrebaja (Valencia)

descriptive plan or the photographic map. It is advisable to create a legend of signs to easily distinguish and identify the type of lesion documented. A superficial crack in plaster is not the same as one that goes through to the building’s walls. It is also important to carefully observe each lesion and identify its direction, rotation and which way it is moving. In order to do so, observe the two sides of the crack and find out whether they are in the same plane or displaced, whether they are parallel or meet, if they run right through the wall or open in just one face, and so on with each lesion.

The study of deformations will be included in a carefully conducted metric and descriptive plan. Here, the combination of data about these deformations and the study of cracks reflected in the plans will produce a diagnosis of the structural movements being undergone by the stonework. Comparing and contrasting this data with the information obtained by the stratigraphic study may in some cases prove the present inactivity of an old lesion or, conversely, its continuing activity.

Functional study

Before going on to draft a restoration project, it is advisable to carry out a study of the historical function of the building and its compatibility with the future function assigned to it. This prior analysis may detect possible incongruence in the concept or distributive violence that is inadvertently being caused to the building in time to correct the course of a functional programme or a preliminary project that does not adequately address pre-existing elements of the traditional building and the necessary prevalence of its constitution and character in the restoration project.

Complementary studies

There is a whole range of more specific complementary studies that are normally reserved for interventions on a larger scale with bigger budgets, as in the case of public monuments. Some of them are listed below in the event of a specific case of restoration requiring them and the existence of sufficient technical and economic means to carry them out:
I. Knowledge

Tool 3
Overall knowledge of the building
The programme of studies

The functional study of the building’s past will help to provide a reasoned function for its future after restoration. Traditional house in Sesga (Valencia)

Archeology: excavation of the subsoil of the building or its environs to discover traces of its past or investigate the foundations

Soil mechanics: reading of the subsoil from the surface using magnetic, electrical and ultrasound surveying systems

Chemical and petrographic characterization: analysis of samples of stone, mortar or plaster to find out their nature and material composition

Dendrochronology: determining the age of the timber used in a construction by observing the growth rings

Biological studies: research into insect plagues, the presence of higher and lower vegetation, and how they affect the materials used in the building

Climatological studies: analysis of the effects of rain, hail, wind, solarization, freezing and thawing cycles, and annual droughts on the building’s state of conservation

Seismic vulnerability: the weak points of a building in the event of telluric movement in the place

A detailed study of cracking and deformation of a building helps to explain the historical evolution of its afflictions and the reasons for them. Apartment building in Plaza del Pilar, Valencia

The functional study of the building’s past will help to provide a reasoned function for its future after restoration. Traditional house in Sesga (Valencia)
I. Knowledge

Historical studies and archaeological interventions: Tools for the knowledge of Traditional Mediterranean Architecture

Some considerations
The interest in traditional architecture, whether from the viewpoint of architecture, construction, anthropology or history, is relatively recent; the first attempts to form a systematic body of knowledge about this type of construction are barely 100 years old. Even more recent is the possibility of applying historical knowledge. The historical interpretation has been applied basically to sumptuary buildings and, as a result, palaces, cathedrals and mosques fill volume upon volume. The primary object of its discourse is formal analysis and symbolic interpretation, and it centres its reflection on the past. In this way, history is understood as the narrative of events that have taken place rather than a method for finding out about reality. It puts history on an equal footing with age, and age, in itself, is not a criterion of valuation, in this case.

Today, traditional architecture in the Mediterranean—or should we use Mediterranean as an adjective?—is an economic value on the rise and this circumstance, about which there is nothing gratuitous, involves different types of intervention. How many people fail to recognise their village, street or neighbourhood after processes of “regeneration” that reduce experience and lived events to caricature, and historical value to values that have nothing to do with its development in an attempt to fix supposed historical stage sets on our retinas?

Historical studies do not seek to legislate intervention in traditional heritage; that is not their purpose. Their purpose is to contribute as much information as possible about the object of study, to be a factor contributing to its understanding and knowledge, at all times considering the nature of this architecture, seen in its permanent mutability. In this era of globalization, or cancelling out...
of the specific in all fields, historical studies have to reinforce differences rather than similarities, and treat each building as a unique, unrepeatable unit. This understanding will facilitate rehabilitation in keeping with the evolution of the building.

On the symbolic interpretations of traditional Mediterranean architecture
The symbolic interpretations to have recreated traditional architecture in the Mediterranean over the last three centuries have been innumerable and of differing natures. From idealized, picturesque, exotic, typical approaches to more creative, pedagogical readings, these interpretations convey different values of an architecture that has, as yet, been unable to cast off stereotypes.

We find the first interpretations in the accounts of pilgrimages. The descriptions in the *Rihlas* centre mainly on the city's more monumental buildings, like on the Grand Tour, quests for knowledge undertaken by an enlightened mentality, which offered descriptions of monumental Greco-Roman architecture. In both cases, though the nature of the journey was very different, the offerings of knowledge about traditional architecture were always incidental. Yet it was this same enlightened mentality that generated the first works of detailed analysis and description of some areas. An emblematic work is Yves Laissus’s *Les savants en Egypte*, the encyclopaedic rigour of which includes the description and analysis of an entire territory and society with a centuries-old culture. This masterwork includes splendid descriptions of the traditional crafts. Along the same lines, also the product of enlightened mentality, were the first, mainly descriptive studies of rural areas, such as the work of Gaspar Melchor de Jovellanos in Spain, and of construction, such as the work of Antoine Desgodets about building tradition in Paris.

Although it was the Romantic artists who introduced popular themes into their highbrow works, the resulting creations were always idealized. References to local custom were incorporated into all artistic genres, from painting to short stories, including music. Recognising the influences of exoticism in the seguidillas in Bizet’s *Carmen* or visualizing the popular Sicilian ambiences in the tarantellas of Mascagni’s *Cavalleria Rusticana* are just a small example of how themes traditionally remote from everyday life progressively incorporate popular elements.

Stage sets of traditional architecture
The first sets of traditional architectures, Mediterranean or otherwise, can be traced back to the national and international exhibitions. As a result of progress and innovations, some exhibitions reproduced architectures that symbolized the unification of territories. A recently unified Italy organized the Italian General Exhibition in Turin in 1884, with the construction...
Knowledge of a Borgo Medioevale that still exists today. Geneva hosted the Swiss National exhibition in 1896, triumphing with the construction of the Village Suisse, reproducing the country’s main traditional architectures. This was the precedent for the Pueblo Español built in Barcelona for the 1929 World Fair, one of the biggest draws of the entire event, which can still be visited today. As in the case of the Village Suisse, the Pueblo Español went further than the reproduction of architecture to create an ahistorical public space that denies any possibility of future, change or mutability. It is an island in time, a perfect set design, set outside time. Its streets have provided sets for all manner of recreations of the past. Last year, the most spectacular scenes of the film Perfume were filmed in its Plaza Mayor. It is both interesting and surprising to see how Jean-Baptiste Grenouille drives the whole town mad in the main square of Grasse, while in the distance we spy the Mudejar tower of Utebo in the Pueblo Español.

In any case, it is quite natural that scenery should be used as such. What is more striking is the use and manipulation of certain natural settings, considered heritage for their value as traditional complexes, as film sets. Aït Benhaddou, in Morocco, still has a great doorway built in 1962 to film Lawrence of Arabia. This doorway is nearly as real/unreal as the sets built in 1937 in the Hollywood studies for the film Algiers, during which Pépé le Moko is chased by the police through the narrow streets of the Casbah.

In these circumstances, it is difficult to separate reality from fiction. New symbolic interpretations, developed in accordance with the needs of the tourist boom as of the mid-20th century, have turned old towns and rural areas into veritable theme parks, where the most important value is not just unbridled speculation on the territory and short-term profits on investment, but creating a standardized product that has almost all the characteristics of the typical villages of international exhibitions. Revitalizing the territory should not mean rejecting this architecture. Nor should it oblige us to create landscapes that never existed, overlooking their past and creating frozen images of indeterminate date.

Traditional architecture and historical studies

As outlined in the considerations above, no type of architecture is immutable, particularly if the architecture in question is traditional. Mutability and changes in configuration or appearance are implicit in traditional architecture, with remodelling or additions of new structural and ornamental elements. We are accustomed to a perception of architecture as something practically permanent and definitive, with almost imperceptible changes that are incorporated into our perception and rapidly fade from our memory. On these premisses, it is difficult to understand traditional architecture as mutable, fluctuating and elastic. Any element in any building, from its foundations to the smallest of decorations, is always the result of a precise happening in
space, and also in time, and events related by links of causality, simultaneity or coincidence are what we might call a process. From a historical point of view, architecture is a process, in that time is vital to its configuration. A building has to be analysed from a chronological and, therefore, historical viewpoint. In very few cases does a chronological process achieve such a tangible and obvious physical concretion as in architecture and heritage. It is its most basic, elementary meaning because it provides us with intrinsic knowledge of the singularity and essence of each house. Each process is unique and unrepeatable, as are the results. No two buildings are the same, just as no two sequences are the same.

Sequential development in traditional architecture is one of its fundamental characteristics. Irrespective of geographical situation, traditional architecture has always taken a long time to develop and its manifestations share an ongoing dynamic of adaptation and modification. It is the essentially utilitarian function of this type of buildings and their long chronological development that explains how a single building may include structural and decorative elements from different periods that may be conserved according to the criteria selected at different times as priority or pertinent. This architecture takes the form of the permanent juxtaposition and manipulation—addition or subtraction—of the existing elements. It therefore requires a dynamic, evolving approach that is never static.

### Approaching a methodology

#### The need to know the context

The analysis of the context involves as precise as possible a determination of the action, the agents taking part and the target of intervention. There is no reason why each event should have a single agent, and an action may be carried out or taken on by various, each with its own specific contextual circumstances. It is contextualization that gives significance to the event and knowledge of it, because it explains and gives specific meaning to its constructional form. The elements of context affecting a given action vary a great deal, ranging from maintenance to the repair or reconstruction of damage caused by war, natural disaster, etc., to other more subjective but equally relevant criteria such as need, ostentation, etc. To this end, two types of context can be distinguished: endocontext and metacontext.

The endocontext is the conditions imposed most directly on the agents and, therefore, on their actions. It directly affects each one of the agents and is, in short, what most directly defines the motives of their actions: physical spaces, social condition and the immediate circumstances. The metacontext affects various agents at once and there is no direct control over it: regulations, customs, technical systems, symbolic values, etc.

Knowledge of the city and the territory, their legislative and legal framework, and their cultural tradition will tell us why two houses are alike and inform us as to their similarities. Knowing who lives in the house, the activities that took place in it, the family members and their social representativeness will tell us why each house is different. In short, the endocontext explains why two houses are different and the metacontext explains why they are alike.

The historical study has to prioritize the contextualization of each event in the house’s constructional sequence, because without knowledge of the context there is unlikely to be any knowledge of the action beyond the merely anecdotal. It is important to know who the agents were, what the house was used for, where it was, and how it was built and designed. This involves answering the basic questions what, when, how and why, which will underpin our knowledge. Contextualization prevents oversimplification and reductionism and allows us to identify and give value to singularities and discrepancies, and this is why the historical approach incorporates and interrelates evidence of all kinds and is, in itself, plural and integrative.

#### The building as a document

The building represents the action we have to analyse and, therefore, the most important and decisive tangible evidence. Each house contains within its structures and ornamentation a register of the actions that have gone to make it up. The building, then, represents the sequence of events that generated it, making
I. Knowledge

It one of the most valuable documents for knowledge of its evolution. As documentary evidence of a historical and constructional process, all the elements that go to make up a building, be they structural or decorative, are forms that have an intrinsic meaning: types of walls, systems of flooring, etc. The textures and the materials reveal not only how the house was made but also when it was built, as these techniques, despite existing for a thousand years, have been modified. The characteristics of the mortar, the stereotomy of the stone, the structure, type and dimensions of the adobe, the formal characteristics of the decoration on the outside, are all fundamental to knowledge of the building. This is why the building represents a document: the document is everything that manifests what has happened. Destroying a building is like destroying a unique manuscript, and as such implies ignorance as well as forgetting.

The building as action: documentary sources

The agents’ actions never take place in isolation and always involve interaction with other agents in the general context of which they form part. This circumstance suggests the possibility of these actions having been included in another type of graphic and written document — the more classical type known as documentary sources for historical knowledge.

There is a whole range of useful documents of this kind depending on the geographical place, the moment in time and the cultural context. They represent a solid base of direct or indirect knowledge for understanding the actions, identifying the agents or determining some of the variables that may affect the endocontext or the metacontext.

The graphic sources, such as planimetric diagrams, maps, photographs, drawings, etc. carried out at different moments in the building’s life provide a means for the precise interpretation of the construction process. Written sources provide an excellent basis for a more concise interpretation of the processes of transformation: contract of sale, title deeds (malkia), wills and habous titles, post-mortem inventories (trika), administrative authorizations, land registry and travellers’ accounts are all vital to discovering the events and the overall sequence.

Attempts have been made to distinguish the validity of types of source, differentiating between structural evidence and graphic or written documentation, and seeking to establish the pre-eminence of one or the other, or accord greater validity to graphic than to written documents. This is a sterile debate based on false premisses: structures and documents are evidence of an event, and are different in methodology and content just as a photograph and a contract drawn up by a lawyer are, but they are essentially identical in their function of contributing relevant information about the construction process of a building. They function dialectically and reciprocally. Structures provide guidance...
A single building may contain decorations from different epochs, and they must all be studied and valued equally.
I. Knowledge

Tool 3
Overall knowledge of the building
Historical studies and archaeological interventions:
Tools for the knowledge of Traditional Mediterranean Architecture

for documentary research, and documentary research determines
the dating of structures. Together they give the building as a
whole meaning and content. Research and the interpretation of
documents, of all types, are always integrative.

Graphic documentation is an important source of information. Jujol holdings, AHCOAC

The documents generated by the actions of the agents have always been
considered the classical documentary source for historical knowledge.

Exceptionally, artistic work produced to commemorate the construction of a house
can provide valuable information. Transcription: “In 1631 Al-Haj Muhammad, son
of the late Haj Jalim, son of the late Al-Haj Tamoun, constructed this house. It is
situated near the mosque of Ibn Toboun. The house was finally transferred to a lady
from the island of Crete, and this house shall therefore be called ‘Bayt al-Kritliyya’.”
The building as a place of experience: oral sources
In many traditional societies in the Mediterranean, the spoken word is a value associated with tradition, where knowledge is handed down orally from parents to children, from master to apprentice, etc. The same norms governing some communities are handed down from generation to generation, without the mediation of any written document, and it is also some of these societies that retain rituals associated with the occupation of space and with construction. Rituals of the occupation of space involving animal sacrifice have continued to be carried out in some places until the present day.
The assessment of oral sources has traditionally been the domain of ethnography and is vital in geographical and cultural contexts where, due to different circumstances, there has never been a tradition of generating textual documentation. Oral sources, in any case, are highly subjective and have to be submitted to a rigorous process of comparison and contrast and a critical analysis to ensure their validity, essentially no different to the process applied to other documentary evidence. Any historian knows that the only hierarchy of source is availability, significance and eloquence for each historical event, and that types of sources require a sense of criticism and self-criticism to interpret the precise content.

Summing up
The novelty of an approach of these characteristics to traditional Mediterranean architecture means that it lacks, to some extent, the necessary tools for correct historical interpretation. It requires a typological systematization of the construction techniques historically used in each place and time, the application of techniques of archaeology of the subsoil and vertical archaeology in the analysis of structures and walls, listing and inventory of the more relevant graphic and textual documentary sources, and ethnographic studies of the perception and memory of buildings and the construction process, as well as generalizing this type of historical interpretation to existing buildings before carrying out the rehabilitation project. It is also necessary to establish general schemes to facilitate the concretion of building techniques and historical and cultural contexts.
To summarize, the historical study gives content and precise value to each building, based on a study of facts and contexts, arranged into a sequence, which explain the evolutionary specificity and constructional configuration. It is neither a story nor nostalgia, because it sees historical or traditional architecture not as a fossil of the past but as something that forms part of the structures and landscapes of our present. It is not intrinsically about the past, because the past is merely its means, not its end, and it therefore analyses part of reality from the chronological perspective that brings together the contributions of agents, factors and specific, complex contexts. It does not seek, essentially, to establish what a
I. Knowledge

Overall knowledge of the building

Historical studies and archaeological interventions:
Tools for the knowledge of Traditional Mediterranean Architecture

It is vital to know about the evolution of buildings throughout their history before undertaking a rehabilitation project. Traditional architecture has for centuries maintained its process of gradual growth by means of successive interventions. Knowledge of them is the basis for respectful intervention. The Torre del Fang: growth and transformations over seven centuries. Photographs: 1 (1990), 2 (1920), 3 and 4 (2006).


3. His extensive body of work includes Las Cartas del viaje de Asturias o Cartas a Ponz (1782-1792), in which he explains with absolute precision the social and economic situation of this region.

4. Les loix des bâtimens suivant la coutume de Paris : traitant de ce qui concerne les servitudes réelles, les rapports des jurés experts, les réparations locatives, douainières, usufruitières, bénéficiales. Manuscript dated 1787. BNF.
Archaeology as a tool for finding out about the building

Evi Fiouri
Archaeologist
Department of Antiquities of Cyprus

Before drafting the rehabilitation project for a building, it is necessary to have comprehensive knowledge of its history and elements in order to form a complete picture: its successive phases, evolution in time, the changes undergone and the causes for them. Only after discovering these things is it possible to decide how to proceed in the rehabilitation process: which elements to keep, restore or highlight, and which to demolish. In this way, it is possible share with others the sometimes thrilling history hidden in the walls and the subsoil of the building. In order to make the building “speak”, we first have to get to know it. There are various ways of achieving this, all based on research, with recourse to other disciplines beyond the specific field of the architect: history and archaeology.

Archaeology is a science that detects, examines and analyses material evidence. Removing the earth to reach human vestiges, studying and documenting their successive phases, reading the history of humankind amid the interposed, interwoven traces of people and their works is the task of archaeology. Its revealing role imposes two successive stages: inspection of the surface and in-depth research. It too has recourse to other exact sciences: chemistry, anthropology and botany. The archaeological method follows the method of the exact sciences. It is, then, based on the meticulous observation and analysis of the object with a view to reaching the cause of its origin.

This is why archaeology can also be applied to building rehabilitation, since this too is a case that requires observation and analysis as a preliminary to knowledge. Like archaeological sites, a building is a silent witness to itself, that knows how to keep secrets hidden in its walls: its built elements, materials and even its subsoil all bear witness to its history. It is, then, necessary to examine these elements well, one by one, and, if necessary, to remove some of them to reach others that they may, in turn, conceal. If classical archaeology proceeds downwards, the archaeological involved in interpreting a building proceeds upwards. The application of the archaeological method to find out about a building is relatively straightforward; it involves proceeding by stages that may anticipate or follow the graphic plan and may even continue during the initial stages of work. In this case, it is necessary to complete the graphic documentation and consider changes to the initial programme if previously unknown elements revealed during the archaeological examination so require.

I. Inspecting the site. Cleaning. First, it is necessary to examine the building, inside and outside, and distinguish the elements to be removed immediately to enable a clearer view: rubbish, wild vegetation, earth piled up or dumped on the floors of courtyards and gardens. It is impossible to conduct a detailed inspection of a building if the ground is concealed by earth and the walls are half hidden by plants.

II. Observing the masonry. The wall as a document: the wall is often a palimpsest on which we can read the history of the building and its evolution in time. In order to do this, we have to attentively examine several elements: materials, construction techniques, the bonding of the walls and all construction elements present, whether visible or hidden (windows, doors, decorations, etc.).

Observing the construction materials. There may be different materials in the same wall corresponding to different phases. Careful examination will inform us whether these materials were used for repairs, to enlarge a space or to divide it into smaller rooms. Knowledge of the most used materials in a given period will help us to date the phases. These modifications are visible in bare masonry, but interiors are usually concealed by renderings that hide the proof of the different stages. In Cyprus, renderings are usually spoiled by damp and have to be replaced. During the task of removing them, it is possible to see all manner of modifications to the masonry, such as bricked up openings or the creation of smaller spaces. If the renderings are in good condition, they should not be removed. Careful observation can detect the remains of a medieval convent uncovered by a recent excavation beside an early 20th-century building in the old town of Nicosia.
I. Knowledge

Tool 3
Overall knowledge of the building
Archaeology as a tool for finding out about the building

---

outlines of arches and bricked-up openings beneath the rendering, which need only be removed from this specific place in order to show the opening and rehabilitate it. In important or delicate cases, thermography, endoscopy or other non-destructive tests may be applied.

It is difficult to date masonry in itself, because Cypriot masons have used more or less the same construction techniques for centuries. This calls for an examination of the mortar used as bonding. The components of the mortar may help to date the masonry approximately. If it is not possible to identify the mortar by organoleptic means, it can be sent to a laboratory for testing. All of this information must be documented to complete the plan and obtain the clearest possible image of the phases of evolution and their associated modifications.

Observing construction techniques. Walls built using a single material, such as stone, are not homogeneous to the eye. This irregularity is due to different construction techniques. A wall may include a different section representing a later phase, such as an upward extension to replace a flat roof with a ridge roof. Some construction techniques can be dated to a precise period and this is of great assistance in understanding the phases of the building. Walls on the lower levels may often be more modern than those higher up due to changes made at any point in the building; as far as walls are concerned, there is no vertical stratigraphy.

Observing the renderings. The renderings of a building do not necessarily belong to the same period. Further, the renderings and their application technique may vary according to the use of the rooms, a factor that must always be taken into consideration. Knowledge of the period when a given rendering material was introduced into the country therefore helps to date the building or its historical phases. In Cyprus, there are four easily identifiable types of renderings used for dwellings: earth, earth mixed with chopped straw, lime and plaster, the most recent. There is also whitewash, either on its own or mixed with a colorant, such as indigo. The walls of rural houses may present successive coats of rendering; they may be of the same type or different, such as an earth and straw rendering beneath plaster, a material that was considered to be noble and rarely used before the early 20th century.

An observation of renderings should not be limited to material alone. The frequency of application is another factor. An apparently uniform rendering may actually comprise several successive coats, as in the case of the whitewash that the occupants applied to the walls every year before Easter. The technique used to apply the rendering must also be taken into account. In urban homes, plaster is applied using screeds to obtain completely even surfaces, whereas in rural houses, the rendering is applied freely, following the irregularities of the wall. The architect has to recognise this difference in renderings and apply them accordingly.

Detecting the renderings. Sometimes the walls give the impression of never having been rendered, though this is not always the case. A careful examination of the masonry may reveal traces of rendering in a corner, at the top of the wall, protected by the projection of the roof or remaining in the gaps between the stones. Sometimes it is enough to observe the technique used to build the wall in order to deduce that it was originally rendered: stone masonry built to be rendered (with plaster, for example) is not very neatly constructed because it is not meant to be visible and is made irregular to allow the rendering to take more easily. It is also necessary to observe the general style of the building and

---

Excavation on the site of a large 18th-century townhouse in Nicosia revealed two superposed floors dating from different periods (18th and 19th centuries)

The wall of a medieval manor near Nicosia presents the original masonry of dressed stone reddened by a 15th-century fire recorded by chroniclers of the time and the rubble and adobe construction of the Ottoman period
individual architectural elements (frames of dressed or carved stone around door and window openings, projecting timber frames) to understand whether now bare walls have always been so or whether their covering was later destroyed or removed. The case of Lefkara, a village where elements of urban architecture were introduced by people who made their wealth from selling embroidery, is characteristic. The fashion of bare stone led to the general removal of renderings from houses that had hitherto stood out for their plastered and painted façades, a sign of wealth at the start of the century.

Examining the joints of the walls. In Cyprus, most of the houses built using traditional architecture grew with the family and its needs, occupations and economic possibilities. The original cell is very often the makrinari or a dichoro, a single room of varying size, to which others were gradually added, first on the ground floor and then the first. This procedure can be seen at the point where the walls meet, showing the original wall against which another was later built. In this case, the walls are not joined together, and this can be seen if the walls are not rendered. This lack of ties often leads to the walls separating.

III. Investigating the floors. Very often, the floor that is immediately visible in a building is in fact neither the first nor the only floor. Fashions, improvements in the owners’ economic situation and the changing uses of rooms throughout a building’s life are reasons for changes in the floor. It is, then, necessary to remove the most recent concrete, timber or tiled floor to find the local marble or pebble paving, or even the simple beaten-earth floor that was there when the building was constructed. These earlier floors have often been destroyed. We have to proceed with caution when removing the more recent floors in order not to destroy the sometimes barely perceptible evidence of earlier layers. Little may remain of an old floor but a few fragments of marble and their plaster beddings. For an architect who is familiar with the technique used to lay this kind of floor, these scanty vestiges are enough to understand and rehabilitate the type of original floor.

Each layer corresponds to a phase in the building’s evolution; each must be graphically documented to reflect which level is to be conserved and, if possible, show the previous layers in evocative fashion. Not all the layers can be used, but neither should they be destroyed. The oldest levels must be preserved, once duly documented. The result is a complete plan that tells us graphically about the history of the building.

On sites with a long history of human habitation, it is even useful to carry out investigative sections in order to detect floors that are older than the existing construction, and document them graphically and photographically.

Likewise, in a courtyard we have to look for the paving, the well and the drainage system by means of a carefully conducted cleaning process, a kind of mini-excavation after prior inspection. Investigating thresholds and foundations. Often it is not possible to see the original floor level. In this case, the search will start at the door to find the threshold, the point where the interior floor comes to an end. Sections can also be made along the walls to examine their foundations, which sometimes turn out to be the walls of older constructions.

Excavations. Most excavations of the basements of traditional architecture buildings are the result of chance findings of archaeological remains when digging to install waste pipes or to
I. Knowledge

Tool 3
Overall knowledge of the building
Archaeology as a tool for finding out about the building

reinforce the foundations. On those sites where human presence dates back millennia, these finds can be frequent. There are houses where ancient tombs or the remains of walls dating from much earlier periods have been discovered in the basement. Nicosia, the capital of Cyprus, is a characteristic example. Inhabited for thousands of years, the present-day city stands on successive layers of habitation, dating back to the Chalcolithic age. In particular, the walled old town of Nicosia, capital of Cyprus since the Byzantine epoch, an opulent town in the Middle Ages, conceals beneath its modern surface countless vestiges of its Palaeo-Christian and medieval past. The Department of Antiquities has declared the entire city sector that stands within the Venetian walls an Ancient Monument. Since then, all construction work has been monitored to prevent the destruction of archaeological remains. According to the new law, a special permit from the Department of Antiquities is needed for any new construction operation or work in existing buildings that requires excavation. In the case of new constructions, the Department undertakes partial excavations on the site or is present at the excavation of the foundations and stops them if archaeological remains are uncovered. In this way, important remains have been discovered in several places, and systematic excavations conducted. Important archaeological remains are conserved. This may be something of a constraint on development, but now Nicosia, as the capital Lefkosia has been called since Frankish times, has started to gain a better knowledge of its past.

In the same house in Lefkara, the difference in renders between rooms suggests different phases in the history of the building: the whitewashed, uneven earth rendering pre-dates the 20th century, whereas the gypsum plastering with its perfectly smooth, even surface could easily date from the early 20th century.
Applying the archaeological method to Lebanese architecture

Intimately linked with its historical origins in the context of memory stretching back thousands of years, traditional architecture in Lebanon is characterized by its close integration with the territory and its adaptation to local resources. Typically Mediterranean in its materials, forms and colours, the Lebanese vernacular habitat dots landscapes as varied as the coast, the plains amid mountain chains and even the high inland plateaus. Whether rural or urban, these traditional houses are a melting pot of the collective memory and serve to anchor nostalgias and identities.

Poorly treated, destroyed and often abandoned, it is with great difficulty that the traditional house has survived the vicissitudes of the times and changes in lifestyles. In those cases when it is not completely transformed or recovered, it is the object of many interventions in which in-depth knowledge of their construction is often lacking.

Recent rehabilitation projects in the Lebanon are however starting to apply similar methods to that of the archaeology of the building. This relatively recent branch of archaeological science is generally applied to listed historical monuments with a view to developing an upward reading of chronological indices, fundamental elements in a stratigraphic analysis. The building studied is, then, analysed as an element of material culture in its own right.

Traditional architecture essentially belongs to a pre-industrial world. Its evolution with society and the numerous modifications it undergoes to adapt to the needs and the new means available to each age make it an excellent support that bears the traces of these transformations.

The aim of this analysis is mainly to implement a relative chronology of the architectural object and its life in a historical context. A concern for comparative typology completes this approach, along with potential research into the techniques implemented in the building. This methodological interpretation of the built work contributes to a better rehabilitation project.

The so-called archaeological approach is essentially based on the collection of data that serves as a support to develop analyses on the following themes:

- The evolution of the building as recorded in documentary sources
- The evolution of the building in terms of its physical interpretation by means of stratigraphic analysis.

The stratigraphic process refers by definition to a study of chronologically sealed layers, from the lowest to the highest, according to the laws of gravity. This method is not limited to the diachronic aspect of the succession of layers, seeking above all to integrate the ethnographic aspect of occupation. Unlike an archaeological excavation, the sequences are read in elevation, by construction or intervention phase, rather than by the accumulation of strata.

The historical study has recourse to various registers in order to interpret these transformations and restore the configuration of the different stages in the life of the building:

- Morphology
- Architectural typology
- Construction materials
- Built structures
- Coatings and renderings used
I. Knowledge

Tool 3
Overall knowledge of the building
Applying the archaeological method to Lebanese architecture

The information needed to carry out these analyses will be obtained by various means:

**Document collection**, directly or indirectly related to the object of study: administrative, cadastral, property and photographic documents, newspaper articles, publications and correspondence

- Oral sources, drawing on the occupants’ memories
- Written sources (administrative documents, correspondence, publications, etc.)
- Iconographic sources (drawings, paintings, photos, etc.)

A **preliminary plan** provides the basis for reconnaissance at the global scale of the building: based on a visual examination, it must quickly be transcribed in a summary graphic form (sketch) and photographs.

A **detailed, targeted plan** enables more in-depth research and delimitation of the building’s specificities: it will be primarily graphic and metric as the basis for all the necessary supports (plans, sections and elevations). This graphic support at scale serves to record all the visual observations made in every nook and cranny, completed by photographs. These observations must however be methodical and differentiate the themes in question (materials, claddings, pigments, disorders, etc.).

It is in this approach, particularly in the elevations, that the interpretation and collection of data coincide most with the stratigraphic method. The vertical dimension of the construction phases will be worked on the basis of detailed sections and elevations.

**Surveys**, judiciously located on the basis of the definition of a specific problem will reveal intermediate supports and potential connections that are not visible to the naked eye. Surveys are vital to an understanding of built work and are used very discerningly due to their destructive approach. The material (constructional or domestic) collected by these surveys contributes to an understanding of the problem raised.

**Samples** are used to carry out visual or laboratory analyses (fig. 06) of the materials or supports with a view to defining their components and proportions. The analysis of samples backs up visual observations by providing precise, tangible support. The information gathered about construction techniques used in the traditional building can be compared with other, similar studies in the framework of a multidisciplinary approach. This approach, often regarded as long and tedious, has the advantage of providing exhaustive information about a form of architecture mistakenly classified as primitive. Generally applied exclusively to monumental and historical constructions, the archaeological method helps to promote the vernacular building to the status of architecture that is “worthy of interest”. The information gathered in this way serves as the basis for a varied database, a comprehensive form of documentation of this disappearing architecture.

Map of disorders (Debbané palace, Saida)
A comprehensive understanding of the building

Some preliminary issues about the method

The aim of this text is to assist anyone who has to rehabilitate traditional Mediterranean architecture in the essential process of knowledge and understanding that must precede any decisions as to intervention.

A simple way of establishing the concept of knowledge is to define it as the capacity to answer different questions: What is it? What is it like? What is it made of? They all share the aim of describing the object in question, both the obvious and, particularly, the not so apparent. If we answer some of these questions, we have established what we know.

However, it is very probable that we do not understand it. At least, we can say that understanding does not derive directly from knowledge in itself. In order to understand, we have to be able to answer a different key question: Why? The reason for all the above: why is it like it is, why is it made of what it is made of, and so on.

If we take action on heritage that is distinguished as the consequence of an intense historical evolution, the aim of knowledge has to be broadened to what it was like or how it evolved from a given state to its present state. As regards the “why”, we have to establish why it was initially like it was, why it has evolved in a way that has made it like it is, etc.

We have to be aware that this is an activity in which neither architects nor engineers are trained, for a very simple reason. Our training is technical—our aims mainly involve designing artefacts according to a process in which the artefact comes first in our minds and, then, by means of the protocols of industrial or constructional production, we make it reality.

When we are faced with an existing building, the situation is very different. We are facing an artefact that already exists and that is not in our minds. Knowledge and understanding of it necessarily require a different method to the one applied in the design of artefacts.

Furthermore, if a historical building is constructed using means and mentalities that are practically unknown to us, the difficulty increases by several degrees.

In this situation, the method should be similar to that of disciplines in which the principal objective is to know and understand something external to ourselves, like the scientific disciplines that seek to understand our environment. Biologists, astronomers and geologists do not design the objects of their study; they try to understand them. This is what we should do when faced with an existing building, and the method should be the same, though adapted to the case: the scientific method. There is no need to shy away from this term, because the scientific method is no different to the rational attitude of everyday life or other fields of human knowledge. Historians, detectives and even plumbers—all human beings, in fact—use the same basic means as physicists or biochemists when trying to solve a problem or answer a question.

The reason why

It is a question of following the five basic phases of the scientific method:

- Tabling the problem or question requiring an answer
- Formulating a hypothesis that temporarily provides the solution or answer
- Organizing proof or observations to verify it
- Developing the proof or observations, and
- Checking the applicability of the supposition embodied in the hypothesis.

In order to be efficient in our work, it is very important for the initial hypothesis to be as close as possible to the reality we are aiming to discover. This will depend largely on our prior knowledge of possible answers to the questions. The general lack of knowledge of historical construction is undoubtedly a great hindrance to this process.

This text aims to facilitate this process of interrogation and the search for answers, especially with regard to historical construction, bringing to bear a series of basic “whats” and “whys” with a high degree of certainty. In each case, more questions must be added and more answers found by formulating explanatory hypotheses which, on many occasions, it may be impossible to compare and contrast.

In general, things produced by technical activity are the result of a fundamental fact: the object in question has to have a value in the environment in which it is produced and this value, when speaking of buildings, is its utility or, more generally, its purpose. One way to find answers to the question why is to pinpoint the purpose that brought the object into being and the means that made it possible. As in many other areas, it is a problem of ends and means.

However, if a rigorous study of any kind of object is difficult, one
about something as complex as traditional Mediterranean architecture may seem insurmountable. An overview of this enormous diversity (which can be found in the splendid book *Traditional Mediterranean Architecture*) suggests that there are features common to all cases, allowing us to find a common explanation (even if it is masked by the features deriving from this enormous diversity).

In this article, I set out to find the common elements shared by all cases and the variables in diversity.

To begin, we could say that the essential purpose of buildings is not the only common denominator; there are also facts that affect every site, such as something as obvious as the action of gravity, which is perpendicular to the plane of the site—i.e. vertical.

As regards diversity, this emerges both from the means and from the end as the result of the variations encountered in different places, not just from the viewpoint of climate, an important factor in diversity, but also with regard to the resources available and the cultures that harness them, which also change with time.

In order to address all of these points, I will follow the method we use when teaching at the Barcelona School of Architecture.

### Points in common

The end result of any building is always the consequence of a synergetic sum of decisions made about various constructional elements that respond simultaneously to different ends. It is the consequence of a more or less conscious, reflective process of synthesis of various factors. It is a process that does not respond to a single pattern and which is, therefore, different in each case and every place.

A study of the building requires these ends and means to be broken down into parts to be analysed in isolation. The success of the operation depends largely on the extent to which this breakdown is representative of reality.

According to the above-mentioned teaching method, any element in a building is, largely, the consequence of the need for:

- A space delimited by a built material form that is stable from the very start
- A production method that is as efficient as possible
- A construction that is as long lasting as possible with the aid of suitable maintenance
- Improvement of the natural environment
- Satisfaction, on the part of the forms and materials, of the desire for beauty that all peoples, however simple, owe to their human condition.

Let us take each of these principles separately. The analysis of any construction shows that the aim is to create a space that is different to the natural space, in most cases by using vertical elements that support other elements added to them at a slope, horizontally or in the form of an arch.

These elongated vertical, horizontal or arched forms have to be constructible and only exist in the imagination of the builder if they have been built before—that is, they are not imagined forms of which there is no experience.

However, any act of construction, as we all know from a very young age, comes up against a major difficulty: gravity. If the elements are not judiciously positioned, they will fall down, so this constructible form has to be stable from the very start. This essential issue marks the existence of all masonry buildings though it does not explain them entirely, which leads us to the following variables.

Behind any popular building there is a scarcity of resources requiring the builder to apply his ingenuity to production efficiency; any solution has to be applied with the maximum of benefits and the minimum physical effort not only for the builder but also for the population in general as regards the extraction and stockpiling of materials. Almost all traditional Mediterranean houses are built of materials available near the building site and based on constructible forms that are stable from the very start.

Nonetheless, time passes, it is windy, it rains, is hot or cold, and what initially solved a series of problems loses its initial form or some of its materials and begins to deteriorate. To prevent this happening, the builder tries to find out what has failed and comes up with a new way of making the construction longer lasting. He also identifies the periodical care it requires. This is the principle of long-term integrity.

The result of applying this principle is a well built, lasting space, but this is still insufficient, because it also has to provide the occupants with a comfortable habitat.

The basic reason for building a dwelling is in fact to adapt the environment. Throughout history, peoples have sought to improve external environmental conditions: to protect themselves from the rain and damp ground; from excessive heat or cold; from too bright a light, etc. If we follow the methods required by these points, we will have an adapted, efficiently produced space that lasts a long time.

But nor is that enough; the dwelling also has to produce a pleasing visual landscape, of which we are proud and that serves to say who we are. The textures, colours, patterns and forms we see, apart from solving practical problems, have to be in keeping with our visual and symbolic culture. This is what we call aesthetic convenience. If we manage to achieve all of these ends, we have produced architecture, and it is quite safe to say that any artefact belonging to the field defined as traditional Mediterranean architecture can be explained by these five ends.

To focus on the most usual case, settled construction (leaving nomadic constructions for another moment), the exterior is always
separated from the interior space by a series of elements that we might call the envelope. It comprises vertical elements, façades built almost always with walls and elements that close the top of the construction, which we will refer to as horizontal, though its lines may not strictly that: flat or sloping roofs and, in quite a few cases, domes. The envelope is the essential element that provides the solution to almost all requirements—space, environment and aesthetic convenience—and is subject to the main agents of deterioration. It will provide the focus for a study of diversity.

The diverse

Having defined the common elements, it is necessary to establish criteria for addressing diversity. There is no point here in producing a list of the existing places, climates and material resources in the Mediterranean basin. The point is to address the consequences of diversity, which are the means to meeting those ends which also respond to a series of ends specified by the place—that is, the elements used to construct the building. As the first step on this path, I will examine the most representative element of the envelope: the wall.

The wall

The wall responds to various practical requirements such as the need for stability from the very start, maximum duration and separation of the exterior from the interior. It also has to be seen as a fundamental element in the symbolic, aesthetic support of the building.

In form, it is a parallelepiped with its long sides (length) and short sides (depth) perpendicular to each other and parallel to the ground; the third dimension, height, is situated vertically. This form is the result of its role in shaping the space and, at the same time, as we all learned when we were very small, it is also the best way to build a stable vertical element that stands up to the immediate action on it of gravity.

The long dimension is defined by the building’s floor plan; the intermediate dimension, or height, is defined by the height of the space we hope to achieve, and the third dimension, the depth, which is key to structural behaviour, is conditioned by the demands of stability and the material or construction procedure used to build it.

Diversity is the consequence of finding the different responses that a wall can provide to the ends listed above: stability from the very start in order to create the space, adaptation to the place from the viewpoint of available materials and techniques (rammed earth, brick, stone, etc.).

A common factor in all walls is the fact that they are the result of the means available near the place as regards materials and efficient means with regard to the techniques of execution. But there would be no point in a wall unless, while separating us from the exterior, it allowed us to communicate with it by means of something as obvious as the openings that enable us to enter and exit, see out and in, and renew the air that we breathe. There is no point in talking of walls without openings or in considering that openings weaken the wall. There are no walls without openings; the openings are the wall and the wall is the openings.

The key element in the opening is the upper element that transfers the weight of the wall above onto the two sides of the opening or the jambs. This is usually a lintel, generally made of timber, or a segmental arch built using the same material as the rest of the wall.

Nor must we forget the vertical elements that delimit porches or semi-exterior spaces: columns or props. Their dimensions depend on the horizontal elements used to organize the porch, be they straight-lined or arched.
At the same time, all together, blind wall and openings, it has to be long-lasting and the answer is obviously very different if there are suitable stones on site to make ashlars that can be left visible or if there is only earth to make a rammed-earth wall. One of the most frequent causes of degradation is water, either from above in the form of rain or from below by capillary action. If a homogeneous material such as rammed earth is used, the whole thickness is built of the same material. If it is built of small elements, such as brick or rough stone, depending on the relation between the size of each unit and the total thickness, two or three withes will be needed. In either case, these two or three withes must be perfectly connected, otherwise they may act independently, generating a high risk of sagging.

If the material is vulnerable, it has to be protected by an outer facing to limit deterioration due to contact with the elements. This facing also has to meet the needs of beauty and identity. It is important to remember that the wall in question has stood there for a long time since its construction; the wall, and any element in the building, is an extraordinarily valuable document for revealing its own history. Changes, additions, degradation and repairs all go to constitute a document that can help us towards the key factor that is an understanding of its history.

However, the elements in which we find greatest diversity are those that subdivide the space horizontally.

**Horizontal elements**

The major difficulty in constructing a building arises when it comes to the elements that subdivide the space horizontally or close it at the top. While the vertical wall works in favour of gravity, the horizontal elements by definition defy gravity. A wall rarely falls (due perhaps to seismic movement), but a poorly supported horizontal element will invariably fall, or, if excessively compromised, it will buckle and break, something that rarely occurs in a wall.

This difficulty, given the diversity of histories, environments and techniques, has generated a rich catalogue of solutions based on two key elements: timber materials, which due to their genetic origin are resistant to bending, and the inventiveness of the human constructor when timber is scarce: the arch, the vault and the dome.

Of all of these elements, the one with a special role in the exterior image of the building is the one that closes the top. The roof may be sloping, vaulted or domed. It is normally a key element in the aesthetic and symbolic expression of the whole.

In most cases, the vertical subdivision of the interior space generated by the walls and the upper facing or roof comprises plant materials, generally tree trunks, which are characteristically resistant to traction and compression, and, as a result, bending. The applications in the face of the two demands on these elements—strength and resistance to bending—depend on the
form (the span covered and the edge or vertical dimension) and the material, resistance to traction and rigidity.

In general, long rectilinear elements that can bridge a total span are costly, so, to reduce the number needed, they are combined with smaller elements that bridge the span between two main rectilinear elements. The unit they produce together is the floor.

The elements that bridge the span in the roof element are normally sloping beams which do not form a triangular framework structure due to the difficulty of tying the different elements. In general, we find a main beam on which a short prop supports two sloping beams, each bridging half the span and generating the slopes of the roof.

In places where the atmosphere is drier there are flat roofs which, in static terms, are the same as the floors, though subjected to greater loads due to the material that has to be added to them in the form of not totally impermeable layers in order to make the whole impermeable.

Nonetheless, the elements to have represented the greatest invention on the part of their builders—and the greatest admiration and number of unanswered questions today, in view of their disappearance from academic teaching—are those that describe a curve: arches, vaults and domes.

Arches can generally be built in one of three ways: with dressed stone voussoirs; with rougher pieces of stone, or with bricks laid to follow the radius of the arch circumference, bonded with mortar. The mortar bond in the two latter cases provides the different thicknesses in the intrados and extrados to achieve the curve.

To understand an arch, it is necessary to consider two key points:

- Its construction requires a provisional auxiliary element, the centring, the characteristics of which will depend on the type of masonry and the specific techniques of each place;
- In all cases, the arch generates forces of thrust and drift that tend to open up towards the abutment or spring.

In order to be completely stable from the very start, the arch requires the abutments or springs to hold their shape, so they have to be a certain width. Historically, builders developed simple rules that relate the span of the arch with the width of the abutment.

If it is an arcade in which the arches rest symmetrically on the impost of a pillar, the thrusts cancel each other out and only generate a vertical weight, unlike the case of the arches at the two edges, which require a broader prop.

Like arches, vaults may be built of perfectly dressed voussoirs, though this is rare due to the difficulty of the task; stone masonry using relatively flat units, similar to bricks, and different thicknesses of mortar to produce the curvature, or orders of bricks.
Many techniques have been developed to reduce to a minimum the need for provisional support for the vault. In those cases where the bricks are laid on edge, work begins at the corners, etc. All of this can be analysed by observing the bonding of the intrados.

In all cases, they generate forces of thrust or drift on their supports, which therefore have to be thicker than the walls that only support floors.

As in the case of the arch, it is important to be familiar with the rule followed by builders since time immemorial, by accumulation of empirical knowledge, relating the form of the vault, the span it covers and the corresponding thickness of the wall that provides its stability. For example, a rule applied to the construction of barrel vaults in the 17th century in Spain advised that the thickness of the wall should be a third of its span. It is reasonable to suppose that all traditional builders have similar rules that have been handed down from master to apprentice, knowledge of which is vital in each case.

All of the above considerations can be applied to domes, with the addition of a further, very important one. When working with circular or nearly circular floor plans, it is possible to establish a system that balances out thrusting by using a tension ring that reduces these thrusts to zero. In consequence, the dome only transfers vertical loads, with a very noticeable reduction in the thickness of the walls.

The building

Finally, we come to the building as a whole. The construction of the building requires the builder to understand the relation between all of the elements. The same understanding is necessary for the agent intending to rehabilitate the building. The building is generated by the interrelation of space and the elements that delimit it. The dimensions of the space are conditioned by the possibilities of these elements. If no large trees are available, it will be difficult to build large separations between the walls. If there are no trees at all, it will have to be built using vaults that require thicker walls, etc. Though space is defined by the initial end of housing a function, it is limited or favoured by material and technical resources.
join facing walls. In other places, the strategy applied combines masonry with timber elements, producing very different behaviour to that of the solid wall.

It is important in this overview not to forget that almost everything we see in the building is the consequence of the vast transformations that have taken place in general in the last century, particularly the implementation of installations.

Most buildings are the consequence of variations and the addition of accessories produced in the 20th century in response to the need or desire to increase environmental and hygienic comfort and also, it must be said, as the result of mistakes caused by ignoring the history of buildings when renovating or adapting them to the times.

One very forceful consequence of the 20th century was the implementation of installations, totally absent when most traditional buildings were constructed. The interrelation between their associated tubes and the historical support calls for a specific study, as an understanding of it is vital to the rehabilitation project. However, it must be based on the realization that we cannot refuse the contributions of the 20th and 21st centuries to the comfort and safety of the users of traditional architecture which has to continue to exist for centuries to come.

The urban phenomenon

This final stage in our examination of buildings moves beyond our scope and marks an end to this text: the grouping of buildings to form a village, town or city—the urban phenomenon. If we hope to understand the building, some of our questions must address the interrelations between all buildings or, conversely, the effect on buildings of the city or the urban fabric.

In short, if we can reach an understanding of how they have come into being, and answer present-day questions, as well as those that are the product of the history and particularities of the place, the techniques, the resources, the culture and the people who live there, and, at the same time, of the whole, then we can say that we have a comprehensive understanding of the building.
Architectural analysis of buildings. Typologies in Cyprus

Eliana Georgiou,
Architect
Technical Assistant in the Department of Antiquities, Cyprus

Restoring a traditional building is to know the local architecture and the traditional way of life. Only this way can one understand the typology, morphology and the building materials of the local dwelling.

The simple life of the people connected with earth and nature is reflected on the simplicity of the traditional Cypriot house. The minimal needs of the family do not force the mason to look for complicated forms of houses. All that it needs is a shelter space under which the Cypriot family joins all their activities. The form of the house simply follows the construction without being influenced by the interior.

An important factor in the formation of the traditional settlements in Cyprus was the variation in the landscape. On the plain areas the settlements consisted of a series of closely packed houses with flat roofs. A high wall surrounded each house thus leading to the formation of a yard. On the mountains, the houses were built attached to each other continuously and packed, exploiting as much space as possible, having tiled roof.

The variety of Cyprus topography allowed the anonymous mason to provide splendid examples of housing complexes, avoiding monotony even when the facades are plane and simple. Important factors in the shaping of the house are the local materials and the experiences and skills of the mason. Local masons built houses without any architectural plans and with materials available from the surrounding area. The houses were constructed mainly from adobe and stone. The openings (doors and windows) are few (fig-1), and sometimes less in the side of the road. Rectangular or square small openings (arseres) were made for ventilation.

The most popular simple traditional house is the *platimetopo makrinari* (fig-4). It consists of a rectangular covered space. As the various functions of the people increased and life became more complicated, bigger space was needed. The *makrinari-dichoro* was then created (fig-5). This was accomplished by joining two *makrinari*, using an arch. The new space allowed more comfort, movement and organization. At the same time, *illiakos* appeared (fig-6).
Illiakos (fig-10) is a covered space formed in front of the house, which extends onto the full length of the south side of the dichoro. All the household activities are transferred in the illiakos. This is achieved, because the climate of Cyprus allows for it. The illiakos was an essential component of the house. The space was used for work, recreation and congregation- a direct connection with nature. The various spaces of the house were not built at the same time, but added according to the needs, the social and financial status of the owner.

As the linear extensions, there were also extensions in the shape of “L” or “U” (fig-7) or in the upper floor because of the lack of space in small plots. The yard, surrounded by a wall, is the heart of the Cypriot traditional house. It plays a vital role in the daily life of the inhabitants, with all the activities taking place there (fig-9).

In the cities, the house is the evolution of the rural traditional house, but more complex. The makrinari remains the basic space. The houses were built attached to each other in continuous and packed strips, lengthily positioned alongside the road. The orientation is according to the road. The illiakos–portio is still the axis of the house. It is the main entrance to the house, opening with an arch to the backyard. Sometimes, it is closed to give more inner space. In each side of it, symmetrically, two makrinaria are located. A second illiakos is made alongside the inner length of the house, supported by arches, in which stands the staircase for the upper floor (fig-2, fig-3). This inner illiakos is repeated at the upper floor level. On the upper floor, above the road and the main entrance, the kioski (fig-11) (in later times becomes a balcony) is an extension and connection with the outer world.

The main entrance is built with great care; it is the element that
I. Knowledge

Tool 3
Overall knowledge of the building
Architectural analysis of buildings. Typologies in Cyprus

gives the character to the urban house. Sometimes, above the door, a carved stone with figures is put. The small windows are replaced by bigger ones with stone frames, and having outer and inner shutters.
The yard in the urban house is smaller and looses its role as a place of work becoming a garden with trees.
Also it is important for someone to consider the internal decoration and furnishing of the traditional Cypriot house. We can see excellent pieces of folklore art, such as gypsum or wooden shelves, traditional weaving machines, wardrobes and cupboards as well as richly engraved chests (fig-17).
Thermal comfort in existing homes

Introduction

The purpose of buildings is to provide islands of comfort. They represent the protection that humankind seeks. They constitute barriers to rain, snow and wind; protection from the cold and, sometimes, subtle filters of light, noise and heat. This search for comfort is not new. Socrates taught the art of constructing a pleasant house according to orientation, sunlighting, the time of year and the configuration of the façade. However, demands have changed, becoming more stringent (I cannot say they have evolved), leaving to one side an integral conception of the building, seeking comfort to the detriment of natural resources.

Today, a sustainable conception of building or renovation has to centre on passive means and efficient installations if it is to achieve its aim of producing comfortable housing using positive energy (which produces more energy than it consumes).

In this respect, we can learn from our forebears, who used different techniques according to the climate: humidification, ventilation, insulation, etc. We can even learn from plants.

Learn comfort from plants?

Plants obtain the comfort they need by means of suitable conception, form and position.

Example: The high plateau starts at 3200 m and continues to a height of over 4600 m; it extends as far as Colombia and even Peru.

Plants share similar characteristics of adaptation that allow them to live in this region with an extreme climate.

Slow-growth plants can absorb the heat from the ground during the day

Silvery pigmentation to reflect solar radiation, which is enormous at this altitude

Small hairs on the leaves help to conserve heat and moisture by creating a barrier between the surface of the plant and the air.

Small thick leaves present the smallest surface area to the cold and to the air in order to conserve heat and moisture, and also to the sun, in an almost vertical position.

Hairs to conserve moisture content.
Traditional architecture and comfort

Traditional architecture takes into account the microclimate in order to achieve hygrothermal comfort for humans and for the building.

Microclimate should determine the choice of site of the building, either to make the most of existing conditions or to evaluate the possibilities of correcting unfavourable conditions: by means of the actual construction, vegetation, surfaces of water, choice of materials, shape, size and arrangement of openings, etc.

In this way, an improved microclimate is created in relation to the regional climate.

But what exactly is comfort? Comfort for people at the scale of the town?; at the scale of buildings, their homes? The comfort of the building? Is comfort today the same as it was yesterday? And what about tomorrow?

If we consult the dictionary, we find “notion of material wellbeing”—a difficult definition to relate to our sensations of cold or heat…

If we go back to Old French to find the meaning, “comfort means assistance”.

“...It was called ‘well being’ in the late Middle Ages, ease or convenience just before the French Revolution. Comfort, in the sense that we now understand it, appeared in France in the industrial age, with a peculiarly British ‘m’, due to the reimportation of this originally French word” (Jean Pierre Goubert, Du luxe au comfort).

In architecture, the term becomes more complex. Material comfort seems easier to express in relation to having access to a bathroom or toilet; the definition becomes more complicated when we speak of thermal comfort—or hygrothermal comfort when our sensations are in direct relation to the two inseparable parameters…

We refer to the comfort of people, but also the comfort of the building. It is interesting to note that human comfort has points in common with the comfort of a building.

For example, too high a level of humidity disrupts our balanced transpiration and can restrict breathing, but it can also be the cause of rot in some woods, of the growth of rot fungi, faster corrosion of metal elements, surface condensation on walls (particularly if poorly insulated) and heat bridges, and many other things besides.

The internal temperature of our bodies is approximately 37°C. The built spaces that surround us are generally less hot. Hygrothermal comfort can be achieved provided our bodies lose heat at a suitable speed: if they lose heat too fast, we feel a sensation of cold, too slowly and we feel a sensation of heat.
Can the same parameters be applied to comfort in the past, comfort today, comfort when on holiday and comfort at home? Humankind has always aspired to comfort, but the concept of comfort has changed throughout history, according to cultural models, technological “progress”, and even with circumstances. When we are on holiday, in the mountains, for example, “away from it all”, an ideal situation sought “just for a few days”, our appreciation of comfort is quite different to what we want at home in the city. That cold, damp, draughty hut actually seems comfortable. However, its temperature and humidity content are far from our usual comfort parameters.

Not so long ago, in our grandmothers’ day, when we were cold in the house we would put on a thicker sweater, or even two. Today, even when the temperature drops, we walk around the house in T-shirts, and even the buses are heated!

The last century was characterized by uncontrolled exploitation of our planet’s resources. Today, an awareness of dwindling resources presents us with the dilemma of how to maintain our comfort in a world without petrol, while conserving the ozone layer.

The answer may be to change our behaviour, using new technologies and salvaging our forebears’ knowledge of building in harmony with the climate, using suitable materials and systems.

Hygrothermal comfort for people

We seek comfort: not too cold, not too hot, no annoying draughts. In the same space, one person may feel comfortable while another feels uncomfortable. The appreciation of comfort depends on the individual, though by playing with essential parameters such as temperature, air movement and moisture levels, it is possible to obtain a balance that suits most people.

Hygrothermal and respiratory comfort depend on various factors, including:

- The individual:
  - His or her metabolism,
  - The clothes he or she is wearing,
  - What he or she is doing.
- Temperature and humidity
- The mean radiant temperature of a given wall or room
- The temperature of objects in contact with our bodies
- The movement of the air on and around our skin

The human body seeks balance; it exchanges heat with the atmosphere by means of various transfer mechanisms: conduction, radiation, convection and evaporation. These exchanges take place by means of the respiratory tract and the skin.

Reminder:
Radiation
- The emission of infrared rays. As a result of this thermal energy, any object that is hotter than the surrounding bodies gives off heat to them. Thermal exchange takes place between the skin and the solid elements in the environment.

Conduction
- Unlike radiation, conduction requires direct contact between the objects. It is the transfer of heat between objects that are directly in contact with each other.

Convection
- Exchange between the body and a moving fluid, almost always air or water. The importance of convection can be considerably modified by exterior conditions.

The interaction between the objective data of the environment and the perception of human beings is a complex process.
Variables associated with people

How we dress. By adapting our clothing to the demands of comfort, we can adapt quickly to climatic variables not only outside the building but also inside. The values of thermal insulation of clothes are measured in clo, the clothing insulation unit that gives a person at rest a skin temperature of 33°C in radiant temperatures of 21°C.

1 clo is equivalent to 0.16m²°C/W of thermal resistance.

With its irrational use of energy, humankind, particularly in developed countries and most particularly in large cities, has forgotten the role of clothing in thermal comfort and energy saving, and, therefore, the protection of the environment. Today, when we are cold, we turn up the heating and when we are suddenly too hot, instead of turning down the heating we open the window. In the dog days of summer, we forget to close the shutters (if we are lucky enough to have conserved them) and open the windows instead of closing them when the air temperature is higher outside the building than inside it. Our behaviour is vital to obtaining comfort at the lowest cost to the environment.

Our grandparents had recourse to some great cutting-edge technology with aesthetic variations, in the size and colours of their choice, representing a low initial outlay, within reach of all budgets, requiring low maintenance, and the lowest return rate: the sweater! A light, short-sleeved sweater, 0.17 clo, a thick, long-sleeved pullover, 0.37 clo!

Metabolic energy (Watt/m² of body surface) and work: the production of metabolic energy depends mainly on type of activity and position. The sensation of comfort varies according to our body’s heat production and heat loss through the surface of our body.

Levels of activity, work: according to one’s level of activity, the body has different needs and reactions. A person at rest, sleeping for example: 41 W/m². A person walking up a steep slope or stairs, 260 W/m².

The body’s capacity to adapt to different climatic conditions: principally in relation to heat: transpiration, increase of blood circulation on the outer layers of the body in order to increase heat loss, change in breathing.

Comfort: difficult balance between temperature and moisture: The balance between air temperature (dry-bulb temperature) and the relative humidity of the air (quantity of water vapour contained in the air), always measured inside the building, are vital data for measuring hygrothermal comfort.

The bioclimatic diagrams indicate the comfort variables as regards humidity and temperature. What interests us is the relation or balance between temperature and moisture, as shown in the diagram below: If the hygrometry of the air is high in relation to the air temperature, the evaporation of sweat is slowed, preventing the body from adapting to the climate, and prompting us to speak of discomfort.
## What are the issues?

Decrease heating needs by ensuring biological comfort, taking advantage of the climate in winter.

## What strategies? (e.g. capturing, storing, releasing...)

Controlling incidence of sunlight, drawing it into the building in winter. The simplest form of heating is the most direct: a south-facing window may be an efficient way of capturing sunlight.

Storing the energy that comes into the building (by means of the thermal inertia of the walls and floors, which can store this energy and return it to us).

Avoiding the impact of the wind on the building and outdoor living spaces.

Avoiding the cold wall effect.

The hierarchical system of spaces ensures the transition between inside and outside: in-between spaces, which are apparently no longer in vogue, play an important thermal role. This buffer space helps to prevent the energy loss caused every time the door opens and creates a space of thermal transition between indoor and outdoor temperatures, providing a comfortable adaptation.

Some ways of capturing solar energy are:

- Collector walls: they capture solar energy, store it in their mass and pass it on in the form of heat to the interior after several hours, thanks to their thermal inertia (*Traité d’architecture et d’urbanisme bioclimatique*). This is the case of the Trombe wall (whose performance is conditioned by climatic factors and the orientation and inclination of the wall) or air collectors (walls or window).
- Greenhouses and verandas are buffer spaces that help to capture solar radiation, which is transformed into heat by the greenhouse effect. Issues requiring further attention are:
  - The risk of overheating during the day in summer.
  - The risk of night-time cooling in winter.

The inertia of the ground can be used to stabilise the indoor atmosphere, thereby obtaining comfort. The ground has thermal insulation capacities that are much used in vernacular architecture. The ground can even be used, thanks to its inertia, to preheat the air in winter (the temperature of the ground being higher than that of the air) and to cool it in summer (the ground temperature in summer being lower than that of the air). These systems allow us to obtain thermal comfort at the lowest cost to the environment.

The movement of air is directly related to comfort. This includes two possible speeds: the very low speed corresponding to natural convection, i.e. without ventilation, and the maximum admissible speed of a (hot) air current obtained by means of ventilation. The result is two curves that represent the outer limits of comfort with and without ventilation.

### Glazing: there are various factors involved in the choice of glazing. Is its purpose to collect or conserve energy, or to manage the hot or cold wall effect? How much natural light does the choice collect? The choice of glazing is complex and calls for particular reflection according to the needs of thermal, energy and lighting comfort, as well as of the activity accommodated by each space. For example, suitable thermal insulation helps to decrease loss and create comfort.

- Low-emissivity triple glazing: 0.7 W/(m²K)
- Rare gas: 1.1 W/(m²K)
- Double glazing with reinforced thermal insulation: 1.8 W/(m²K)
- Classic double glazing: 3.3 W/(m²K)
Above we explained how solar thermal radiation basically comprises direct or indirect solar contribution in the form of radiation, which conditions our sensation of comfort far more than the intrinsic temperature of the air. Solar contribution essentially comprises the solar radiation that finds the surface of buildings. The radiation acts on the envelope of buildings, walls and roofs, and on other materials such as the floors or pavements that absorb the radiation and re-emit it. The energy (manifested in the form of heat) is stored in the walls, enters the building, travels through the floor structures and other associated construction elements. This radiation is the source of discomfort.

There is direct solar contribution through openings and windows, and indirect solar contribution through exterior walls and the associated construction elements through which they penetrate. Direct solar contribution constitutes a large heat load against which solar protection is effective. Indirect solar contribution is principally due to the insufficient or poorly designed thermal inertia and/or insulation of the dwelling's envelope (walls, roofs). Furthermore, the untimely entry of overheated air, not indispensable to good ventilation, is also an aggravating factor.

The role of closing and protective elements as regards thermal comfort and energy saving. Closing and protecting elements ensure:

- Direct mechanical protection by means of an obstacle (intrusion, fire, bad weather, wind)
- Protection of the building (heat, cold, corrosion)
- A source of comfort (thermal, visual, acoustic)
- Filtering of natural light.

They also serve to characterize and give architectural value to façades. As regards solar radiation, closing and protective elements act thanks to the application of two essential principles:

- Insulation (a heat or light screen to radiation)
- Reflection (partial return, reflected from their outer face, of radiation)

Depending on the nature of the closing and protecting elements, it may or may not be possible to combine the presence of each of these two types on the same glazed opening. The different types of closing and protective elements can be grouped as follows:

- Closing elements: shutters, blinds
- Protection: essentially blinds, subdivided into exterior, interior and incorporated into the glazing
- Curtains and films applied to the glazing

A comparison of the efficacy of solar protection in the summer shows, for example, that exterior protections are in general appreciably more efficient than on the interior, those integrated between layers of glazing are of intermediate effectiveness. A white Venetian blind on the interior, fully let down, will reduce the radiation through the glazing by 44%, whereas on the outside it will be 85% effective. Most exterior protections at an opening will allow just 5 to 15% of the energy reaching it to enter the premises (CEBTP “Caractérisation…”, p. 57).

Another notion to remember is the influence of the colour: a white cloth interior blind, fully let down, will lessen the radiation transmitted by 60% as compared to a scant 20% for the same blind in a dark colour, in the same conditions (Víctor Olgyay, Arquitectura y Clima).

These protections may be adjustable and even motorized to adapt to the intensity of radiation. According to the materials and systems used, they may be more or less difficult to maintain. It is important to bear in mind that cleanliness will affect their performance.

Some protective elements

- Blinds: blinds are most effective if they are opaque and placed on the exterior. In these circumstances, they can massively (34-59%) reduce solar contribution, thereby helping to improve comfort by lowering solar radiation and the surface temperature of glazing.
- Special glazings: glazings whose characteristics give them specific properties. These characteristics depend principally on the thickness of the air cavity, the composition of the gas present between the two lights, and the nature of the frame elements.
- Sunshade and projecting roof: architectural elements that project to provide increased shade and absorb excess solar heat in the summer, allowing the sun to shine in during winter without concealing the field of vision from the window.
- Louvre blinds: exterior adaptable frames made up of openwork panels that can be folded back.
- Curtains: their efficiency can be considerably increased by backing them with reflective aluminium fabric, placed as near the glazing as possible.
- Shutters: adjustable panels to close openings.
- Roller blinds: horizontal elements such as rigid slats that roll up horizontally and block out the sun.
- Vegetation: preferably deciduous trees and vegetation that allow sun to shine in during the winter (seasonal shading). Deciduous trees protect the façade in the summer and allow energy gain in winter. Vegetation oxygenates and cools the air.
by evapotranspiration and filters suspended dust particles. Trees thereby reduce the effective exposure to the sun by 20-40%. Vegetation can provide a screen against wind or guide it according to our needs.

- Sunshades and porch roofs are solar protections that can shield exposed walls and openings. Among other things, they provide protection from direct solar radiation.

The internal contribution made by domestic equipment may be quite considerable and cause discomfort.

Another internal contribution to be taken into consideration is the product of the calorific contribution of the occupants in the event of over-occupation.

The importance of colours
The colour of walls has a big influence on the temperature of their surface. The lighter and more reflective they are, the more they reject solar energy.

Thermal protection of roofing. Whether the roof is horizontal or sloping, and comprises tiles, metal elements or other materials, it is the component that receives most insolation and contributes most to thermal exchange. Judicious thermal insulation is therefore vital for both comfort and energy saving. Insulation by means of a sufficiently thick layer is an important contribution to comfort in both summer and winter, not to mention the corresponding improvement in acoustic comfort.

The role of inertia. The inertia of a building measures its capacity to store heat and slow its loss. It thereby helps to attenuate the effect of overheating due to solar contribution. Its contribution is, then, vital for façades that face the sun, depending on the climate and place, and is especially important in climates with large diurnal temperature differences. Massive walls and heavy roofs mitigate the effect of these large differences.

Comfort and over-occupation. The heat produced by the metabolism is by no means secondary, and it accumulates. Further, the air pollution of rooms inhabited by many people obviously varies according to the number of individuals.

Occupants give off heat and moisture. A seated person gives off in the region of 100 watts at an ambient temperature of 25°C. One way of limiting internal thermal contribution is to avoid over-occupation.

Use natural lighting and limited, well-chosen artificial lighting: for reasons of economy and thermal and visual comfort, it is desirable to use natural lighting in the daytime, which does not mean letting solar radiation directly inside. In the evening and at night, when natural lighting is insufficient, it is a good idea to use low-consumption light bulbs. Halogen lights increase room temperature considerably.

Limit the use of exothermic household appliances. Electrical domestic appliances also give off heat. It is worth knowing the
consumption of each apparatus, which is listed in the manufacturers’ notices.

Natural cooling systems

- Ventilation. Natural cooling by means of ventilation is feasible and worthwhile when it is cooler outside than it is inside. In general, at night the exterior air temperature is lower than inside dwellings (except during the hottest period), and ventilation should take place at the coolest hours of the night (between midnight and six a.m.). This night-time cooling effect can be increased by opening windows in opposite façades, where possible. In dwellings built on two levels, the effect is even more marked if the open windows are in opposite façades on two different levels (chimney effect).

- Evaporative cooling. The use of expanses of water creates microclimates and lessens diurnal temperature variations. Different aspersion systems also cool ambient air. Misting procedures may also be used. With high temperatures and low relative humidity, water evaporation will bring down the temperature by increasing humidity. The fountains in Arabic courtyards are one example.

- The thermal inertia of the ground: the earth heat exchanger. This system can only be used in buildings surrounded by sufficient land with available subsoil. It requires modest investment and a level of technical knowledge that places it within the reach of numerous professionals. Continuing performance and comfort are dependant on regular maintenance. Initially, the system consists in introducing exterior air to renew the air inside the house through a conduit that is naturally maintained at a lower temperature than that of the exterior atmosphere, as it is sunk deep in the subsoil. This system also serves to preheat the air in the winter, as its passage through the conduit raises the temperature of the air taken in. Performance is largely dependant on installation conditions: the nature of the earth, the diameter, nature and length of the conduit, the rate of air flow, topography and thermal insulation of the parts of the conduit above ground, etc.

1 Contact : Maria.Lopez-Diaz@anah.gouv.fr

Surfaces of water help to create comfortable microclimates (Spain).
**Acoustic comfort in existing homes**

Noise is way ahead at the top of the list of nuisances bemoaned by the French, being all the more unbearable when it affects them in their own homes. We therefore have to consider the physical reality of noise and its effects, which depends largely on its source, type, time of emission, emergence and repetitiveness, etc.

For example, a dripping tap can ruin a night’s sleep, though the noise represents just a few millionths of the sound energy of a vehicle in the distance that does not bother anyone.

**The production of noise**

Noise is a vibratory phenomenon that is propagated in the surrounding air, either directly or indirectly.

If the sound source is propagated directly in the air, for example by means of a loudspeaker, we speak of airborne noise; according to whether the source of this airborne noise is inside or outside the home, we refer to interior or exterior airborne noise.

If the air is caused to vibrate by coming into contact with an element that receives an impact, such as a hammer blow against a wall, it is impact noise.

If the air is caused to vibrate due to the functioning of equipment, such as a washing machine, it is equipment noise. It is further possible to distinguish between equipment noise outside the home (lifts) and the noises of indoor equipment.

Noise may of course respond to several headings: a lift produces airborne noises by means of its motor, impact noises by means of its doors and equipment noise caused by the movement of its cabin. Depending on where one happens to be, one of these noises could appear to be predominant.

**The perception of noise**

The subjective part in the perception of noise is frequently more important than the noise level as measured by a sound-level metre; for example, the noise of a water heater switching on may reassure an owner-occupier, whereas it could irritate a tenant. Likewise, tiredness or stress, or the kind of relation one has with one’s neighbour also affects one’s perception of the noises he makes.

**The transmission of noise**

Whatever the type of noise (airborne, impact, equipment), it travels between its source and the point of reception along complex, often multiple paths, preferring those that present the least resistance, which are called sound bridges. Thus an exterior airborne noise will pass easily through an open window, and an impact noise or an equipment noise will be easily transmitted by a partition or piping.

The limitation of the discomfort due to noise involves first limiting it at source and second introducing appropriate obstacles between the source and the reception point, bearing in mind that the paths taken may be multiple and difficult to locate—there is no point closing one window if another is left open.

Furthermore, it is important not to underestimate the masking effect of continuous noise such as the outdoor traffic. In this case, the installation of soundproof windows may lead to the appearance of interior noise, such as equipment noise that was hitherto masked but is now more noticeable!

The phenomenon of reverberation also has to be taken into account: it generally affects sufficiently large rooms with walls that are rigid or tiled, for example. Normal furnishing will attenuate this phenomenon but it may be necessary to implement complementary measures in the form of acoustic treatment. Reverberation often affects communal areas such as corridors and foyers, producing an uncomfortable noise environment.
I. Airborne noise

Apart from the preferred process of reducing the nuisance at source, which is not always practicable, the main obstacle to exterior and interior airborne sounds are horizontal and vertical facings, walls and partitions. These walls are all the more effective against airborne noises as they are not generally susceptible to vibration, and heavy walls in particular are highly efficient in acoustic terms. Of course, a heavy wall with windows in a poor state of repair is less of an obstacle to airborne noise, since it is the weakest part, the window, that governs the overall effectiveness. There are, however, also light walls, partitions comprising two gypsum plasterboards joined together by a metal frame, that also have excellent soundproofing qualities; the air trapped between the two elements then acts as a buffer and attenuates airborne noise. Their level of efficiency can be further improved by filling the space between the plasterboard with special fibrous materials, generally mineral wool.

It is also possible to increase the number of gypsum wallboards, this being a particularly appropriate solution for the rehabilitation of old dwellings, as the resulting partition is lightweight and represents a minor added load on the building’s structure, at the same time offering comparable efficiency to heavy walls. These solutions, however, can only be employed for interior partitions.

a. Exterior airborne noise

To counter exterior airborne noise, rehabilitation work has to focus principally on the weak points, specifically doors and windows, air inlets, rolling shutters and roof structures. It is necessary to ensure that these interventions do not compromise ventilation systems; the interior comfort of the dwelling could otherwise be affected and the built fabric will suffer.

Doors and windows

The principal aim is to suppress any direct entrance of air and, with it, all means of transmission of exterior noise. A careful examination of the situation by a professional, known as an acoustic diagnosis, should produce the best solution for the budget available.

- Conservation of the opening leaves, fitted with acoustic glazing. In this case, it is important to ensure that the fixed frame and the opening leaves can bear the additional weight of the glazing, which is considerable.
- Replacement of existing doors and windows by new airtight elements fitted with acoustic glazing. If the fixed frame is in a good state of repair, it may be conserved.
- Construction of a double window. When correctly carried out,
this solution is highly effective and also conserves the exterior appearance of the façade, an important factor when dealing with valuable heritage.

**NOTE:** Double-glazing for insulation generally makes little difference to soundproofing, especially if the two lights are the same thickness and quite close together. It is advisable to choose specific windows (with opening leaves and fixed frames) and glazing whose acoustic properties are specified on the product.

It is also advisable to ensure that the ventilation systems generally associated with windows do not counteract their acoustic performance.

**Air intakes**

There are specific air intakes, referred to as acoustic, with facings that are lined with absorbent materials. These cut out exterior noise and allow correct airing of the dwelling.

If the replacement doors and windows are not fitted with built-in air intakes, it is advisable to restore ventilation, possibly by effecting openings in the masonry.

**Rolling shutter boxes**

These boxes often constitute an acoustic weak point in the façade. The situation can be improved by replacing the existing boxes by denser materials and blocking up all direct entry of exterior air. If possible, the inside of the box can also be lined with insulation materials such as mineral wool or absorbent foam (see above). If replacement is chosen, the element should be substituted by window blocks with built-in rolling shutters, which are good acoustic performers.

**Roofs**

Roofs are particularly sensitive to exterior noise, especially aircraft noise, which is particularly annoying after building a loft conversion. An initial solution is to have thermal-acoustic insulation fitted. If this proves to be insufficient, it will then be necessary to have recourse to more extreme solutions, such as separating the roof from the rest of the building’s structure.

b. **Interior airborne noise**

Interior airborne noise calls for interventions to structural floors, separation walls or landing doors and partitions.

**Structural floors (and ceilings)**

Structural floors (and ceilings) may be acoustic weak points as a result of the pipes that run through them. This may be due to gaps that let sound through, in which case elastic sleeves or soundproofing materials should be fitted, or to excessively rigid
I. Knowledge

connections of pipes to structural floors, in which case the elements should be separated, for example using vibration cushioning to prevent the vibrations of the pipes being transmitted to the structural floor or ceiling. The direct passage of noise through the facing is counteracted by packing the gaps with soundproofing material.

If the noise is transmitted directly by the structural floor of the dwelling upstairs it may be necessary to consider the construction of a double ceiling according to the same principle used in the case of common walls. It is vital to carry out a diagnosis of secondary transmission, particularly by vertical partitions, since this may be the primary cause, making the construction of a double ceiling both expensive and ineffective.

Furthermore, the routes taken by sound in old buildings can be complex and require professional analysis.

**Common walls**

Thermal insulation materials placed on the interior of dwelling walls are often so rigid that they reduce the acoustic performance of the facings between homes. It is advisable to replace them with suppler thermo-acoustic materials, which are attached by bonding or inserted between the wall and a gypsum wallboard attached to a metal frame. The same solution can be applied if the transmission of noise between dwellings is caused by structural weakness of the common wall.

**Landing doors and partitions**

Landing doors with acoustic weaknesses should be replaced by officially approved doors. Partition walls between a dwelling and a landing can be addressed in the same way as partitions separating dwellings (see above).

II. Impact noise and equipment noise

The lighter a wall is, the more transmission of noise will be facilitated by direct contact between the facings of a dwelling and the parts subject to impact or vibration.

Various resources are available to resolve this problem, including anti-vibration supports, cladding laid over underlay, floating floors, suspended ceilings, etc.

It is important to remember that pipes can carry impact noises a long way. Likewise, the slightest error in the fitting of soundproofing
mechanisms can ruin the entire noise attenuation system. In particular, any point of direct contact of a floating floor with its support will render this major investment ineffective.

**Impact noise**

- **The structural floor**
  The principle of intervention consists in preventing the element from vibrating when subjected to stress due to the impact of an object. One solution is to cover the floor of the dwelling where the noise is created by a form of cladding that will absorb impact (carpet, plastic flooring with resilient underlay, etc.) or to introduce a resilient layer between the support of the structural floor and the floor cladding that is sensitive to impact noise, such as a tiled floor or rigid parquet. Another, fairly extreme solution would be to build a floating floor, which should be entrusted to an experienced professional to ensure its proper construction.

- **Intervention on the structure**
  If it is not possible to intervene in the dwelling where the noise is produced, it will be necessary to introduce barriers to prevent their transmission. This requires a diagnosis carried out by specialists, requiring the intervention of an acoustician.

**Equipment noise**

- **Intervention on equipment**
  In France, most electrical domestic appliances, boilers and plumbing fixtures have an NF mark that specifies their acoustic performance; nevertheless, their application will be dependent on external factors that have to be taken into account and corrected as applicable. A quality tap will only be silent if the water pressure is not excessive. Likewise, an extractor outlet will hiss if the airflow is not balanced.

Passive equipment such as pipes must in all cases be attached to heavy walls by non-vibrating clips. Intrinsically noisy equipment such as an extract ventilation motor can be effectively suspended and enclosed in casing lined with absorbent materials.

**Reverberation**

Acoustic correction consists in general of cladding walls with absorbent coverings; in this case, the characteristics of the facing with regard to airborne noise are not modified.

---

1. See the technical leaflets published by the ANAH, particularly "Bruit et confort acoustique and Bruit".
2. The idea of the illustrations are provided by the CSTB on behalf of the ANAH.