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Vernacular Architecture

Towards a Sustainable Future

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Preface

Sustainability is a word that has monopolised a large number of the scientific debates in a broad range of spheres connected not only with architecture, urban planning and construction, but also with the product market, tourism, culture, etc. Organising a conference on such a broad concept as sustainability, which has unfortunately lost part of its meaning because of repeated, banal use, could look like an attempt to follow the latest fashion and keep up with the times. However, the sustainability proposed as the focal point of the conference is indissolubly linked to vernacular architecture made out of earth or other materials and the lessons this architecture of the past can teach us for the future. The concept of sustainability as it is presented is wide-reaching and covers not only environmental issues but sociocultural and socioeconomic questions also. The lessons we can learn from studying vernacular architecture in these three broad spheres are manifold, and can help us not only to further the conservation and retrieval of this architecture already in existence but to rethink new architecture in the light of what we have learned.

In this line of reflection the congress VerSus 2014 | 2nd Mediterra | 2nd ResTapia—International Conference on Vernacular Heritage, Sustainability and Earthen Architecture—was held at the Universitat Politècnica de València on 11th, 12th and 13th September 2014. The main aim of the conference was to discuss and debate the lessons that can be learnt from vernacular architecture to create sustainable architecture today, both for the restoration of traditional buildings and the design and construction of new ones. The conference comprises three important events in a single venue.

The first event is VerSus 2014, which addressed the study of vernacular architecture and the lessons in sustainability it teaches for the future, organised within the frame of the European project: "VerSus: Lessons from Vernacular Heritage to Sustainable Architecture (2012–14)", approved for funding under the European Programme 2000, led by the Escola Superior Gallaecia (Portugal) with the cooperation of the Universitat Politècnica de València (Spain), CRAterre-ENSAG (France), the University of Cagliari (Italy) and the University of Florence (Italy). The congress VerSus 2014 constitutes the closure of this project that represented an important moment of reflection on the themes proposed for discussion with other experts from all over the world. The second event was the second edition of the conference Mediterra—Mediterranean Conference on Earthen Architecture, organised for the first time in 2009 in Cagliari (Italy) by three of the partners of the UNESCO Chair—Earthen Architecture, Building Cultures & Sustainable Development: CRAterre-ENSAG (France), the University of Cagliari (Italy) and the Escola Superior Gallaecia (Portugal). The third event was the conference ResTapia—International Conference on Rammed Earth Conservation, organised for the first time at the Universitat Politècnica de València (Spain) in 2012 with a view to increasing specific knowledge about the restoration of earthen architecture in general and rammed earth architecture in particular.

Given the large number of themes related with these three events, which were satisfactorily brought together under the umbrella of the conference VerSus 2014 | 2nd Mediterra | 2nd ResTapia—International Conference on Vernacular Heritage, Sustainability and Earthen Architecture, on this occasion the international debate addressed five major issues: sustainability concepts in vernacular and contemporary architecture, conservation of urban and rural settlements; documentation and conservation of vernacular architecture; lessons from vernacular heritage for sustainable contemporary architecture; documentation of earthen architecture and proposals for a new architecture in the Mediterranean context (2nd Mediterra Conference); documentation, conservation and proposals of rammed earth and earthen architecture (2nd ResTapia Conference).

The scientific committee was made up of 58 outstanding researchers from 25 different countries from the five continents, specialists in the subjects proposed. All the contributions to the congress, both the abstracts and the final texts, were subjected to a strict peer-review evaluation system by the members of the scientific committee. About 200 papers by 366 authors from 32 countries from the five continents were published, chosen by this process from the over 430 proposals submitted. Apart from the papers, lectures were delivered by two important guest speakers, researchers in the realm of vernacular architecture,

José María Ballester (Director of the Area of Rural Development of the Fundación Botín, Spain) and Marcel Vellinga (Oxford Brookes University, United Kingdom). This constituted an important contribution both to knowledge about vernacular architecture on our planet and the lessons it teaches us and the proposals for the future of architecture at a moment of necessary reflection. All the articles were published in two books. The first of these, *Vernacular Architecture: Towards a Sustainable Future*, contains the texts about the study of vernacular architecture and the lessons it teaches for sustainable architecture, while the second book, *Earthen Architecture: Past, Present and Future*, specifically contains the papers addressing the study of vernacular and historic earthen architecture as a contribution to the sustainable architecture of the future.

The international conference VerSus 2014 received the aegis of: ICOMOS-ISCEAH (International Council on Monuments and Sites—International Scientific Committee on Earthen Architectural Heritage; UNESCO Chair—Earthen Architecture, Building Cultures & Sustainable Development; ICOMOS-CIAV (International Scientific Committee for Vernacular Architecture); PROTERRA—Iberian-American Network on Earthen Architecture and Construction. It also received the institutional support of: IPCE—Instituto del Patrimonio Cultural de España, of the Ministry of Education, Culture & Sport of the Government of Spain; INTBAU-España (International Network for Traditional Building, Architecture & Urbanism—Spain).

The organisation, publication and implementation of the conference were possible thanks to the aid received from the European Union Culture Programme regarding the European Project VerSus (grant nº 2012-2792/001-001 CU7 COOP7), Universitat Politècnica de València, Escuela Técnica Superior de Arquitectura and Instituto de Restauración del Patrimonio of the same university, Conselleria de Infraestructures, Territori i Medi Ambient of the Generalitat Valenciana; companies like ARESPA—Asociación Española de Empresas de Restauración del Patrimonio Histórico, Tarma—Restauración & Patrimonio, Grupo Tragsa, Revista EcoHabitar, IEB-Instituto Español de Baubiologie, KIMIA—Productos y Tecnología para la Rehabilitación; AT Studio; Associazione Nazionale Cittá della Terra Cruda.

Finally we would like to thank all the authors who contributed to the quality, range, diversity and richness of these publications with their articles. We give special thanks to all the partners of the European project "VerSus: Lessons from Vernacular Heritage to Sustainable Architecture" for participating in the conference and their help in spreading the word about it all over the world. We are grateful to the aid of all the members of the advisory committee and the scientific committee for their work throughout the long process of revising the abstracts and papers. And, above all, we thank the organising committee for the complex setting up of the whole conference, the style and language reviewers for their corrections and all the collaborators for their invaluable work in the management and organisation of all the stages of the process

Camilla Mileto, Fernando Vegas, Lidia García Soriano & Valentina Cristini
June 2014

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Conservation of morphological characters as an approach to thermal comfort

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ABSTRACT: Many Egyptian towns are characterized by vernacular buildings, which considered a great value in urban heritage, and characterized by its significant compatibility with the climate and social environment, therefore, it is important to study this heritage and to benefit from its buildings. Recently, new architectural styles appeared, these styles lead to slight reduction of thermal comfort in indoor spaces. This paper aims to achieve thermal comfort in the indoor spaces using the vernacular elements to reduce the energy consumption and to contribute in sustainable process. The paper depends on the analytical method in the analysis of the vernacular architectural model and the latest changed model to compare between the two different models and extracting the results that support the importance of vernacular architecture. Autodesk simulation CFD 2013 was used; the results indicate that there are important parameters which affect the thermal performance of the vernacular architecture building model.

1 CONCEPT OF VERNACULAR ARCHITECTURE

Vernacular architecture is the term reflects the link between design, construction and the culture of the communities as an urban collective activity which practiced and learned to the new generations with some help from craftsmen. In addition, it is the term given to architecture which describes the reality of space and time, and which is characterized by a lot of features and distinctive features using the vocabulary of simple environmental heritage during the period of time in certain specific geographic region. This style of architecture focused on the emotion "reaction" spontaneous auto-free interventions with the presence of different cultural and continuous developments according to the needs of users.

2 CONCEPT OF THERMAL COMFORT AND ITS LIMITS

Thermal comfort is defined as that condition of mind which expresses satisfaction with the thermal environment. A lot of empirical data have been collected on how these parameters are defined. This Application note gives a short introduction on thermal comfort, especially in respect of humidity and temperature. The factors that have a relevant influence on the thermal comfort of the occupant spaces can be divided into environmental and personal factors.

Environmental factors include:

- Temperature
- Thermal radiation
- Humidity
- Air speed
- Personal factors entail:
- Personal activity and condition
- Clothing

Considering these climate factors can make more apt to the needs of users, in addition to more efficient.

Figure 1 illustrates a comfort zone on a bioclimatic chart, a simple tool for analyzing the climate of a particular place. It indicates the zones of human comfort based on ambient temperature and relative humidity, mean radiant temperature, wind speed, solar radiation and evaporative cooling. In the chart, dry bulb temperature is used as the ordinate, and relative humidity as the abscissa. Based on the dry bulb temperature and humidity of a place, one can locate a point on the chart. If it lies within the comfort zone, then the conditions are comfortable. In case it is above the zone, cooling is required; if it is below the zone, heating is needed. If the point is higher than the upper perimeter of the comfort zone, air movement needs to be increased. For conditions when the temperature is high and relative humidity is low, air movement will not help. On the other hand, evaporative cooling is desirable. If the point lies below the lower perimeter of the comfort zone, heating is necessary to counteract low dry-bulb temperature. If the point lies to

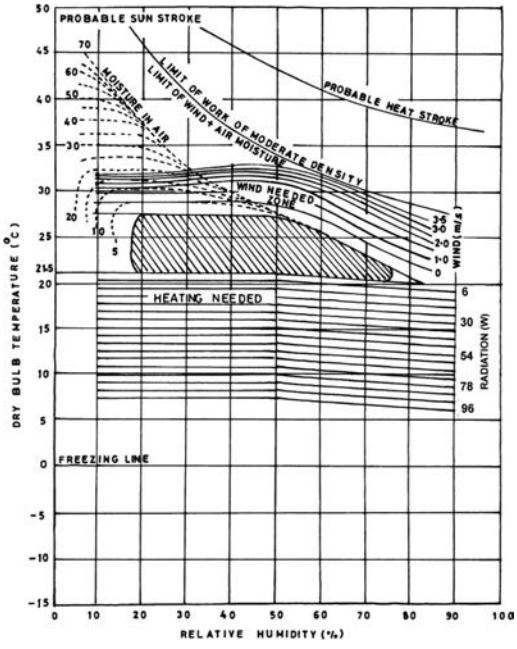

Figure 1. The limit of the thermal comfort zone (A.R. Abd elrady & M.H. Hassan).

the left of the comfort zone, either radiant heating or cooling is necessary. Thus, a bio-climatic chart can give ready information about the requirements of comfort at a particular time.

3 CLIMATIC CHARACTERISTICS OF ASWAN CITY

Aswan city characterizes with arid climate. The average daily temperature in August (the hottest month over the year) is 33.8°C, and it is around 15.8°C in January (the coldest month over the year).

In summer, the temperature can be more than 40°C. The purity of the air as well as the regularity of the brightness of the sun plays a role in the intensification of heat, especially in the afternoon when the sun is perpendicular to the sub-region.

On the other side, the winter in Aswan city is very cold. However, the regularity of the brightness of the sun works to give them a kind of temporary warmth during the day with an average maximum temperature of 23.8°C in the month of January, while the average minimum temperature is 8°C in the month of January; the average temperature ranges between day and night around 15.8°C. The average of the precipitation in Aswan over the year is 1 mm.

Table 1. Temperature variation in Aswan.

Daily average	Min temperature	Max temperature	Month
15.8	8	23.8	Jan
17.7	9.4	26.1	Feb
21.9	12.7	30.4	Mar
21.7	17.5	25	Apr
20.4	21.2	28.5	May
22.8	24.3	42.1	Jun
22.5	24.5	41.2	Jul
22.5	24.3	42	Aug
21.1	22.2	39.6	Sep
22.8	19.3	36.3	Oct
22.2	14.5	30.2	Nov
17.4	10	25.5	Dec

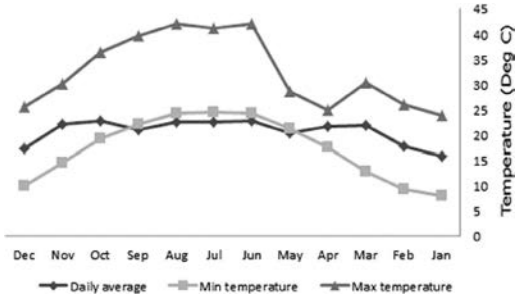

Figure 2. Monthly averages for temperatures in the weather station in Aswan (A.R. Abd elrady & M.H. Hassan).

4 THE ROLE OF MORPHOLOGICAL CHARACTER COMPONENTS IN ACHIEVING THERMAL COMFORT

There are many features which reflect the morphological character of vernacular architecture as well as it plays a vital role in achieving thermal comfort such as courtyard, roofs, and facades.

4.1 *Courtyard*

The courtyard is considered one of the most important features in vernacular architecture in Aswan; many studies proved that courtyards enhance the interior environment of the rooms which opened on it. Also courtyards are the suitable solution for the building in the hot areas as Aswan city. The courtyard considered as a thermal regulation because it works to reduce the air temperature at night and save the cool air in the early hours of the day as a result of replacement of hot air (less dense) by cool air (heavier dense). After sun shine, the air becomes cool air in the courtyard because of water and green elements also because of covering of large parts of this courtyard.

Figure 3. The courtyard as a feature of morphological character in vernacular architecture in Aswan (A.R. Abd elrady).

Figure 4. Sample of roofs in Aswan (A.R. Abd elrady).

4.2 *Roofs*

The roofs in vernacular architecture take many forms such as flat roofs or domes or vaults. People in vernacular community depend on clay brick as a main material for building these roofs. They use palm fronds which covered with dry clay in flat roofs. The method of construction and the used material are the reasons of reducing the air temperature in the indoor spaces.

4.3 *Facades*

Vernacular architecture characterized with solid facades, we can see non or few windows in these facades, all indoor spaces were opened on courtyard as a suitable solution in the hot area to enhance the thermal comfort, the thickness of the external walls was about 50 cm to reduce the thermal load which passed through these walls, the color of theses facades were often white to reduce the problem of solar radiation.

Figure 5. Solid façade in Aswan (A.R. Abd elrady).

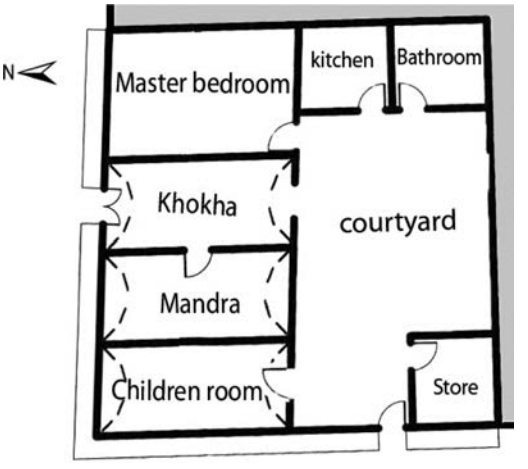

Figure 6. The plan of the first model "vernacular architecture model" (A.R. Abd elrady & M.H. Hassan).

To prove that the vernacular architecture and its morphological character is a suitable solution for arid areas such as Aswan, two models from Aswan were chosen, the first model is the vernacular architecture and the second model is the modern architecture after contemporary developments.

In this research, we depend on Autodesk simulation CFD to prove that vernacular architecture and its morphological characters are more suitable for hottest areas than modern architecture which uses modern morphological vocabulary and modern material such as concrete. We choose the first day in August as one of the hottest day in the year to run this simulation; we got our data from the meteorological station in Aswan as it shown below.

- Air temperature: 42°C
- Wind speed: 1.93 m/s
- Wind direction: north west
- Relative humidity 9.76%

The first model lies in Abouelreesh village, Aswan, the model is an old house with vernacular characters and consists of courtyard, *khokha*, *mandra*, master

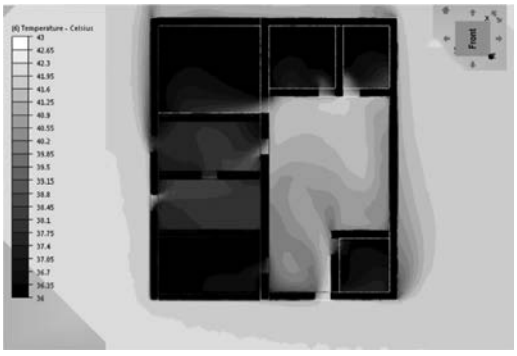

Figure 7. The result of the simulation in the vernacular architecture model (A.R. Abd elrady & M.H. Hassan).

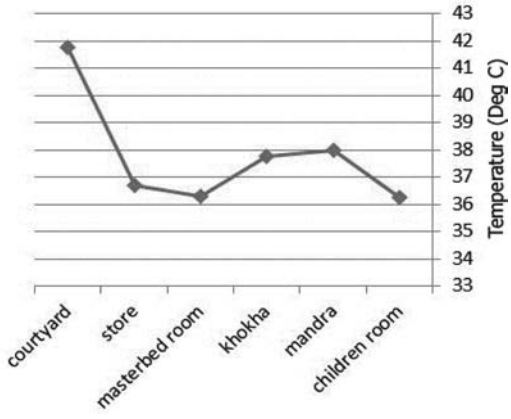

Figure 8. The air temperature diagram in the vernacular architecture model (A.R. Abd elrady & M.H. Hassan).

bedroom and children room. All rooms opened on courtyard except *mandra,* guest's room, which opened on *khokha*, entrance hall space. The house has two facades on the north and west direction. All walls had been built by local material as dry clay and bricks which have been made of clay.

After running the simulation, we have got the results of comfortable temperature in each space of the house as shown in Figures 7 and 8.

The figure indicates that the maximum temperature obtained is 40.9°C, and the minimum temperature obtained is 36.0°C.

The figure shows that the air temperature was between 36.0°C and 37.0°C in all rooms except courtyard, *khokha* and *mandra*. The maximum air temperature was in the courtyard, in the time that was the air temperature between 38.0°C to 38.5°C. The main reason for these obtained results is the vernacular elements as courtyard, used material, dooms, and thickness of the walls.

5 EFFECTS OF CONTEMPORARY DEVELOPMENT ON THERMAL COMFORT IN THE VERNACULAR ARCHITECTURE IN ASWAN

In the recent time vernacular architecture have been influenced by demolition of old buildings and construction of new buildings based on a strange vocabulary of architecture, which threatens the absence of morphological character of this urban environment. All these previous changes are a result of contemporary developments such as social, economic and cultural developments.

5.1 *Social developments*

Poor adherence to customs and traditions considered one of the most important social developments which affect vernacular architecture in Aswan, these social developments because of Opening to the outside world as a result of global migration, particularly the Gulf states and the European or because of the multiplicity of the media at the moment and thus import many of the ideas and foreign cultures that are not compatible with our local culture and thus influence the character of fine vernacular architecture in our country.

5.2 *Economic developments*

In the last years, the economic factor had been become one of the most important factors that affecting the architecture. It plays a vital role in decreasing the total cost of the project via decreasing the cost of raw materials used in the process of building and construction, as well as the methods used to complete the construction process.

5.3 *Culture developments*

There are many Culture developments that have occurred in the life of vernacular communities over the years and have affected all of Architecture, Urbanism and the morphological characters of vernacular architecture, the huge development in communication field considered one of the culture developments beside the evolution of the media and appearance of many types of media such as written, hearing and visual media, You cannot overlook the power of influence of the media on people individually and in groups in light of the change in our time, which was described as the era of information and communication technology.

After these contemporary developments the people in the vernacular community change the morphological characters in their building and they have borrowed new type of modern architecture vocabulary, so they have used the concrete in

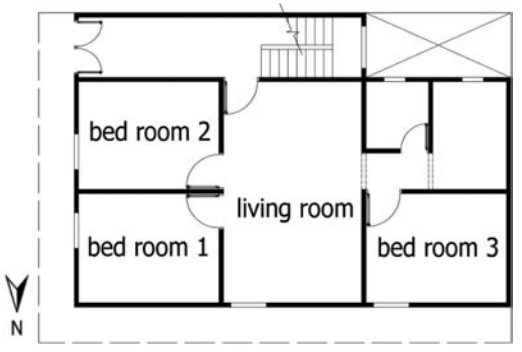

Figure 9. The modern architecture model, second model (A.R. Abd elrady & M.H. Hassan).

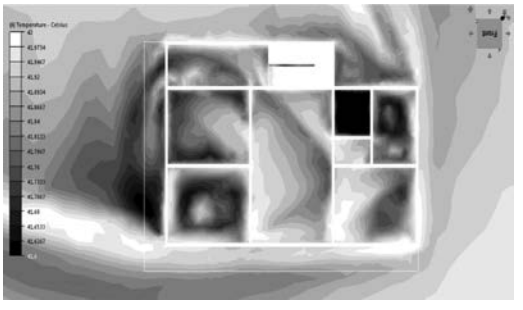

Figure 10. The result of the simulation in the modern model, second model (A.R. Abd elrady & M.H. Hassan).

their flat roofs and they have neglected the courtyard in their design, they have replaced the thick wall which is 50 cm in its thickness with another one which is 25 cm or 12 cm.

The second model explains all effects of contemporary developments on the morphological characters of vernacular architecture. The model is one of the modern types of architecture which have been built with new material as concrete. The house was built in 2006 after destroyed the old vernacular house. It consists of three rooms, living room, kitchen and bathroom as it shown Figures 9 and 10.

After running the simulation process we have got the next results which shown in Figures 11.

The figure indicates that the maximum temperature obtained is 41.98°C, and the minimum temperature obtained is 41.49°C.

The figure shows that all spaces in this model are far away from the thermal comfort area than the vernacular architecture model, first model.

The main reason for these obtained results is the new material and new methods in construction.

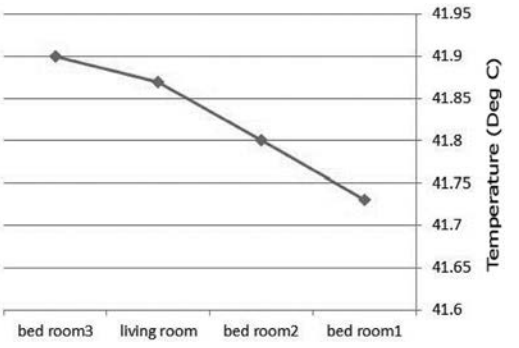

Figure 11. The air temperature diagram in the modern model (A.R. Abd elrady & M.H. Hassan).

6 RESULTS AND RECOMMENDATIONS

The research obtains many results about the morphological characters of vernacular architecture such as the following.

In the vernacular architectural model, the first model, the air temperature located near the thermal comfort area than the modern architectural model. So the first model is more suitable to consume energy in the hottest area as Aswan.

In the vernacular architectural model "the first model", the air temperature about 36.0°C in all rooms which opened directly on the courtyard, although the highest air temperature in all other rooms as *khokha* and *mandra*, this is because of the cool air which located in the courtyard at night moved from the courtyard to these rooms after sun shining, and the rooms preserve the cool air from escaping to outdoor spaces as a result of big thickness of the interior and exterior walls.

Morphological character of the vernacular architecture as courtyard, dooms, solid façade and used material play an important role in achieving thermal comfort, however the people neglect this morphological character, the spaces suffer a lot as a result of increasing of thermal load on the interior spaces.

So we should refer to the importance of the morphological character of the vernacular architecture as an approach to the thermal comfort. In this direction, there are many recommendations which are very necessary to achieve thermal comfort in the interior spaces, these recommendations for architectures and architecture education, governments and peoples in vernacular communities.

Recommendations for architectures and architecture education: we should update and change our material studies in the stage of undergraduate to teach the students the importance of vernacular architecture and its morphological characters as

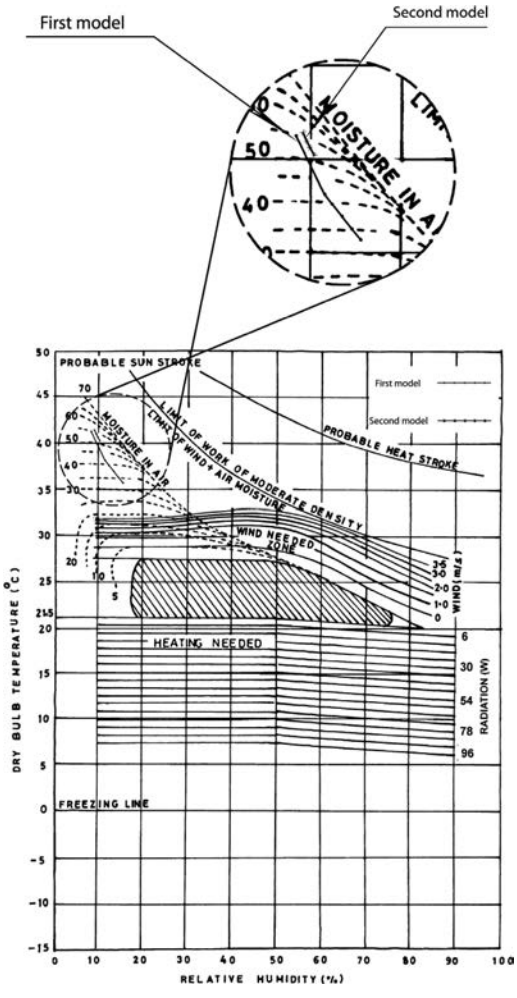

Figure 12. The location of the two models from the thermal comfort zone (A.R. Abd elrady & M.H. Hassan).

a tool to achieve many social, environmental and economic goals. Recommendations for government: in this field the governments should activate the law of conservation for historical building and vernacular architecture, and it should set special organization for conservation and rebuilding the oldest models of vernacular building with its morphological characters. The governments should work on increasing of people's awareness in vernacular communities. The governments should stop against the increasing of cities in the direction of vernacular areas.

Recommendations for people in the vernacular communities: we should work on activating the role of community participation in the field of conservation of vernacular architecture and maintenance of historical buildings, the new generation should return back to their roots as a step in the way to preserve their vernacular production from disappearing.

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