The Wisdom of Mediterranean Traditional Architecture Versus Contemporary Architecture – The Energy Challenge

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Abstract: Domestic vernacular architecture has evolved over many years to address the problems inherent in housing. Through a process of trial and error our predecessors have found ways to cope with the extremes of climate. The influence of Western cultures is, however, all pervading. The trend towards an internationalized style of building could result in a reduction in the traditional solutions, which have served several cultures well for many centuries.

Of course, people quite rightly demand high standards of comfort in buildings. Such standards can be achieved by using modern air-conditioning systems, which are expensive in initial cost and are very demanding of energy in the long term.

It is possible to create the standards required with the careful use of traditional techniques of thermal control. The advantages are clear; there is a dramatic reduction of energy needs and an increased use of the architectural style with which people feel at ease. This is not to say that designers should ape the ways of the past. Modern materials, computer technology and innovative construction techniques must be used in the search for efficiency and cost-effectiveness. However, to ignore our architectural heritage is at our peril and to disregard the accumulated wisdom of the past is at best ill-informed and at worse arrogant.

This paper examines the traditional forms of vernacular architecture in Cyprus and explains how the designs create an appropriate internal environment. The contemporary and evolving styles are analysed to indicate how modern techniques address the problems of thermal control. Finally comparisons are made to determine if lessons can be learnt. The comparisons will be made from results derived from optimization studies of the contemporary houses, through varied design and the use of natural sources of energy to achieve comfort conditions.

For the optimization studies microcomputer version of "SERI-RES" and "5000 Method" were used.

Keywords*:* Traditional, archetype, solarium, courtyard, climatic modifiers.

1. INTRODUCTION

The protection from unfavourable, harsh climatic conditions and achieving comfortable microclimate are the primal objectives of architecture. The Mediterranean traditional architecture evolved to produce buildings that would be in harmony with the harsh climates of its various regions.

In the traditional architecture the mechanism of indoor thermal regulation was incorporated in the building. The topography, the construction, the morphology even the layout and use of internal spaces participated in the operation and function of the thermal regulating mechanism. Characteristic examples of this phase in the various regions of Mediterranean give the anonymous architecture and the planning of traditional settlements. In unfavourable however climates the design models of anonymous architecture, in combination with the other restrictions and demands directed it, gave only generalised solutions in the problem and the internal conditions abstained considerably from the current requirements of comfort. This resulted to the creation of the conditions for the energy consuming mechanical phase of heating and air conditioning that promoted the industrial production of energy from the nineteen century. Then, the fast and spectacular developments in the technology of installations of heating and air conditioning for cooling, as well as other technical innovations, the international influences, including tourism, have shifted architecture away from the wise traditional values and principles. While the traditional Mediterranean residences provided shelter from extreme climatic conditions with various methods without consuming a lot of energy, the mechanization and the internationalisation caused the rejection of the tried methods and the lack of knowledge of building physics stripped the building structure from its basic operations and they left the building in the mercy of climate. The modern buildings have become climatically inept. The appliances of air conditioning have replaced natural cooling and this incurred high consumption of energy [1].

The submission of architecture to the machine leave the problems of ensuring basic conditions of indoor comfort unresolved; problems of cost, operation and maintenance of mechanical installations, with primal problem that of energy over consumption. To the developed countries the buildings

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led to absorb enormous percentage of total consumption of energy that reaches up to the 50% of primary total energy (Britain) [1].

In these days of fuel shortage it is necessary that our modern buildings also provide this shelter with the least expenditure of energy. Growing concern with environmental degradation has reawakened the interest in the use of ecological materials, processes and sources of energy. This led to a new approach of architecture that of bioclimatic architecture, which considers the building totally from the stage of its inception as a place of energy exchange between the indoor and the external environment, natural and climatic. It considers the building as a living organism; a dynamic structure which utilizes the beneficial climatic parameters (solar radiation for winter, sea breezes for summer, etc.) whilst avoiding the adverse climatic effects (cold winds for winter, solar radiation for summer). In this approach the mechanical systems are integrally interconnected with the architecture and have to be taken account as organic elements of the building [2].

In order to assess the energy demands for heating and cooling in buildings and evaluate the free energy systems available to contribute to these requirements, the comfort criteria and the local climatic conditions must be carefully considered and analysed [3]. Through bioclimatic chart analysis, it is then possible, to outline the appropriate architectural strategies that could result to indoors thermal comfort for that location for winter and summer. Such bioclimatic analysis is important for preliminary architectural designs [4]. The selection of the appropriate design strategies, derived from a bioclimatic analysis, compatible with each other and other architectural aspects, could considerably reduce the cost of a building by minimizing, the mechanical means for cooling and heating [5].

There is today a vast accumulation of technical information and yet our present-day buildings tend to be less comfortable than the traditional [6]. A retrospective examination of traditional architecture is necessary to determine how our predecessors tackled thermal design problems, both in the context of their life styles and with the tools and techniques available to them. It is also important to understand the differences between the present-day approach and strategies and those of the indigenous builders.

The study describes the evolution of vernacular architecture and reveals in the form of buildings, a complex of cultural values, needs, influences, wishes and dreams, and how they were influenced by the climatic conditions of their locality. It further makes a comparison with the present day approach. These aspects are complimented with measurements of thermal performance of buildings and thermal calculations carried out with the aid of microcomputer programmes for thermal analysis and which conclude to the comparative assessment of results, indicating that we could have lessons from the past.

2. THE ARCHETYPE

Vernacular Cypriot architecture is difficult to define; like the land from which it springs or grows it reflects the varied life style of its inhabitants and the availability of the resources of each region.

The variety of terrain on the island (plains, hills, mountains, seashore) spawns a variety of needs, building materials and hence building form (Fig. **1**). In addition, the long experience of local builders and their devotion to tradition, intermingled with the ability to receive and assimilate foreign cultural preferences are reflected in the variety of habitats created on the island. Tracing the evolution of vernacular Cypriot architecture, an archetypal form of a single, long, rectangular roomed building ("Makrinary"=Long room) is

Fig. (1). A traditional Cyprus mountainous village.

revealed as the simplest basic shelter of the Cypriots [7]. The division of this room, ("Dhichoron"=Double-space), the addition of the Portio ("Heliakos"=Solarium), and other rooms plus the courtyard, developed the layout into various configurations (Fig. **2**) which interrelated with a specific life-style, needs, climatic conditions and topography [8].

3. TRADITIONAL BUILDING ELEMENTS – INDOOR CLIMATIC MODIFIERS

3.1. The Solarium and Courtyard - Fundamental Bioclimatic Elements

The solarium and the courtyard constitute fundamental traditional building structures of thermal control, which reflect the wisdom of traditional Mediterranean architecture (Fig. **3**).

In the countries of Mediterranean and the regions with hot climates, in which the sun is desirable in the winter while in the summertime the cooling and ventilation is necessary, the solarium and the courtyard are indispensable solar features of houses, unique elements of local architecture.

Both components, although outdoor, open spaces of building, they are focal elements around which the various activities of all other spaces, are composed and synthesised whether the house is found in the plains or in the mountains, in the village or in the city. They form the heart of the dwelling spatially, socially and environmentally.

They are important architectural characteristics and they show the instinctive approach of passive solar design and planning that contributed in the climatic configuration of the Mediterranean house. Their form evolved naturally from the climatic conditions, the needs of the family and the social

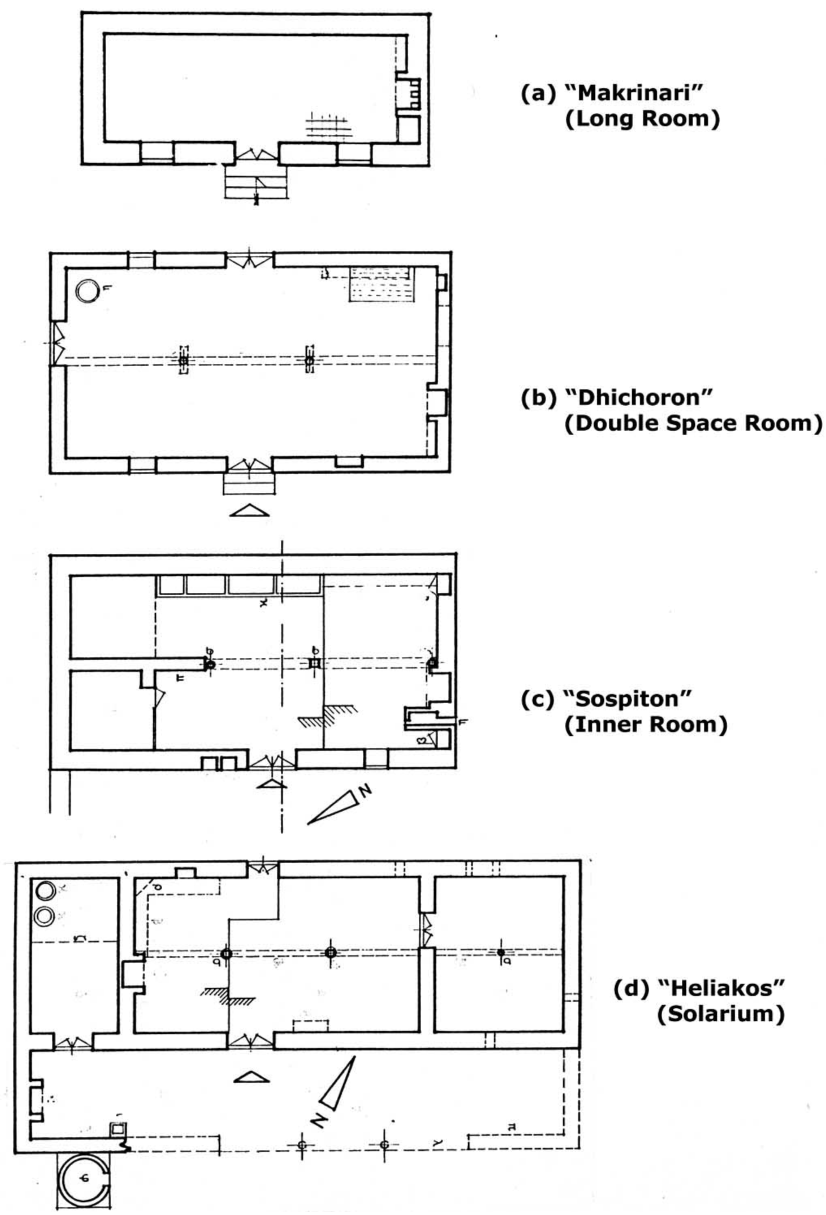

Fig. (2). The evolution of the Cyprus house. An archetypal form of a single, long, rectangular roomed building is revealed as the simplest basic shelter of the Cypriots.

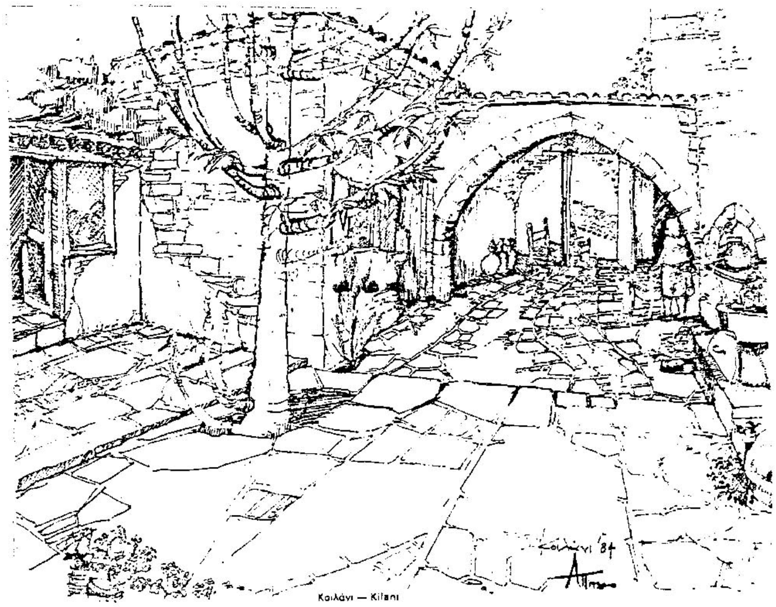

Fig. (3). The solarium and the courtyard constitute fundamental traditional building structures of thermal control.

structure of community. Always adjoining each other they act upon as transit spaces and connect and unite the exterior with the internal building layout. They are extensions of the house outwards and simultaneously extensions of the exterior spaces indoors.

Their form and function varies from region to region, even from locality as expression of their sensitive response to the various influencing parameters. The solarium and courtyards have multiple uses in the local architecture that vary depending on the region, even the locality, the climatic conditions and the social structure [9].

In brevity this study will examine the traditional forms of solariums and courtyards of domestic vernacular architecture in Cyprus and it will explain how they create appropriate environment through their varied design and the utilisation of natural resources of energy for the winter and for summertime [10].

3.1.1. Winter

Both components are two fundamental means used in traditional building design to temper extreme weather conditions. Combined with their other uses they always create a microclimate that moderates the climate surrounding the building.

The planning of courtyards and solariums varies depending on the degree, the frequency and pattern of solar radiation, winds, rain and snowfall.

a. Access to the Sun

In the old houses the main concern of the design of the courtyard and the solarium was to ensure privacy while also providing the benefit of good conditions for solar access to the southern elevation. The configuration of the house with courtyard and solarium is a key device for the achievement of this aim by providing enclosed private spaces. Also this geometry of houses makes explicit the intention to provide insolation to different rooms at times when sunshine may be most beneficial. Nevertheless the proportions of both components can play a critical role in solar access.

When the courtyard is directed to the south it acts as sun space that accepts the desirable solar radiation of winter. This is an aspect our predecessors judged empirically and intuitively. However, today the evaluation of their performance is possible with the aid of modern technology.

The extent of solarium cover admits the rays of the winter sun to penetrate and so solar radiation can be utilised. For this reason the solariums in the mountainous regions are moved in the upper levels for better wintry exploitation of the sun. In vernacular architecture the width of projection of the cover varies and it was intuitively sized by the indigenous builders.

b. Utilisation of the Sun

With suitable configuration of the solarium and the courtyard in combination with internal mass in elements such as in stone staircases, with pools, paved surface areas for storage and utilisation of the sun.

c. Buffers to the Cold Winds

When the courtyard and the solarium are facing towards exposed, vulnerable in winter sides to the prevailing cold winds, they act upon as buffers protecting the main building with the creation of calm pockets protected from cold winds and low temperatures.

- Surrounding Buildings: The buildings that surround the courtyard protect it from cold winds; their height nevertheless determines the creation or not of wind whirls in the courtyard.
- Vegetation: The vegetation and the protective hedges in form of wind breakers impede the cold winds of winter or at least they lower their velocity and conse-

quently the heat losses from the building. The planting in the exposed aspects blunts the influences of unfavourable climatic changes [11].

3.1.2. Summer

Besides their importance as climatic modifiers, the courtyard and solarium form a key issue in building design for summer conditions. In multiple thermal modes, varied design and careful construction combined with the surrounding landscape they moderate temperatures round the building. The most frequently found ways are:

a. Evaporation

In the hot arid regions of Mediterranean, such as the island of Cyprus, evaporation for air humidification is necessary for the creation of comfortable conditions. This could be achieved with water sprays over the solarium and courtyard walls as well as the vegetation that surrounds them.

- Ground Surfaces: Natural coverings of courtyard as grass and other plants moderate high summer temperatures and promote cool atmosphere with the evaporation.
- Fountains, Pools and Sprinklers: The configuration of courtyards with fountains, pools and sprinklers offer pleasant cool exterior spaces and with the evaporation of water benefit adjacent indoor spaces. In old mansions in the courtyard a fountain is incorporated which offers additional evaporation and increases the levels of humidity and therefore creates a pleasant environment.
- Spraying: Moreover the local habit of residents to sprinkle water or to wash with water the floor of courtyard and the vegetation in this it evaporates water and refreshes the atmosphere, creates cool currents and it increases the humidity.

b. Temperature and Radiation

The temperatures in and around the building can also be tempered by the design and nature of the surrounding surfaces combined with the night sky radiation. The surfaces exposed to the clear sky cool down by radiation and the air immediately in contact with them also become cooler.

In the summer the courtyard building configuration is of particular significance for the Mediterranean hot arid regions such as the island of Cyprus characterised by large diurnal fluctuations (15 to 25 degrees centigrade) and its potential inherent in the courtyard to act as cold sink by radiating heat during the night to the cold sky. Furthermore, the additional mass of the courtyard and the solarium absorbs the heat during the day and release it during the night to the cooler exterior ambient air.

c. Ventilation, Winds and Breezes

In the Mediterranean region, ventilation is necessary for comfort and hygiene; even on hot summer days when the outdoor is warmer than the building interior. In traditional buildings a great deal of attention was given to ventilation especially to the pre-treatment of air. The courtyard and solarium design and landscaping regulate the flow of air by transporting inside fresh, clean air from outside, when this is cooler than the interior. The influencing parameters are:

- The Form and the Layout of the solarium and the courtyard.
- The Region where the residences are found (Coastal, mountainous or urban regions)
- Elements as Wind Towers: above the roofs of adjacent buildings (7m-8m) with the orifice towards the prevailing breezes. The placement of a fountain in their base cleans and refreshes the air that is channelled in the courtyard.
- Arches, Overhangs and Porches that direct summer breezes when on the windward sides maximise and distribute the flow of air.
- Vegetation and planting of trees channel summer breezes in the building.

d. Shading

The treatment of courtyard and solariums offers important techniques in providing shading and extend thermal building control. The main elements of courtyard and solarium for shading are:

- Enclosing Elements.
- Arches, and Overhangs that intercept the sun in the summer and leave it unhindered to the winter.
- Vegetation: Climbing deciduous plants, such as traditional grape-vines, in horizontal pergolas that offer shade in the summer and admit the sun in the winter. Dense compact vegetation in the east and west for protection by the low sun of summer in the morning and afternoon [12].

3.2. Other Climatic Building Elements

Besides the solarium and the courtyard, the two fundamental means that were used in the traditional planning of buildings for the mitigation of extreme climatic conditions, there a lot of other architectural aspects and structural elements which exist in the old houses that reflects the traditional wisdom [12] such as:

a) *The Layout and the Orientation of the Building* with big glass surfaces aspecting south for solar access in the winter when the sun path is low in the sky and with calculated shading devices that admit the solar radiation of winter and provides solar protection in the summer.

b) *Openings*

- Small openings in the east and the west to avoid the summer sun in the morning and the afternoon.
- Small openings and in the north to avoid cold winter winds but also for achievement of cross-ventilation in the summer.
- Small windows placed mainly above the staircase for ventilation.
- Shutters, Screens and Pergolas that allow ventilation, lighting and view but simultaneously control the penetration of the sun in the summer.

c) *Lightwells* evolved to ventilate and light the interior of dwellings in densely built urban environments.

d) *Materials and Methods of Construction.* These vary depending on the region and locality [13].

4. THE OPTIMISATION STUDIES

For the attainment of this aim, the comfort standards for single family detached buildings in Cyprus, taken as a basis in the optimization study, through investigation of current thermostat settings, reviews of thermal comfort studies in Cyprus and internationally were established in the first stage. This is followed by an analysis of the prevailing climatic conditions in Cyprus to assess how energy demands for heating and cooling arise in domestic building and to evaluate the free energy systems available to contribute to these requirements. Furthermore an evaluation of traditional, existing and new built buildings was carried out, to identify deficiencies in the regulatory systems inherent in the built form that result in heating and cooling demands [14].

In this respect influencing factors were reviewed:

a) Building regulations and planning legislation

b) Architectural trends

c) Building construction

d) Energy sources and usage

Initially simplified thermal calculations were carried out using “Method 5000”, a well established method adopted by the commission of the European Communities Handbook. These were followed by detailed hourly simulations of selected variants in order to compare the thermal performance of the traditional and the contemporary building, using dynamic simulation models such as SERI-RES [15, 16]. In the final stage, recommendations for new buildings are made, through comparative assessment of obtained results.

In these series of studies two main variables are tested:

- The Courtyard and the House Shape
- The overhang of the Solarium

4.1. The Courtyard and the House Shape

From optimization studies of building simulations carried out with SERI-RES on Cypriot houses, it was found that the introduction of courtyards with south aspecting windows incurs more heating savings than houses without courtyards.

Furthermore, the more complex courtyard houses (Fig. **4**) such as the Π-Shape save more energy in the house than simpler forms. The more complex shapes result to a number of additional factors intervening in their thermal behaviour leading to the extra heating savings in the building. Such additional factors were found to be:

a) The more composite internal layout encompassing more spaces and surfaces facing south.

b) Larger internal thermal mass whose position, size and distribution reduce temperature fluctuations by retaining heat within it.

c) Enhanced thermal protection on external envelope as a result of the courtyard morphology of the more complex shapes.

d) More useful exchanges through openings and surrounding walls.

4.2. The Overhang of the Solarium

The extent of the solarium cover admits the rays from the winter sun to penetrate and so solar radiation can be utilized. For this reason the solariums on the mountainous areas move in the upper levels.

In vernacular architecture the width of projection of the cover varied and it was intuitively sized by the indigenous builders so that in the summer it intercepted the sun and in

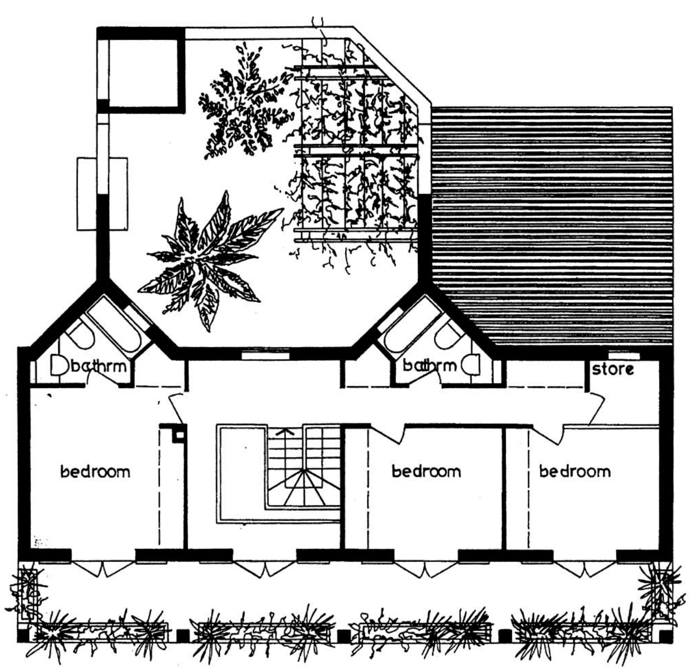

Fig. (4). The more complex courtyard houses save more energy in the house than simpler forms.

winter it allowed it to enter.

Optimization SERI-RES studies show that the introduction of the permanent solarium overhangs, even when effectively designed (Fig. **5**), results to a reduction of heating savings by 8%. This is attributed to the loss of useful solar gains intercepted by the permanent overhangs.

However, the summer shading benefits are exceedingly more to justify the incorporation of solariums on the houses facades.

4.3. Shading Devices

The parameter of shading was further introduced in the house design in the form of shutters and compared to that of overhangs and extended walls. The operation of shutters is controlled by the building users. The overhangs and extended walls were introduced as permanent features of the building design; the width of their projection has been defined so that in the summer the solar aperture of the glazing is completely shaded from the high summer sun, while permitting rays from the low winter sun to penetrate and so solar radiation could be utilized. These two shading devices are examined in two tests:

- **Introduction of shutters** on the re-orientated fenestration. The introduction of controllable shading devices (shutters) to intercept the summer sun, incurs considerable reduction of cooling; the total savings are increased by 30%.
- **Introduction of shutters-addition of overhangs and extended walls** on fenestration. Incorporating further in the design fixed shading devices of overhangs and extended walls, concludes to additional energy savings of 20%.

Permanent shading such as overhangs and side walls must be designed in terms of orientation and dimensions for solar gains in winter and at the same time reductions of overheating in the summer. Movable shading devices offer flexibility and intrinsically have the potential for controlled operation. However they are subject to user intervention, as it is going to be expressed at a later stage of this article.

Regardless orientation, permanent overhangs and extended walls limit useful solar gains. Movable shading devices however are advantageous due to their flexibility and intrinsically have the potential for controlled operation and therefore optimized performance.

5. THE INHABITANTS

Besides the solarium and the courtyard, the two fundamental means, used in traditional building design, to temper extreme weather conditions, there exist numerous other architectural aspects and building elements in the old buildings reflecting the wisdom of tradition.

The inhabitants themselves however were the single most powerful contributors to the success of their climatic designs. Their genuine approach to problem solving, and their tendency for self-sufficiency, is expressed in their willingness and ability to organize daily activities in such a way so that all spaces were used dynamically without having to be maintained at equal levels of comfort. At any given period the active use of the building could be restricted to those areas most comfortable at that time. Furthermore the inhabitants were attending the use they made of the building and thereby changing its thermal characteristics; the variations taking place according to the time of the day or according to

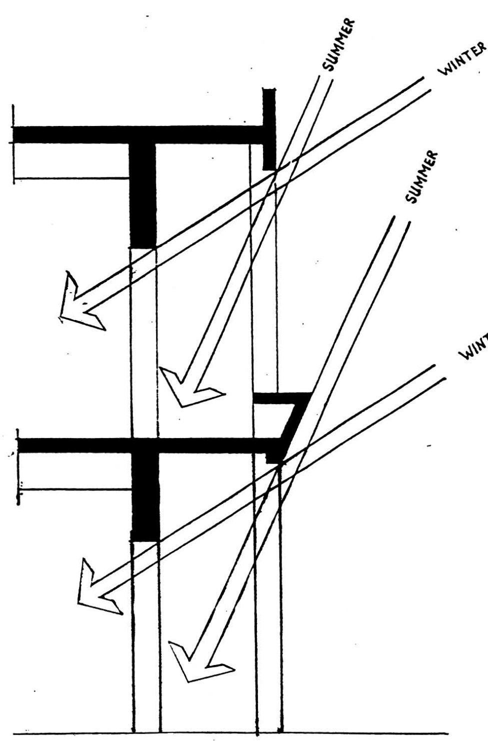

Fig. (5). Optimization studies show that the introduction of the permanent solarium overhangs, even when effectively designed, result to a reduction of heating savings by 8%.

the seasons. By this method it was possible to protect the building interior from solar radiation in summer, to retain warmth or coolness as required and even to cool the building interior by evaporation of water from the skin and the surrounding courtyard and vegetation [17].

6. DEPARTURE FROM TRADITIONAL WISDOM

The traditional thermal considerations used in building design have been contemporarily forgotten or abandoned and there are no signs in the new buildings to remind us the wisdom of the old.

The Cypriots left behind the sincerity and warmth of the Greek life style of close human contact and modeled their lives on Western social prototypes. This brought about different socio-economic relations. The small size of the Cypriot community and hence the strong identity of the individuals, exaggerated the "status" influence on the society and was soon reflected in their homes. The cramped spaces copied from the West left no option or even consideration for traditional orientation.

Furthermore the imposition of general regulations, such as the 3m set back from the boundaries, predetermined that buildings were built in isolation. This is in contrast to the natural, organic evolution of the traditional grouping of buildings close to each other using common walls which create thermal envelopes as "sun-shadows" and "wind-shadows".

The influence of the post-war movement for "International", mass production architecture, due to:

- Training of architects in various countries
- Mass media
- Tourism demands
- Uniformity of materials and technology

Quick, cheap and easy approach to design solutions has further resulted in Cypriot buildings which are climatically inept. Buildings no longer act as climatic moderators to soften the unpleasant climatic extremes, an architectural task the traditional wisdom handled skillfully. On the contrary; adoption of international styles aggravated adverse climatic conditions. Adoption of foreign architectural solutions in Cyprus often accentuates the extremes of the climate.

The buildings have become enclosures for artificial environments and often their shells act as an additional obstacle to the efficient use of their mechanical installations. By behaving "worse than the climate itself" such designs demand more consumption of auxiliary energy through mechanical equipment simply to control their indoor environment.

In addition to the above influences, there are more interrelated factors which increase the complexity of the architecture of the contemporary Cypriot building. The trend towards greater standards of comfort in recent years, coupled with the tendency of the human animal to adapt to its environment has led to the increasing use of air conditioning systems, and more energy demand than the common sense approach of our predecessors.

As our society becomes more demanding and litigatious, the safety factor in engineering increases not only for present but even more so for future demands. These cost increases are passed on to the ultimate user of the building [18].

7. THE MODERN VILLA

The architectural scene in Cyprus today is in discord and disharmony with the natural environment. The attempts at originality are obvious in building design, but also obvious is the lack of wisdom to confront the harsh climatic conditions. The result is modern buildings which are struggling to achieve indoor comfort conditions and consequently devour large amounts of energy.

Maximum exposure of the external envelope of the building to the sun is inappropriate for Cyprus. It will also be colder in the winter. The tendency to elevate the building on columns (pilotis) with the prospect of integrating shops or stores in the future or to housing the car of the family, results in similar problems. More of the surfaces are exposed to ambient temperature fluctuations. Elevated buildings no longer have that contact with the earth that keeps a constant 10 to 13 degrees centigrade temperature.

However with a wind, the raised pilotis creates a higher velocity (Venturi effect) of air moving under the building which causes the temperature to drop significantly. This is convenient in the summer, but detrimental during the winter. The modern building does form a court but it is typically underneath the building with no solar access in winter. It no longer serves as the welcome social, transit space between outside and inside, public and private as the traditional courtyard. Its traditional range of functions; children rearing, containment of the animals, and space to live during the majority of the seasons are reduced to the storage of garbage and car parking.

The solarium is no longer a solar feature or indeed the focal space of the Cypriot building. It became the manifestation of social status and no longer resembles its original form and functions. Its name has also changed; it is replaced by its European version "Entree" and "Hall".

This contemporary scene brings about a sense of nostalgia for the traditional wisdom which may encourage designers to derive lessons from our ancestors.

8. TRANSITION FROM THE TRADITIONAL TO CONTEMPORARY BUILDING

It is evident that the task of modern architect is considerably more complicated than that of indigenous builders. The demands of modern life introduced new factors and considerations into the design of buildings beyond the "basic" traditional ones. As technology advances and life becomes more demanding, the judicious and optimal organization of complex variables involving technical, social, utilitarian and cultural aspects, still converge on creating comfort and convenience to the user. The priority of architects in the design process alters; machines become more important in producing appropriate comfort standards. Moreover as the feeling of comfort is a subjective perception it varies from person to person from culture to culture and over time. So it is unfair and wrong to judge thermal comfort levels in traditional buildings by the same yardstick that we use for modern ones [19].

However the tools, materials and techniques available to the modern architect are more than the indigenous builder had access to. In addition the architect has the advantage of the accumulated knowledge of predecessors.

Through these two key areas, of viable traditional approach to building on one hand, and the highly complex set of design criteria of conventional practice on the other the basic objective is to derive recommendations for the efficient utilization of energy in contemporary architecture [20].

9. CONCLUSIONS

The study identifies and analyses the characteristics of the vernacular Mediterranean houses, which are inherent in solar and bioclimatic architecture, compares those with modern building concepts and solutions for thermal comfort and through comparative and optimization studies concludes to the optimal choice between the different design alternatives based on their potential for thermal efficiency.

The archetypal house is recognized and its evolution is traced identifying the solarium and the courtyard as the two core building elements which are fundamental bioclimatic components and act as indoor climatic modifiers in the Cypriot traditional houses. These two elements were examined and it was explained how they create appropriate environment through their varied design and the utilization of the natural resources of energy for both the winter and summertime.

Besides these two main elements of traditional architecture which mitigate the extreme climatic conditions, the well developed spatial organization in which the insolation criteria are obvious in orientation, other architectural solutions and components are identified which reflect the traditional wisdom and which are used in modern passive solar architecture. Such components are the varied designs of windows and their shading devices such as shutters, screens, pergolas and overhangs.

From these, the courtyard, the overhangs/side walls and the manually operated shutters were tested in a series of parametric, optimization studies and it was found that the complex courtyard houses, such as the Π-shape, save more energy than simple forms. This was attributed to the additional factors of this type of courtyard houses intervening in the thermal performance, of the introduction of carefully chosen parameters in the optimization studies, which act as regulators in the complex, courtyard building shapes, such as insulation on the envelope and south orientation with more surfaces exposed to the south. It was obvious from these shapes and courtyard studies that the development of the building variables in various shapes, into dynamic and effective pattern of design choices and constraints, necessitates thermal studies for each single building with its own geometry, configuration and particularities in an integrated design approach.

For fenestration shading it was concluded that optimized design of fenestration overhangs and side-fins, without shutters could best provide sufficient summer sun control in order to maintain thermal indoor comfort. The results do not dispute the effectiveness of the manually operated window shutters, especially in cases in which the design concern in buildings extends beyond the thermal and physical determinate and the decision to use shutters is dominated by considerations other than energy and thermal comfort. The application of shutters is often circumscribed by a number of design considerations environmental as well as architectural, economic and behavioural. The function of solar control might then be carried as a secondary function and shutters might be installed primarily for privacy, security night insulation, or as a traditional semantic feature. However, the common practice in Mediterranean and conclusions from previous studies reinforced the beliefs that the response of the Mediterranean inhabitants was powerful enough to initiate shutter's shading operation for the maintenance of indoor comfort.

The analysed passive responses of the traditional architecture to the local environmental conditions and influences represent a treasury of knowledge and information patterns for modern solar and bioclimatic architecture. It is therefore concluded that the successful climatic design should not ignore the accumulated experience and wisdom of our forebears but rather it should develop after a deep understanding, through scientific comprehension, rather than an emotional appraisal of traditional architecture. Architectural expression should respect regionalism and based on a multi-disciplinary design approach

On the other hand, the mass knowledge and technology coming from the West should not be ignored either. The architecture must be a synthesis of both aspects so that it is in harmony with the traditional values suitable for the contemporary societies, their cultural identity and human scale and based on the appropriate technology.

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