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Analysis of User's Perception on How to Achieve Thermal Comfort in Kano State Luxury Homes

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ABSTRACT

Luxury homes form an important part of development of urban settings in Nigeria, it is predominantly but not always on one building accommodation spaces that contains all necessary components and style of modern residential units. However, the location of these building largely makes them different in relation to the kind view they offer. The congestion and rapid increase of urban activities in Kano State has resulted to thermal comfort challenges, this problem have remained stagnant in the air for quite a long time, despite the control in design of buildings that have emerged of recent, there still remains the problem of indoor air quality and humid hot interior spaces that affect building occupants. The main aim of this research is to highlight how User's perception can be used to achieve thermal comforts in the luxury homes in Kano, which can be accessed through examining the effects of thermal discomfort on building users, assessing the actions of users on thermal comfort challenges, evaluating users response on how thermal comfort can be achieved. After extensive review of literature, a research gap was established. Data was collected from the aforementioned study area through administering questionnaire, observation and personal interview. A qualitative and quantitative research approach was employed; SPSS and MSExcel were used for the quantitative data analysis. Findings revealed Users discomfort level, the adaptation techniques they have adopted and suggesting design considerations and ways to which thermal discomforts can be mitigated. Recommendations were made for designing homes with high level of comforts achieved through the idea of the users of buildings. Conclusion was made on the ease of determining the discomfort level of user, and the importance of incorporating their idea and thinking at the starting point in building designs.

Keywords: Discomfort, Luxury homes, Thermal comfort, User's perception

INTRODUCTION

Thermal comfort is simply understood as the condition humans find themselves when they are satisfied with their environment. Preserving this state of mind or condition of thermal comfort for building occupants is now the imperative issue. The resultant effect of not meeting up this standard is sick building syndrome and poor indoor air quality. Factors that determines thermal comfort however ranges from metabolism, local discomforts, relative humidity and clothing insulation. However, no matter how much thermal comfort will be dependent on weather and the environment, the design of the building has 75% role to play in it. (Chenvidyakarn, 2007). Most buildings today have thermal discomfort issues due to lack of design consideration. Taking Kano state for instance, most buildings are designed for just the designing sake with not much attention paid to its orientation or proper climatology check. The home owners too worry more about aesthetics and height of their buildings compared the conduciveness of it.

Special consideration should be taken by architect in designing buildings as it's a changing world now, apart from the fact that there is every need for thermal comfort to be achieved, it's also important to note that there is a recent assumption by the construction gatekeepers that life is happening only indoors, meaning people leave inside now and cars live outside. (Saberi, Saneei and Javanbakht, 2002). Luxury home users happen to spend a lot of money in making sure they achieve all they want in buildings, they pay so much to alienate all levels of discomfort and hitch in their homes, and this explains why luxury homes are characterized according to the worth of the properties. The congestion and rapid increase of urban activities in Kano State has resulted to thermal comfort challenges. This problem have remained stagnant in the air for quite a long time, despite the control in design of buildings that have emerged of recent, there still remains the problem of indoor air quality and humid hot interior spaces that affect building occupants. Therefore, this research strives to answer the question of how and what can be done and also the role the users can play to help to mitigate thermal discomfort.

The main aim of this research is to highlight how User's perception can be used to achieve thermal comforts in the luxury homes in Kano, which can be achieved through the assessment of the actions of users on thermal comfort challenges and evaluation of users response on how thermal comfort can be achieved. Comfort standards in luxury homes of Kano state has been declared low by the dwellers. Their perception on how it can be increased or achieved will however be taken into cognizance in other to address the problem. The new development in housing has shown how important it is to place users in a position to make decisions and participate in the design process; as stated by Qusoiri, Bambang and Johnny (2010), that owner's participation brings about a better end product, one which echoes the need and target of the users better than that of the designer working on his own. The growing complain of inadequacy of good dwelling facility in terms of comfort in Kano state is getting to an alarming stage, most people develop thermal stresses as a result of these inadequacies, thus the motivation to carry out this research in the field of thermal comfort in residential settings.

Designing for Thermal Comfort in Residential buildings

The main purpose buildings are designed is to provide a comfortable living space (Saberi et al, *2002), as Le Corbusier defined a building as a shelter from cold, heat, rain and simply termed* it as a light and sun receiver (Xu, Zhang and Xie, 2006), for this soul reason a field of science was created known as Thermal comfort. Indoor space design should be in such a way that the occupants' health and comfort are guaranteed. Saberi, (2009) referred to this comfort as one of the primary reasons why buildings are erected, indoor and outdoor comfort should however matter for the designers all the time. Kohli, (2010), explained the guidelines to achieving a thermally conducive environment, which he named Thermal comfort design criteria, he further described these criteria to be based on environmental and personal factors. Environmental factors such as Dry Bulb air temperature, radiant temperature, relative humidity and air velocity, while the personal factors are activity level and clothing value.

Darby and White (2005) stated that there is no fixed standard of thermal comfort design, because human can live in ranges of climates from tropics to temperate regions, but different approaches have been employed in trying to achieve thermal comfort in buildings. The heat-balance and the adaptive approach were suggested for thermal design procedure by Darby and White (2005), while Saberi et al, (2002) strategized comfort or climatic models for design procedures. An adaptive thermal comfort design methodology was proposed by Pieschowski and Rowe, (2007) on their research on Building Design for Hot and Humid Climates which included Analysis of building location and function, determining thermal comfort envelope, modeling the thermal and computational fluid dynamics (CFD) and lastly selecting a climatic control system for the building, he concluded that with close cooperation of the design team, energy efficiency can be achieved.

Energy Design Resources, (2006) stated a new system for Thermal Comfort design is by using Credit 7.1, whose intent is to make available a thermal environment to improve dwellers comfort and performance, which can be achieved by designing HVAC systems and envelopes that meet ASHRAE 55-2004 requirements, if such approaches as active, passive and mixed – mode taming for ventilation are considered. As can be shown on Figure 1 below:

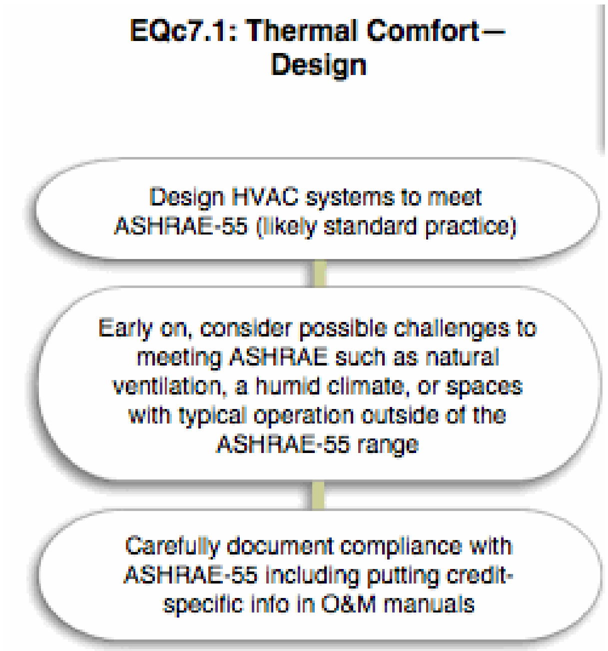

Figure 1: Thermal Comfort Design (ASHRAE-55) Adapted from: (LEEDuser, 2011)

Thermal comfort in residential buildings can however be achieved in different ways during the design stage, but it is perceived in different form based on the nature of the design and the area the design is been situated. An adequate study will help generate and achieve thermally conducive environment, other parameters to achieving this comfort may include but not limited to a passive solar architecture and a careful selection of heating and cooling techniques within the building. However, as complex as thermal comfort may be, it is dependent on so many factors such air temperature, air movement, thermal radiation, and metabolism rate and has a very important role to play in achieving thermal balance below are different techniques in maintaining thermal comfort;

Orientation and Spatial Organization: this affects the ability of a building to gain solar radiation and maximize ventilation too.

Shading: Solar heating glass through the window helps it to gain heat; therefore locating shading devices around the window will help reduce the heat generated.

Material, Texture and Color: The nature of materials can affect how much thermal conductivity it has. A look at their conductivity index will help careful selection and usage.

Vegetation: high shrubs and trees help in moderating the temperature around buildings, it can also provide shades around windows and walls and the green ground cover reflects long wave of radiation reflected towards the building. (Chenvidyakarn, 2007)

Effect of Thermal Comfort; the Users adaptation

The environment plays an important part in the life of its inhabitant. Some place are inviting and comfortable while others are dull and uncomfortable, the reason why this is so is however very intriguing to look into. The psychology of an environment is a field that deals with all these; it tries to understand the connection between the human performance and his physical milieu. This physical milieu has to do with the spatial-physical dimension and how users react in terms of actions and behaviour. The environmental psychology can simply be put as relationship between human behaviour and his built environment. (Wimelius, 2004)

Human satisfaction is subject to the nature of his environment, it is how ever very important to acquire their opinion, as stated by Adedayo, (2010) seeking users view in creating livable environment for potential owners assist in meeting up their needs and aspiration, thus their satisfaction is expected to have been captured too.

Inefficiency in thermal comfort has lead to the dissatisfaction of users and they have resulted in taking actions to mitigate discomforts and thermal stress. Nikolopoulou and Steemers (2003) defined Physical adaptation as the changes one makes in other to adjust to their environment, thus identified two types of physical adaptation namely reactive and interactive. Reactive means altering ones clothing levels posture and position while interactive means making changes to the environment, which is the upmost for this paper. Thermal comfort is very subjective and thermal equilibrium is achieved when there is a balance between heat gained and lost by the body to the environment, therefore there are physical measures applicable to maintain equilibrium through the environment. (Heidorn, 2006) .

The Employers guide (2010) has divided the interactive physical adaptation to the environment due to thermal discomfort in to two periods

When people are hot: they should place insulating materials around hot pipes, provide cooling systems, increase ventilating measures, provide shading devices by using blinds or reflective films to reduces glare and effect of heat from the sun, Siting frequent living environment away from heavy plant, machinery and direct sunlight.

When people are too cold: they should make provision for portable heaters, reduce exposure to cold areas, provide insulating floor covers and try and use wall materials that retain heat. (Employers Guide, 2010)
This however shows that there are measures buildings users can make to adapt to thermal discomfort, especially residential settings.

THE STUDY AREA

Kano state is in northern Nigeria, it is the second largest metropolitan populated state in Nigeria after Lagos. Its urban area covers 137km2 and comprises of six major local governments areas. As of 2006 census, its population was calculated to be 2,163,225 (Habeeb, 2011). The occupancy rate according to population given above is approximately16 persons/m2 this alone is enough to envision its congestions level. This congestion was however brought about due to the high commercial and industrial activities going on in the town, this have made Kano state the richest state in the northern Nigeria. These various industrial activities have left the residential living environment within the town in a poor condition. (NGEX, 2006)

The climate of Kano state has also played a great part in the thermal discomfort of buildings. Table 1 below shows the summary the climatic conditions of Kano State.

Table 1: Summary of Climatic Conditions of Kano State

Climatic Conditions	*Average Measurement*
Rainfall	4.10"/Rainfall Peak months
Humidity	80% Moisture Content/ Day in wet season
Temperature	33-34 o C /Day
Wind Speed	18mph in 185o in the North Easterly Direction
Sunshine	9hrs/day

Source: (Kano Meteorological Agency, 2011).

METHODOLOGY

This research is part of a user satisfaction through user participatory study carried out in luxury homes in Kano State Nigeria. Questions the researcher seeks to answer are stated in the objectives mentioned above. Data was collected through secondary approach by reviewing relevant works and primary source by administering questionnaires. Systematic random approach was used in selection of respondents and questionnaires were administered to the Users of luxury homes in GRA (Government Reserved Area) district of Kano State, other areas studied for this research include Bompai and Ahmadu Bello roads closed to the GRA. Out of the 100 questionnaires administered, 5 respondents claimed their buildings are not luxury homes and they do not belong to the class of people that own them, 7 respondents explained that their homes suffer no thermal discomfort and they felt nothing had to be accessed. 11 respondents did not return their questionnaires and 5 were invalid, leaving 72 respondents. Below is the summary questionnaire shown in Table 2;

Table 2: Summary of Questionnaire Administered

Response Level	*Number of Respondents*
Valid response	72
Not Returned	11
No thermal discomfort Issues	7
Non-Luxury Homes	5
Invalid response	5

Source: Field Survey, (September 2012).

DISCUSSION OF RESULTS

Assessing the Actions of Users on Thermal Comfort Challenges

Majority of the sample studied have made one or two efforts that have still remained ineffective. These strategies can be divided under 2 headings based on the building class they fall into;

Finishes: it has been observed the dwellers of the study area did not fold their hands to keep allowing discomfort getting better hold of them. Below is the break down little works that have been carried out, shown in Table 3;

Table 3: Actions taken to remedy discomforts through finishes

	Replacements	*Users (%)*
1	Rugs and Carpets with floor tiles	*10*
2	Asbestos ceilings with POP and PVC ceilings	*63.5*
3	Oil and Emulsion paints with Silk paints	*45*
4	Exterior walls finished with crack tiles or bricks	*32*

Source: Field Survey, September 2012

The above shows that respondents have taken action and made replacement in their interior spaces, 10% have changed to floor tiles to enhance coolness and high temperatures generated by rugs, 63.5% have replaced the old asbestos ceiling which increases mould and dampness, and whose water is known to be poisonous to POP and PVC ceilings, 45% of have replaced emulsion paints that washes off easily and oil paint that increases room temperature with Silk paint that are easier and tender on human with little or no water permeability, the exterior walls were not left out too as they enable water penetration to interior walls and 32% of the sample size have finished exterior walls with crack tiles and brick facings,

Figure 2 below shows a summary chart of Users that have decided to make good the effect of thermal discomfort as regards their finishes. A total of 37.63% took action while the other 62.38% did nothing to change the state of their discomfort.

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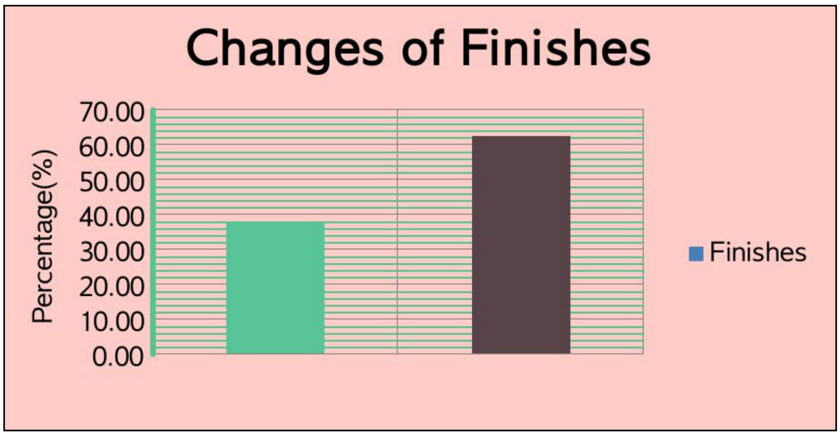

Figure 2: Changes of Finishes *Source: Field Survey September, 2012*

Fixtures: changes have been made as regards building fixtures too, in order to arrest the issues of thermal comforts. This can be summarized on Table 4 below;

Table 4: Actions taken to remedy discomfort through fixtures

	Replacements	*Users (%)*
1	Sliding windows to casement windows	*73*
2	Incandescent bulbs to halogen bulbs	*73.5*
3	Covering Fenestrations with thick blinds and curtains	*42*

Source: Field Survey, September 2012

The table above displays how actions on buildings were taken to mitigate the discomfort of users. 73% replaced their windows from sliding windows which is of 50% ventilation efficiency to casement windows which have the 100% in other to reduce ventilation problem. 73.5% however ranges incandescent bulbs that generate heat to halogen bulbs which does the opposite function. 42% of the users made provisions for thick wall curtains and blinds in other to reduce solar radiation and reduces the effect of glare and sun lightning,

Figure 3 below, shows the level of Users that have taken actions to those that have taken no action in achieving thermal comfort by changing their fixture, measured in percentage. As earlier discussed in the Table 4 above, 62.83% of the users took actions to remedy thermal stress while 37.17% remained indifferent.

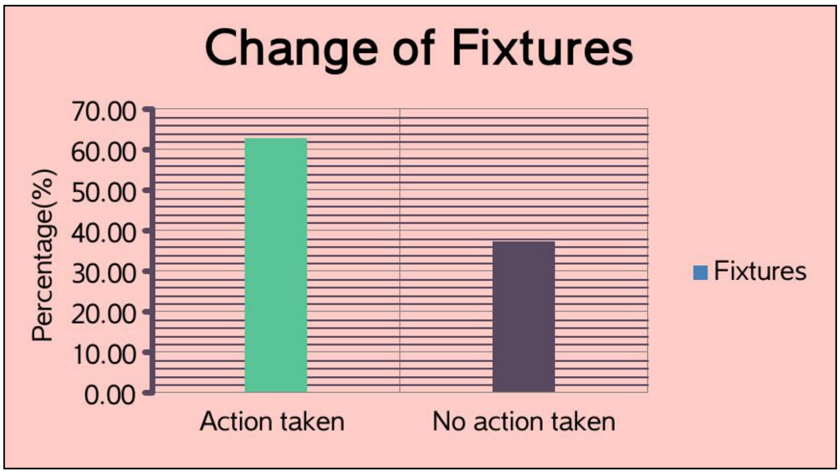

Figure 3: Change of Fixtures
Source: Field Survey September, 2012

Users Perception on how thermal comfort can be achieved

The respondents have shown there optimum concern in relation to thermal comfort issues. They have suggested their perceptions on how solution can be proffered to address thermal comfort issues. Table 5 below shows response of users on how to achieve thermal comfort in homes.

Table 5: User's Perception of achieving thermal comfort

Response	*% of Users*
Take building windows away from sun	75.0
Locating of houses away from the road	82. 0
Planting more trees	67.0
Proper selection of interior finishes	50.4
Locating houses away from commercial areas	72.0
Checking direction of wind and driving rain	74.9
More number of windows/Bigger Windows	92.3
Using window hoods and fins	49.5

Source: Field Survey; September 2012

The table above shows the response of users 75% complained about solar orientation and suggested building fenestration should be located away from the sun. 82% of the user wanted their buildings away from the road; they however suggested it as a solution thermal discomfort, explaining that it will improve the indoor air quality and smoke away from the building, thus signifying usage of building setbacks. 67% declared that planting more trees will enhance cooling effect on the building and be a form of shading. 50.4% complained of their finishes and explained that architects should make better specification when it comes to finishes to encourage the use of material that will repel heat and enhance air movement. 72% wanted their houses out of town; they suggested that houses away from Kano town will offer more comfort and better breathing atmosphere than the congested town. 74.9% suggested checking the climate of sites before buildings are placed on site. 92.3% mentioned that window sizes be increased to allow free movement of good and unwanted air, some went as far as wanting more windows in their building just to address ventilation problems. Shading devices were suggested to be placed on site by 49.5% of the respondents so as to cast unwanted sun rays away from the building and reduce the effect of trapped heat in side building. Figure 4 below shows a chart that summaries the user's perception on thermal comfort achievement.

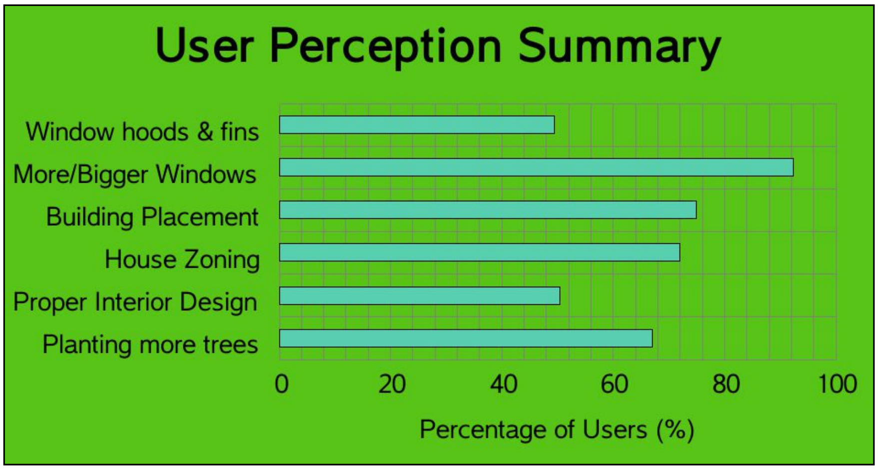

Figure 4: Users Perception Summary Chart *Source: Field Survey; September 2012*

RECOMMENDATION AND CONCLUSION

Good and healthy living is subjected to a good living environment, the health and welfare of building Users should always remain on the upper hand on the mind of architects, therefore adequate consideration and attention should be paid to their wants and need. Designing houses that are not habitable remain a posing problem in our society. The need to alienate that has become very important. This research shows the need to imbibe thermal comfort of the users in all design stages so as to achieve a breakthrough and satisfaction for building users. There are new trends in architecture today in other to achieve good thermal environment, especially for weather of places like Kano states.

Thus; recommendations can be made to;

Embark on a survey of site and end users before carrying out a design

A proper design process and procedure should be employed

Adoption such design concept that by-passes effect of weather and climate on the building as shown in Figure 5 below;

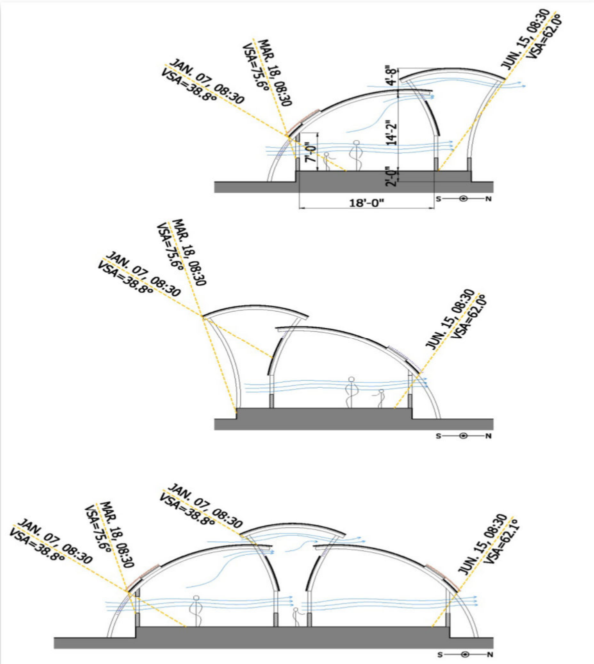

Figure 5: Section through a thermal responsive building design
Source: Adopted from (Kohli, 2010)

The figure above shows a building that is thermally responsive, have solar panels to absorb sun rays and rain protector to shield the building rain, with landscaping its curvilinear envelope will allow easy shading. The construction materials are also very light and allow ease of air flow within the interior space. As stated by Kohli (2010), thermal comfort feel is psychological, physiological and cultural, depending how the users of the buildings perceive it.

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