# themediterraneanmedina

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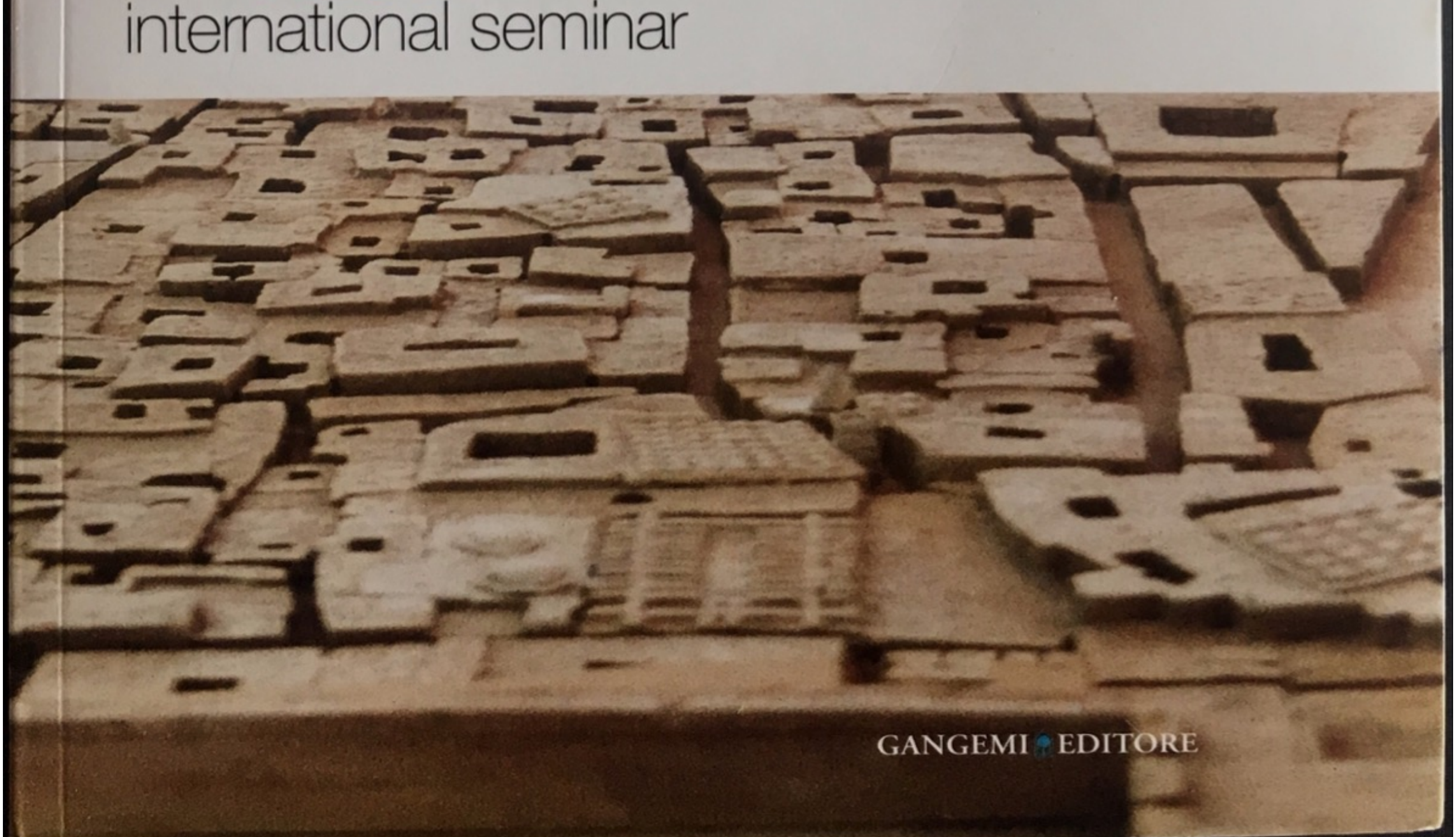

GANGEMI EDITORE

This volume collects the Proceedings of the International Seminar *The Mediterranean Medina* that took place at the School of Architecture, Pescara, 17th to 19th of June 2004.

The seminar patronized by the Italian Ministry of Foreign Affairs and promoted by the Department IDEA (Infrastrutture Design Engineering Architettura) of the Faculty of Architecture of Pescara with the Department ICAR (Scienze dell'Ingegneria Civile e dell'Architettura) of the Polytechnic of Bari, aimed at studying the particular physical characters and the transformation of the Mediterranean city.

We apologize for the late publication of the Proceedings due to the onerous task of collecting the articles and presenting them in a unified graphic and editorial form. Nevertheless we presume the delay did not invalidate such an extensive and deep analysis of the Mediterranean city.

We would like primarily to thank all the participants who sent their article and images on the subject of their presentation to the seminar. We thank Giangiacomo D'Ardia, Head of the Department IDEA, and Claudio D'Amato, Head of the Department ICAR, for the scientific and economic support to the seminar and the publication of the Proceedings.

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# THE ENERGETIC-ENVIRONMENTAL CHARACTERISTICS OF THE COURTYARDS. THE ORTIGIA COURTYARDS CASE STUDY

*Michele M. Lepore*

In most warm climates much of the day-to-day activities take place out-of-doors. It is therefore necessary to treat the external spaces just as carefully as the building itself. Adjacent buildings, pavements and dry ground heat up quickly, causing both a painful glare and reflected heat radiation towards the building during the day; at night they will reradiate the heat stored during the day. Enclosure of out-door areas by walls, which are themselves shaded, will help to avoid such effects and at the same time keep out dust and hot winds.
Trees, plants and water in the enclosed space will cool the air by evaporation, help to keep dust down and provide shade, visual and psychological relief.
The best external space in this type of climate is a courtyard. Here a pool of cool night air can be retained, as this is heavier than the surrounding warm air. If the courtyard is small (the width is not greater than the height), even breezes will leave such pools of cool air undisturbed.
The small courtyard is an excellent thermal regulator in many ways. High walls cut off the sun, and large areas of the inner surface and courtyard floor are shaded during the day. Cooler air, cooler surface than earth beneath the courtyard, will draw heat from the surrounding areas, re-emitting it to the open sky during the night.

## The Courtyard House and the Climate

Courtyard house, though commonly associated with the Mediterranean and Middle Eastern regions, is found in most of the climates and world regions. It is the dominant prototype of many of the world's hot arid climates. This is not to imply that hot arid climates is the only one that makes sense to employ the courtyard house, nor is it intended by the author that only the courtyard form has merit in the hot arid climate. Many different societies in very different locations have used this traditional dwelling form. The courtyard house works equally well and is found extensively in composite climates that have cold season. The Romans built their courtyard houses throughout Europe and to the limits of their northern borders. Courtyard house can accommodate snow in the winter as well as sun and shadow in the summer.

## Microclimatic Characteristics

The unique properties of the courtyard house are not generally or fully appreciated particularly with respect to climate. A courtyard house will moderate its own microclimate. A well-designed courtyard house is cool during the day when ambient temperature is high and warm at night when it is low. Temperature, humidity and light may each be calibrated towards a desired result by the form and proportion of the court; by the size, type and colour of the garden plants; by the type, colour and extent of the paving and by the colour and treatment of walls and degree of plants cover on walls. These factors were fully understood by the vernacular builders of the various societies that inhabited this house form.
Semi-open spaces, such as *liwanat*, verandas, or galleries are efficient shade generators and are oriented to take advantage of climatic realities. Proportionally tall walls are also used effectively to provide shade to the court floor. Much of the daily activities occur outside the rooms, in the courtyard or under the *liwanat*. In the northern hemisphere, a north oriented *liwan* will be in perpetual shade and is used during the summer months, while a south facing *liwan*, being protected from the cold winter winds but exposed to the warm radiation of the winter sun, is a favourable outdoor space during sunny winter days.
The orientation may be changed so that the sunlight enters directly through south facing windows (in the northern hemisphere) or is reflected into the house across from south facing court walls. The softer, diffused and penetrating quality of reflected

daylight in a house and the view from inside onto the facing court wall sunlit, rather than in shadow, will often be preferred. Indirect daylight and direct sunlight are two very different concepts which have distinct qualities and which have to be articulated in different ways. Sunlight and its geometry must be fully appreciated and planned for in combination with climatic functional requirements.

Courtyard can be designed to contribute both of the diametrically opposite commodities of sun and shade. Sunlight penetration must be considered in relation to climate and weighed in relation to other priorities, such as the level of urban density. It may be preferred that some parts of a house be oriented into a shaded, vegetation filled *liwan* with cool air, rather than the harsh light of direct sun. Latitude and climate will influence form and in some regions it will be desirable to include direct sunlight, in other to exclude it. The courtyard can also be designed in passive solar way to generate different seasonal preferences with respect to the direct sun.

## The Courtyard as Climatic Moderator

Vernacular courtyard houses have achieved thermal comfort in hot arid zones through clustering to reduce solar heat gain; through a proper orientation and proper use of materials; through manipulation of number and size of openings and through such devices as wind catchers and courtyards. The relatively static cooling system used in courtyard houses can provide the basis for understanding the modifications that can generate air movements by a combination of radiative and convective actions. In hot arid zones, that experience large diurnal temperature swings, the air temperature drops considerably after sunset from re-radiation to the night sky. The air is relatively free of water vapour that would reflect the heat or infrared radiation back toward the ground, as occurs in warm humid regions. This radiation effect (not to be confused with the convective cooling effect of the ambient night air) allows surfaces to be chilled significantly lower than the ambient air temperature. This effect is most pronounced under still air conditions and is enhanced when radiating surfaces can be protected from the warming effect of night winds. The heat, which is lost during the night, allows the courtyard to remain cool most of the day.

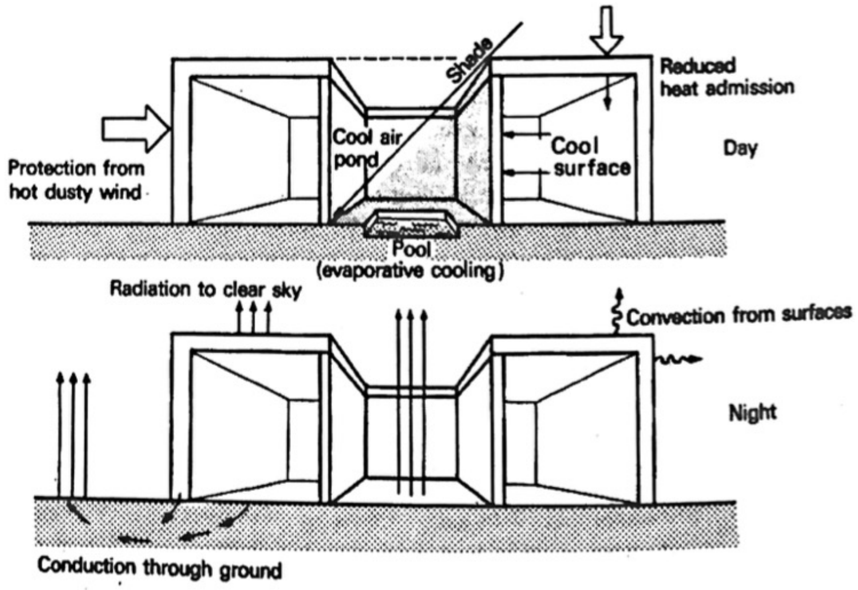


**Fig. 1**
Thermal system of a small courtyard house

This phenomenon has been used in the architectural design of houses to enhance thermal comfort, by employing the courtyard concept. Nature is hostile at ground level in these zones. People learned to close their houses to the outside and open them inwardly onto internal open courtyard. As evening advances, the warm air of the courtyard, which was heated directly by the sun and indirectly by the warm buildings, rises and is gradually replaced by the already cooled night air from above. This cool air accumulates in the courtyard in laminar layers and seeps into the surrounding rooms, cooling them. During the following day, the air of the courtyard, which is shaded by its four walls and the surrounding rooms, heat slowly and remain cool until late in the day when the sun shines directly into the courtyard.

The *liwanat* help to reduce the quantity of heat gain during the day by obstructing the direct solar radiation. High parapet walls can also shade the narrow community streets in similar manner. In a multi-storey courtyard house, the height of the courtyard is greater than any of its plan dimensions, thus the area exposed to this radiation is reduced to minimum, leaving adequate rooms in the shade even in midday when the sun is near the zenith. Limiting the number and sizes of the exterior fenestration further reduces heat transfer from the outside. The warm wind passing above the house during the day does not enter the courtyard but merely creates eddies inside, unless baffles have been installed to deflect the airflow. In this way, the courtyard serves as a reservoir of coolness. Cold air decreases in density and gravitates to the bottom of the courtyard well, from where interior spaces, provided with outlets strategically located, may be ventilated. The court space can be covered by a lightweight mat or lattice to preclude the sun's intrusion and the building up of radiation in the interior court walls. By means of a fountain and plants, the very low relative humidity of the air is raised to a comfortable level. In addition, the courtyard is usually washed or showered a few times daily. All this is aimed at raising the relative humidity.

The courtyard in a house acts as light well as well as an airshaft bringing both daylight and air-movement to the rooms around it. The diurnal range is much higher in the hinterland than in the coastal regions. In the hot-dry hinterland the courtyard functions in three regular cycles, taking advantages of the diurnal range of temperature during summer.

During the first cycle, the cool night air descends into the courtyard and fills the surrounding rooms. Walls, floors, columns, roof, ceilings, and furniture are cooled at night and remain so until the late afternoon. The courtyard loses heat by irradiation to the sky.

During the second cycle around noon the sun directly strikes the courtyard floor. Some of the cool air begins to rise and also leaks out of the surrounding rooms. This action sets up convection currents in the rooms that may afford further comfort. The courtyard now begins to act as chimney. At this hour the ambient temperature is very high outside. Thick walls do not permit the external heat to penetrate to the inside of the house. Three out of four external walls on an average are party walls; thus the house remains enclosed on all sides and is insulated from heat gain during the day.

During the third cycle, the courtyard floor and the inside of the house get warmer and further convection currents are set up by the late afternoon. Most of the cool air trapped within the rooms spills out by sunset.

During the late afternoon the street, the courtyard, and the building are further protected by shadows. As the sun sets in the desert, the air temperature falls rapidly; the courtyard begins to follow and a new cycle begins.

The thick construction achieves a form of equilibrium by storing or dissipating heat during the diurnal and seasonal changes. In larger houses, several courtyards of different sizes are integrated to set up air movement within the whole building. Where raw water is available in plenty, as in houses with its own well, the occupants may spray water on the courtyard floor during the afternoon, producing evaporative cooling. The action also adds some humidity to the dry air, which may further enhance comfort conditions within. It is for this same reason that the earthenware jars filled with water were placed in the courtyards of traditional houses.

In multi-storey atrium buildings, the courtyard acts mainly as ventilation shaft and may help bringing adequate daylight only to the upper floors of the building. The dimensions of the courtyard must be carefully considered in relation to its widths and depth so that the necessary climatic advantages can be achieved. If the courtyard is narrow and deep, then it may act only as ventilation shaft and light well, not bringing any cool air to the surrounding rooms.

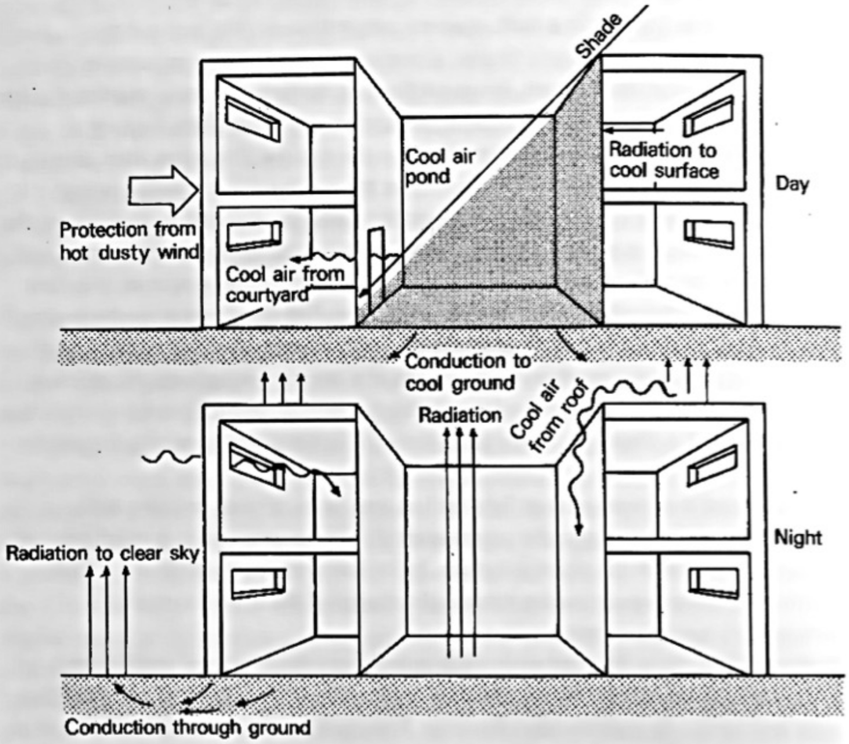


**Fig. 2**
Thermal system of a large courtyard house

## The Courtyard Form

The salient feature of the courtyard house is the central and private open space. The court is the heart of the house and provides the house light, air and water. A proper proportioning of the court, with the width shorter than the height, reduces heat gain. Also the use of massive building materials, such as mud brick that possesses an inherent thermal storage capacity and time lag delivery, is important. The thick exterior walls and roofs slowly absorb heat from direct solar radiations, both diffusing and delaying its impact on the exterior spaces. The mud brick retains a significant amount of heat until it can be released back to the outside at night, by radiation and convection. The remainder is delayed as much as 12 hours and radiated into the interior at a time when ambient air temperature is lowest.

When the courtyard form is a standing alone hollow square, it will maximize the surface to volume ratio, which is appropriate for small building in hot humid climates. It is only appropriate to larger buildings in hot arid or composite climates, when the thermal mass and fenestration can be balanced.

However, it is worthwhile to note that when the courtyard form becomes packed into an urban environment, sharing its party walls with its neighbours, it actually minimizes the surfaces to volume ratio. This is why it is such an appropriated dwelling form for the hot arid climates. Studies of the traditional courtyard houses found in many of the Mediterranean countries reveal that the proportioning of the courtyard void to the building solid is a delicate balance that has been perfected through centuries of fine adjustments, as results of trial errors, to respond to specific climatic needs.

The morphology of indigenous courtyard proportions could be used to define climatic types. The few exceptions would be mainly attributable to religious and societal preferences. Where winter heating is required, the courtyard is open and horizontal to allow winter sun penetration. Where summer cooling dominates, the building is usually multi-storeyed (generally limited to two storeys) to maximize shade in the courtyard. The building volume is compact and the courtyard, if elongated, is along the East-West axis. Olgyay studies show that the optimum for all climatic conditions lies in a form that is oriented to the East-West direction in his major axis.

## The Ortigia Courtyards Case Study

The "Laboratory of Architecture Construction" chose as case study the topic of the courtyards, which characterize a big part of Ortigia buildings in Syracuse. The hypothesis of choosing to study courtyards derives from the role that these spaces have had in the course of the centuries: places of interference between the houses private ambits and the street collective ambit. In Syracuse building tradition, the courtyard is configured as a filter between internal and external spaces; place of social expression of the dwelling unit structure, familiar, architectural, economic. These places were chosen as study-cases because of their interesting spatial and environmental characteristics.
The study, faced in the laboratory, was focused on the definition, according to the need-performance approach (base of the building intervention expression and of evaluation), of the open space that is also a characteristic "closed" space of Ortigia urban structure.
With a just didactic aim, one tried to understand the valence of the courtyard as "place" going between the internal spaces facing it and the urban space of the street and the square. One supposed some possible specific use in relation to which light systems, expressly designed, should allow to improve the dwelling conditions according to the different climatic conditions.

**Fig. 3**
Ortigia Island, Siracusa

**Fig. 4**
Shadow on Beneventano building, Siracusa

**Fig. 5**
Section of Beneventano building, Siracusa

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