POST OCCUPANCY EVALUATION OF VERNACULAR HERITAGE HOUSING IN MADEIRA: A CASE STUDY OF INHABITANTS’ SATISFACTION

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Abstract Vernacular building traditions are repeatedly cited in the academic literature as exemplary models of environmental practice. This paper analyses through inquiries whether a very specific type of vernacular heritage housing in Madeira Island, Portugal provide comfort. Studies that explicitly examines these kind of vernacular housing and its inhabitants is unknown. Therefore, research that addresses the vernacular traditions of the Madeira Island may emphasize its potential for continuity and viability for maintenance end rehabilitation. Madeira’s Housing is an important expression of the action of man over nature, making emerge a harmonious landscape between the built and its surroundings. In response to the accentuated topography, terraced platforms appeared to soften this inclination. Here the vernacular building revealed itself as a wise design, where the masters of the craft create a communion between the space, utility, comfort and the volumetric balance, emerging a new artificial element that connects with the natural space. A total of 13 recent questionnaire responses from the initially based survey of 66 houses, with almost a century, was analysed to understand the residents’ satisfaction with existing conditions through post-occupancy evaluation. Several variables were associated with the dwelling and thermal comfort. It reports that the inhabitants have been able to achieve some degree of thermally comfortable conditions for much of the year. The results of this research provide valuable information for future housing sustainable rehabilitation. This may also enable the Local Authority, to identify ways of improving the quality of life for residents.
1. INTRODUCTION

Vernacular building traditions are repeatedly cited in the academic literature as exemplary models of environmental practice. Therefore, research that addresses the vernacular traditions of the Madeira Island may emphasize its potential for continuity and viability for maintenance and rehabilitation. Sustainability is indissolubly linked to vernacular architecture and the lessons learned with this architecture of the past can teach us knowledge to apply in the future [1]. Sustainable buildings aim to be adapted to local social–economic, cultural and environmental contexts. It should include all factors that may affect the natural environment or human health, having in mind the consequences for future generations [2]. The demand for sustainable buildings with minimal environmental impacts is increasing, leading the construction industry to adopt new technologies for building design [3].

Post Occupancy Evaluation is becoming an increasingly suitable tool not only for the academic community. It seeks, from the perspective of the user, the opinion about buildings in use. This practice can feed back data into the design process related to building's overall performance. Strategies are often driven by construction and project management perspectives rather than focus on organizational issues and user behaviour [4]. More recently, this kind of evaluation takes a closer look at the ultimate-user satisfaction. Consequently the evaluation survey which targeted early occupation of a template design schools in Victoria, it was discovered that teachers and students were more likely to extend their learning environment into the new shared spaces. Results of a user survey of the staff and students who use a net zero-energy building which relates the users’ perceptions to some of the environmental control systems installed were reported [5]. Although the study showed that the people surveyed were satisfied overall with their work environment, the authors stated that was still the need for more information on how to get the best from the windows and the ceiling fan systems for who may only use the classrooms intermittently.

Other surveys were carried out to access users’ opinion from different kind of buildings and even different cultural background. A post-occupancy evaluation survey targeted full-time representative of the wider working population in Australia to help assess discomfort glare in open plan green buildings [6]. Three green buildings located in Brisbane (Australia) were selected. It was concluded that green buildings may not achieve comfort along with the subsequent energy savings. Suggestion is made for further research on these types of buildings and on the people to ensure that the maximum financial, social and environmental benefits are realized. The customers’ experiences and feelings in a daylit and non-daylit cafes as well as the cultural differences between two countries, the UK and South Korea, were studied [7]. The questionnaire was done in terms of quality of lighting, feelings, attractiveness, satisfaction and eye discomfort. The authors found that there was a significant cultural difference in factors affecting perceived lighting quality. Nevertheless there was no significant relationship between perceived lighting quality and perceived eye discomfort at daylit cafés.

Housing is the kind of building that is familiar to all users. Post-occupancy evaluation of user satisfaction was carried out to perceive the residents’ building and environmental conditions of old and new housing in Bangkok [8]. From the study was possible to make
recommendations for future improvements to public housing quality regarding the quality of life for residents. An analysis of Viennese housing estates in the Passive House (PH) standard that have been inhabited for more than two years were done [9]. Based on this study it was possible to present recommendations for future housing projects and assessment systems to fulfil the envisaged goals of sustainable buildings design.

This paper analyses through inquiries whether a very specific type of vernacular heritage housing in Madeira Island, Portugal provide comfort. Studies that explicitly examines these kind of vernacular housing and its inhabitants is unknown. So, this is considered a pilot study to provide valuable information for future housing sustainable rehabilitation. This may also enable the Local Authority, to identify ways of improving the quality of life for residents. However, it is considered to be the first approach for future work in the field. A post occupancy evaluation is suggested including energy monitoring for fine-tuning and increasing energy efficiency as well as for gathering knowledge for planners and developers [9]. The final goal is to set an experienced background to define new field of research, both through a more detailed questionnaire and also through monitoring, in order to quantify what level of comfort can be experienced within these buildings.

2. MADEIRA’S VERNACULAR ARCHITECTURE CONTEXTUALIZATION

This architecture is made by the people and for the people, without the aid of an architect, demonstrates the relationship between the population and its surroundings through the care with which they treated the climatic constraints at regional and local levels and that is clearly related to the seasonal variation of temperature, regardless of cultural differences and of the level of development of each community [10]. The research and study of the essence, the behavior, the possibilities of traditional technologies used in a specific territory, is like the rediscovery, always renewed, of the profound meaning of Portuguese architecture. Thus, this work allows the knowledge of Portuguese cultural memory through the construction processes to the mark and characterization in geographic space and in historical time. On the other hand, this work allows the safeguarding of identities that make up features of a country and a region. Traditional solutions and resources to "ways of doing" always improved Portuguese creativity. [11] This knowledge transmitted through the local architecture is based on the careful planning of housing, in its shape and orientation, in size, number and orientation of the doors and windows, in size and orientation of the roof in relation to the Sun and wind, in the use of various techniques of insulation in walls and roofs, in the control of ventilation and shade density and appropriate choice of materials.[12]

The main characteristics of the Madeira’s vernacular houses are the wooden structure and thatched high-pitched roof. Some of the houses are made of wooden walls and a few of stonework as shown in Figure 1. This vernacular architecture, in Madeira Island, stands out for being an unidentifiable type from out of the Portuguese territory. There are three types of these vernacular houses: “Fio or Empena”, “Meio-Fio” and “Redonda” (Figure 2).
The “Redonda” house typology was the permanent home of the farmers in the parishes of S. Jorge or on the Ilha and the “Fio” House, which later evolved into “Meio fio”, arose with the need to have a shelter in the parish of Santana fast to build and with the minimum of comfort. The parish of Santana, being flatter, was the place of the crops and the parishes of S. Jorge and Ilha and were the place of residence. Because they were distant and so the population shouldn’t have to go back every from work to residence emerged the “Fio” House. However, currently, on the Ilha there are no records of the “Redonda” House. Thus, for the reasons presented the “Redonda” House has an interesting complexity, and lesser-known by touristic reasons, this was the type chosen for an academically seasonal housing proposal [1].

The “Fio ou Empena” house consists of one floor building, built entirely of wood, with a full frame fitting that join together perfectly. Supports of its longitudinal beams are directly on the stones of the floor. These constructions are able to be moved to another site thus changing the first implantation site. This Typology is characterized by having the kitchen in a separate volume of the house, which is built entirely in wood, with a frame filled with fittings that join and fit perfectly. The “Meio-Fio” house presents the elevation frame coverage around the perimeter about 90 cm above the soil. This innovation arises in the twentieth century, making it a better use of interior space, and in more evolved cases it is provided with an attic reachable by an outside steep staircase. The “Redonda” house presents four facades and a hip roof with rounded corners. The shutters sliding of the windows are found only in this type of construction. In some buildings there is also an attic accessed by a steep staircase. This typology was more concentrated in the parish of São Jorge and Ilha. In the parish of Ilha this typology is already non-existent [1].

Figure 1. Madeira’s vernacular houses with thatched high-pitched roof and wooden or stonework walls
3. RESEARCH METHOD

3.1. A case study survey

There is no information available on characteristics and environment conditions of the vernacular dwellings in Madeira. Therefore, the aim was to investigate the level of (dis)comfort felt in these buildings, based on occupants’ satisfaction. In this study, the post occupancy evaluations were focused on the quality of daylight, thermal comfort and ventilation. The study involved field surveys which were conducted in S. Jorge and Santana places of Madeira Island, Portugal. The objective was also to understand the relationship between different use patterns and their influence on or association with overall satisfaction. The goal was to collect data that would represent the different type of occupancy of these old dwellings, as housing, residential tourism and bar/restaurant.

A total of 13 out of 66 vernacular buildings were chosen for the field surveys and typical outer views are illustrated in Figure 2 (“Fio or Empena”, “Meio-Fio” and “Redonda” house types). The main characteristics of these houses are the wooden structure and thatched high-pitched roofs. Some of the houses are made of wooden walls and a few of stonework which elevates the frame coverage above the soil. This vernacular architecture in Madeira stands out for being the dwellings that characterize the most of the island of Madeira. It were developed according to the habits and customs of the population, adapted to the site and built with local materials without any influence of foreign styles [1].

![Figure 2. Outer view of the “Fio or Empena”, “Meio-Fio” and “Redonda” houses](image)

3.2. Questionnaire design

Participants were interviewed based on a questionnaire reproduced in Figure 3. It is a single simple page survey and the questions in it can be broken down into three groups of general information:

- Perceived daylighting quality;
- Perceived thermal satisfaction;
- Perceived airing/ventilation of the building.

Buildings were randomly selected during the field survey. In this field surveys, owners who lived in the buildings for a few years were asked to complete a questionnaire in order to provide enough adaptation time for the indoor environment conditions all over the year.
Participants were persons of a nontechnical background so they could provide a significant answer on (dis)comfort issue. This is considered a pilot study to test the effectiveness of this first and simple questionnaire. The final goal is to set an experienced background to define new field of research, both through a more detailed questionnaire and also through monitoring, in order to quantify what level of comfort can be experienced within these buildings.

Identification and location of the building: __________________________________________

1 - Level of satisfaction with the quality of daylight:

<table>
<thead>
<tr>
<th></th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very unsatisfied</td>
<td>Very satisfied</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 - Level of thermal comfort during the winter:

<table>
<thead>
<tr>
<th></th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very cold</td>
<td>Comfortable</td>
<td>Very hot</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3 - Level of thermal comfort during the summer:

<table>
<thead>
<tr>
<th></th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
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<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very cold</td>
<td>Comfortable</td>
<td>Very hot</td>
<td></td>
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</tbody>
</table>

4 - On thermal discomfort, which of the following best applies?
- Morning
- Afternoon
- Night
- Always

5 - On thermal discomfort, which of the following best describes?
- Lack of airing
- Too much daylight
- Draft
- Lack of daylight
- Cold ventilation
- Lack of heating
- Lack of cooling
- Other: ____________

6 - Which of the following uses to adjust your comfort?
- Open/close shutters, curtains
- Open/close windows
- Open/close door
- Use of heating
- Use of cooling
- Use of fan
- Other: ____________

7 - What kind of heating do you use? __________________________________________

8 - Is the air usually stuffy?
- Yes
- No

9 - If it appears that the air is stuffy when it is noticed?
(eg: winter, summer, in the morning, .... Etc.) __________________________________________

Figure 3. Questionnaire base

3.3. Data collection

Determining satisfaction is a very subjective issue since it is dependent on personal experiences and individual emotions. This data collection does not reflect the demographic, socio-economic factors and living conditions. Interviews were conducted to explore residents’
experiences whether the participant is or is not experiencing discomfort. A lack of familiarity on indoor environment may result on inconsistency between different results. However, it is considered to be the first approach to future work in the field. Most of the inquiries are related to “Meio-Fio” house types.

In a previous study it was observed that the overall lighting conditions of these houses were approximately gloomy [12]. Therefore, the first general lighting question asked occupants to describe their overall satisfaction with the quality of daylight. Of interest is whether there is a relationship between general day lighting and building operation where the options were chosen to cover a broader range of possible from “very unsatisfied” to “very satisfied”.

The second part dealt with dwellers’ experiences of their physical environment reflected through an individual’s perception of thermal comfort. The levels of satisfaction from a -3 (uncomfortable – very cold) to 3 (uncomfortable – very hot), being comfortable or neutral registered as zero. It is expected that any occupant who selected comfortable, views their current environment in a positive manner. One third part dealt with the indoor air quality. It was of interest to record if the inhabitants perceived the quality of the air.

4. RESULTS AND FUTURE WORK

To understand the situation of the vernacular housing in Madeira Island, an enquiry was carried out by quickly interviewing the residents. This was the first study about user’s opinion on such buildings and it is presented as a pioneer project to prepare and define a more deeply and rigorous survey on Madeira’s vernacular housing. Some of the original owners had allocated the house to others by selling and some of them had changed the final use (restaurant). Others had allocated the rooms to others by short period renting (tourism purposes). Even though, the length of the residency of the respondents were more than 5 years which made them able to elaborate on the satisfaction with the indoor environment. Thus satisfaction with the indoor environment was related to natural lighting, thermal comfort (Figure 4), ventilation and air quality.
Questions on level of satisfaction with the quality of daylight were asked to residents. As it was verified that the indoor space was a little gloomy, the range of the possible answers were from “very unsatisfied” to “very satisfied”. In relation to the building unit satisfaction the natural lighting presents an undefined ranked. The answers were dispersed from “very bad” to “very good”. The best score was obtained from a “Redonda” house. This kind of building has windows on every façade against windows on two façade for other buildings. This kind of dwelling has certainly more daylight level than the others. All buildings have their interior brown finishing with low light reflection.

Questions that asked residents how satisfied they were regarding thermal comfort. Only two of the respondents had heating devices. Nine of the thirteen answered from neutral to hot in the winter and from warm to very hot in the summer. Operating windows and external door during the summer was not enough to obtain comfort. In fact, 5 reported lack of heating and also poor daylight levels for the uncomfortable environment. None of these had reported a very unpleasant daylight environment. In spite of the roof finishing, only 3 complained on too much draft. Overall, 6 mentioned that thermal discomfort was felt in the morning, while 4 was during the night. Questions on the air quality were enquired. All the respondents were fairly satisfied.

To understand how the personal background and socio-economic factors of the respondents may affect satisfaction a number of factors should be analysed. We have just found a few well-maintained buildings. Most of the residents had very little opportunity to manage the building due to the limited financial capacity. As a community feature satisfaction and accessibility to leisure and daily activities can be identified in further interviews as being important to the residents’ wellbeing and enjoyment of their surroundings.

In terms of natural lighting windows on several facades affects light. The two sided window facade allows sunlight to the centre of the dwellings. This is better on the four sided window facade to distribute daylight through the whole floor. There were no complains on solar radiation. However, there is a need to further investigate natural lighting levels and how it affects the occupants.

Building satisfaction dimension may cover questions on dwelling material satisfaction should also be asked to residents who might experience many problems, such as cracking, leaking, and degradation of floors, walls and roof cover. There were also questions when how building elements perform based on the occupants’ comfort as the operation of windows, doors, but not on the missing sanitary facilities.

5. CONCLUSIONS

This research demonstrates that, currently, plan ahead means studying the past and understand the techniques used in traditional architecture but also evaluate the post occupancy of these architectures. In fact, this research is the only study conducted at the participant’s own places, on these terms, and is also the only study that collects opinion on comfortable issues as specified by participants. It has explored the relationship between lighting quality and occupants’ welfare through analysis of the evaluation path obtained
from a field survey. The results have shown large differences between the responses, derived from an inconclusive luminous environment. One conclusion of this study is the clear influence that draft has on perceived indoor air quality and its subsequent effect on occupant health, although uncomfortable in indoor environments during winter time. In order to validate the outcomes more concretely, further field studies are recommended as the current study includes a few limitations. First, the results could be affected by the different kind of buildings and also influenced by the cultural and socio-economic background of the respondents. Secondly, the study did not address any monitoring of the variables proposed in this study and causal relationships between the perceived comforts and building operation.

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REFERENCES


