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Bioclimatic values in the rehabilitation of Traditional Mediterranean Architecture

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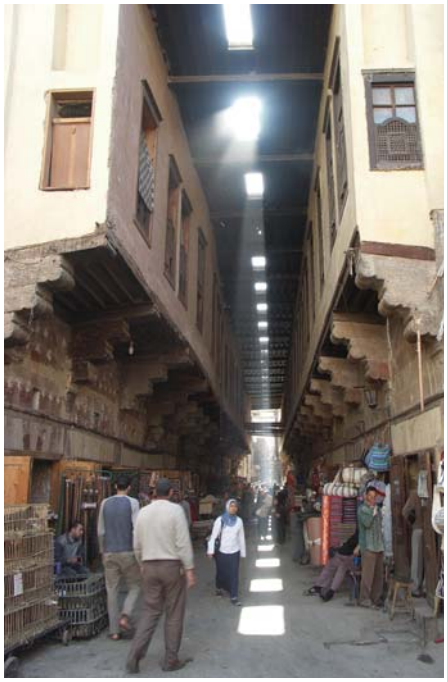
The traditional architecture we find in the Mediterranean basin continues to be of an extraordinary richness. It is the product and the reflection of societies accustomed to intense interchange, and it has taken form slowly precisely thanks to these interchanges.
It is however important to point out immediately that it is a disappearing architectural form, because it was produced on the basis of a logic that we call pre-industrial, when things happened slowly, when the shapes of architecture were distilled with the passing generations and when know-how was handed down from father to son in families of builders (known as master builders, *maalem* in Arabic). The societies living in the Mediterranean have changed radically since the arrival of the phenomenon of industrialization, now refined for the umpteenth time in the form of globalization. The communities that built and dwelt in this architecture have disappeared or are breaking down, and other logics are now at play (migration, second homes, creation of ghettos, gentrification, fall in property value leading to replacement by new buildings, etc.).[1]
Sometimes, our romantic, melancholic view prevents our seeing that its inhabitants have to be able to transform it in order to adapt it to the needs and aspirations of the present day. In this article we will attempt to present the richness in bioclimatic terms of this architecture and to reflect on the possibilities of rehabilitating it to make the most of its huge potential, with all the respect it deserves.



Covered passages in Cairo (Egypt)

The house in a place in the Mediterranean

Having ventured to speak of the concept of Mediterranean Traditional Architecture[2], we must straightaway stress its wide diversity. In climatic terms, the Mediterranean is characterized by a temperate climate that changes rapidly as we move south, becoming hot and dry, or becomes quickly colder as we move inland and to higher ground in the nearby mountains[3].
Its traditional architecture responds to a balance between its inhabitants' various needs (use of the building, subsistence economy), available building materials and, of course, protection from the natural environment.
Firstly, it is important to consider that traditional architecture takes radical and ingenious forms when environmental conditions are very severe. For example, the wealthy houses in Cairo, Egypt, developed the *malqaf*, a kind of skylight, borrowed from hot areas of Persia, to harness the breeze from the Nile and draw it through the main rooms in the house for ventilation. Then in various hot, dry places in the Mediterranean with rather cold night-time temperatures (Matmata in Tunisia, Cappadocia in Turkey, Guadix

The *malqaf* of El Set Wasela (Egypt) and a diagram showing the ventilation system

and Paterna in the Iberian Peninsula, Matera in Italy), cave dwellings were built, homes dug into ground that was easy to excavate, to make the most of the thermal inertia of the site.
In colder mountain climes, the kitchen (also the centre of energy) is placed at the centre of the house with walls that also harness thermal inertia, though in this case to prevent the heat leaving too quickly. In most Mediterranean countries, the houses tended to stand two or three storeys high, with livestock kept in a semibasement ground floor to harness their body heat in the winter (in summer they were sent to graze in the mountains and the interior was cool) and the harvest was dried in the well aired attic, providing excellent insulation.

Underground dwellings in Matmata (Tunisia)

Underground dwellings in Paterna (Spain)

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Detached house in the Pyrenean foothills in Guixers (Spain), fireplace and loft

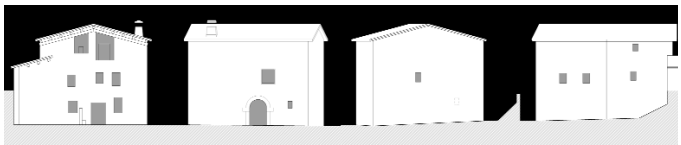
However, when the climate is more temperate and there is an intense cultural residue, the repetition of a specific model of architecture is more associated with the culture of a society than with the climate. Consider the example of the courtyard house. In desert climates, a high, narrow courtyard (for example in the *ksar* of Tamnougalt in the southern Moroccan Atlas), [4]collects the cold night air and keeps the space cool for much of the day, providing ventilation but not allowing sunlight or sand to enter. In more benign climates, however, the courtyard is larger but does not have a clear bioclimatic function, since it is closely connected to the culture of privacy of an inward-looking house that characterizes Islamic culture.

Courtyard of a kasbah in the Tamnougalt ksar (Morocco)

Courtyard of Dar Ben Abdallah in Tunis (Tunisia)

Then we have to be wary of the word "tradition". Since when and in relation to what is a building traditional? For example, throughout the Mediterranean, the lines between traditional and cultured architecture are ambiguous and blurred. The "traditional" Lebanese house, the house around a central hallway or the three-arch house[5], is very similar in structure and functioning to the house on the *terra firma* of Venice, the Catalan *masia* and the typical Ottoman house with its central sofa.
From all of the above we can deduce that most traditional Mediterranean architecture is situated in areas with a temperate climate. But the conditioning factors represented by the temperate climate, to quote Rafael Serra, *"are merely those of other types of climates, less harsh but with the essential characteristic that they may all be present at once. These are the 'problem of the cold' in the winter, which may be dry or damp, a distinction that is not important in more extreme climes though it is in these. The 'problem of the heat' in the summer (dry or humid), almost as intense as in other climates, despite lasting relatively few days. Finally, the 'problem of changing weather' in intermediate periods, when there may be extreme cold or heat for short periods of time."*[6]

The Tamnougalt Ksar (Morocco)



Percentage of openings in the façades of a detached house in the Pyrenean foothills in Guixers (Spain); south, east, north and west façades

The art of choosing a good site and the intermediate spaces

It will come as no news to anyone that traditional architecture has its own particular wisdom when it comes to choosing a site in the territory. This is its starting point. A form of architecture that is poorly positioned in relation to the sun, which is the great dictator, will rarely have bioclimatic virtues. But a good siting also means concealing from or exploiting the wind, orienting each of the rooms according to its daytime or night-time use, and so on.
Here we have to insist on the idea expounded above: the more severe a climate, the more radical the solutions. Here we can give examples, too: a ksar is a fortified village in the valleys of the southern Moroccan Atlas Mountains that protects itself from heat, cold and sand by crowding the houses together and seeking to reduce the number of façades that exchange heat with the exterior. Conversely, a farmhouse in the Pyrenean foothills is a building that can stand open to the four winds on a south-facing slope and positions its front door in the façade that is protected from the cold wind.
By this token, villages on mountainsides have always constructed their streets to follow contour lines with the ground floor of the building in front dug into the ground to avoid blocking the sun from the building behind, and its front door on the street above. This type of arrangement usually guarantees cross ventilation. This is a concept developed by the Modern Movement, but one that had long been current in traditional Mediterranean architecture. One good example is the Lebanese custom of placing small sandbags at all the doors to keep them open and allow ventilation between the front and the rear of the building.

Houses terraced on a natural slope in Berat (Albania)

The sandbag used in Lebanese tradition to prop doors open, creating cross ventilation of the rooms

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Foyer of a house in Lefkara (Cyprus)

Roof of plant matter with jasmine in Jesús Maria (Spain)

Gallery of a house in Bda (Syria)

The vegetation in the Riad Berebere in Marrakech (Morocco)

In addition, in a temperate climate such as ours, traditional architecture seeks protection, pleasant views and sea breezes by means of what we might refer to as intermediate spaces between the interior and the exterior, which generate pleasant microclimates according to the period of the year and time of day. The diversity of these spaces is what makes traditional Mediterranean architecture so singular.

A covered street or a porch at the entrance to a house is the first space of this kind. Of solid construction or comprising canes and plants, such as vines or jasmine, it welcomes the visitor and protects the inhabitants when they sit at the front door to wile away the time or mend a tool, etc. This is a key element that in climatic terms leads to the life in the street and the sociability that characterize Mediterranean places.

A similar space, and one that is common to the architecture throughout the Mediterranean, is the gallery, a raised porched space, usually with columns that support arches, which serves as a hallway to a series of rooms but is also large enough to sit out or dry the harvest in. In Catalonia, it is also known as *solana* (a sunny outdoor space), which is the same as the Arabic *riwaq* or the Greek *iliakos*.

A particular example from the Near East is the *iwan*, originating in Persia. This is practically a room with one of its sides missing, a covered but open-air space for a variety of functions, serving as a hallway for the rooms that open onto it. The simplest structure is two rooms with a central *iwan*, but the layout may be further complicated by juxtapositions, courtyards, etc., producing rather complex compositions.

A very simple but effective element is the eave, a projection of the roof that provides shade in summer and allows winter sunlight in as a result of the varying trajectory of the sun, which is lower at this time of year. A similar but more sophisticated phase is the *tribuna* (bow window), a small room that can be closed off from the other rooms in the house and that looks out onto the exterior through a glazed facing. This is a place to spend the winter hours that harnesses the greenhouse effect for heating and transfers some of the heat to adjacent rooms. The *tribunes* in Barcelona's Eixample are an obvious example, though it is closely associated with tradition and can be found everywhere, being particularly abundant in the architecture of Turkey.

This brings us to the courtyard, the paradigm example of the "inside-outside" intermediate spaces of traditional Mediterranean architecture. Its bioclimatic behaviour and the strong cultural links that have guaranteed its continuance are outlined above. It only remains to add that in every region the proportions of its floor plan and section offer the most suitable response to the climate of each place. The house with peristyle of Hellenistic tradition was followed by a series of adaptations of the courtyard: the Roman *domus*, the courtyards of the Catalan Gothic townhouses and, of course, the appropriation of the tradition of the courtyard (*west*

Eaves of a house in Gjirokastra (Albania)

The buildings of Ait Larbi in the Dades Valley merge with the surrounding landscape (Morocco)

ed-dar, the centre of the house, in Arabic) by Islamic culture and the radicalization of its use, turning it inwards.
It was in Islamic culture that the courtyard found its ultimate application, together with vegetation and water. Water was introduced in the form of a fountain or small pool, thereby creating a microclimate with a degree of moisture. This environmental improvement also introduced vegetation, as in the example of the *riad* of Marrakech.

Local materials, breathability and thermal inertia

The world of pre-industrial construction was characterized by low-cost labour offset by the great expense of transporting construction materials to the site. It was therefore natural to try to use the materials closest at hand to the site or those that were easiest to use. This led to earth, local stone, lime mortar or plaster and wood becoming omnipresent materials in construction. Some materials from the agricultural world, such as straw, were used as good insulation in many different solutions.
It is interesting to see how this subsistence economy configured the landscape of a territory. The tones of the earth and stone used to build houses blended in with the colours of the surrounding hills to form an inseparable part of the landscape.
At the same time, what was usually a solid earth or stone construction (rammed earth, adobe, rubblework, etc.) was characterized by using its thermal inertia to guarantee comfortable interior spaces. In this way, the surfaces exposed to the sun's rays absorbed the heat, but since thick stone or earth walls transmitted it slowly, the interiors remained cool during the day. The walls then stored the heat and transferred it to the inside, maintaining a pleasant temperature throughout the night.
This phenomenon, explained here in relation to the walls, is also applicable to the traditional flat roof. The terrace was a flat ceiling of timber beams covered by a hand's span of earth that provided a roof and also, depending on the time of year, another room (bedroom, kitchen, drying shed, threshing ground, etc.). Flat roofs of this kind are found in the North African Atlas, the mountains of Lebanon, the Alpujarras of Andalusia and, formerly, across a whole swathe of the Pyrenees[7] and the Alpes-Maritimes.
Another important factor was the breathability of these walls—that is, their capacity to absorb moisture and dry out, and to balance exterior and interior humidity. This was possible thanks to a culture of using breathable coatings such as plaster, earth or lime mortar renderings, and whitewashes.

Light filters

Finally, traditional Mediterranean architecture is characterized by an infinite wealth of solutions to provide filters on the openings in buildings (doors, windows, balconies), thereby responding to the variations in our temperate climate with the threefold aim of providing thermal insulation, shade and ventilation.

Gallery with a whole range of filters in Sidi Bou Said (Tunisia)

Solar Protection with curtains in the Kasbah of Algiers (Algeria)

Making a hole in a façade has always been a delicate task. There was a temptation to make a large hole, but caution advised making it smaller. We have to remember that the use of glass (to provide insulation, let light in and allow visibility) was a luxury for those societies and a great deal of ingenuity was needed to make as large a window as possible without creating an imbalance in heat gain. Whereas initially these openings had just a wooden shutter with a spyhole (a smaller opening with a small opening shutter), they were gradually succeeded by larger openings protected by waxed paper, and it was only considerably later that glass was incorporated. This is a good example of how traditional architecture is not immutable; it constantly changes as it absorbs, we might say, "modernizations". Adaptability is certainly one of the foremost values of this type of architecture, as it has demonstrated over the years. It has taken the incorporation of technologies that are remote from the human scale to bring about a breakaway that traditional Mediterranean architecture continues to resist today as a more sustainable and environmentally friendly alternative.

There is a whole range of solutions. For example, in Catalonia, a window opening could comprise the frame and the operable sash of the window, protected on the outside by a *paravent*, or outer shutter, another shutter in the interior behind the glass to graduate the light and, finally, net curtains or drapes tamed the sun and provided privacy. The Mediterranean is full of different types of blinds: adjustable elements to control the intensity of indoor light. This is the case of the simple cord blind which, with its various positions (completely up or down, half up/down or resting on the balcony railing) helps to control the indoor temperature. It also applies to the more complex Venetian (or Majorcan, depending on the place) blind, a kind of lattice of adjustable slats on a frame. In this case, the light and air let into a room can be precisely adjusted: completely open, completely closed and the endless variations between, as shown by the images that accompany this article (directing the light to the ceiling or to the floor, allowing someone inside to look out, etc.). Islamic societies combine the climatic need to filter the light of a blazing sun and the culture of the veil—seeing without being seen. Here the *mashrabiyyaa* comes to the fore. This carved wooden lattice fills the window, allowing in air and very filtered light while allowing those on the inside to look out. Much of the opening is fixed but it also has movable frames, also made of wooden trellis.

Conscientious rehabilitation

Rather than incorporating bioclimatic gadgets, the rehabilitation of a building has to bring a sensitive approach to the traditional

Recovery of a parapet to allow ventilation on a terrace roof in Hebron (Palestine)

Exterior and interior views of the *mashrebeeyeh* of El Set Wasela (Egypt)

elements described here. Conscientious rehabilitation work should not prejudice or ignore them.

However, we also have to accept that these passive systems of environmental control do have their limits. In themselves, they guarantee reasonable comfort levels, but if we want a constant temperature of 20°C and relatively humidity of 50% when the outside values are 35°C and 30%, only an active system will do the trick. However, this is nothing new: to combat the cold in a traditional house, the inhabitants light a fire, which is merely another artificial system for producing heat.

A rehabilitation project has to weigh up the needs of a programme (the client's requirements), the values of the architecture in question (cultural, architectural and also bioclimatic) and knowledge of the current state of the building. The RehabiMed method insists on the need for knowledge prior to the intervention—that is, it is necessary to make a careful diagnosis of the building (including the thermal balance) before undertaking rehabilitation. It is, then, necessary to understand how the building functions, and to rehabilitate and modernize it on this basis.

Having read this article, readers will deduce that we favour a form of rehabilitation which, on the basis of traditional construction and ambient control mechanisms, seeks to adapt the conditions of the building to present-day needs; but also brings a sensitive approach to thermal inertia as opposed to insulation without criteria (for example, in a thick-walled building the north-facing façade can be hyper-insulated, and less or no insulation used on the faces that receive more sunlight to exploit their thermal inertia), maintains the breathability of the walls (for example, using lime renderings and breathable whitewashes or silicate paints rather than the cement renderings and vinyl paints that break with this hygrothermal balance), respects intermediate places (for example, avoiding the speculative appropriation of these spaces by metal window/door frames) and conserves traditional solar filters (for example, avoiding the systematic replacement of frames by simplistic aluminium or PVC solutions). Only after integrating these parameters is it appropriate to consider the real need to introduce an active atmospheric control system (be it heating or air conditioning).

Once the building has been rehabilitated, it is occupied by the people who are to live in it. We began this article by saying that the society that produced this architecture has disappeared so the new user might not know how to "work" the building. We think that new users have to be told how to use it by means of a short instruction and maintenance manual presented at the end of rehabilitation work. The "Majorcan" blind would therefore have instructions for use to optimize its functioning, as though it were a domestic appliance.

Although, for example, it requires an effort to maintain a wooden-framed window rather than install the low-maintenance solutions

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The multiple possibilities of wooden blinds with adjustable slats in Barcelona's Eixample district (Spain)

offered by the market or opt for the convenience of a standard aluminium blind with remote control, we think that it is these aspects that demonstrate a conscientious approach to the rehabilitation of traditional Mediterranean architecture.

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