Understanding comfort in homes designed on principles of *Vaastushastra*

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Abstract: *Vaastushastra* is an ancient vernacular architectural practice that has been utilized by Indians since the Indus civilization. This paper examines comfort levels in homes designed using these principles and are built in Dubai. Some of these principles are similar to passive design theories and the correlation can be understood by examining the former. The correlation of *Vaastushastra* to passive design could be the underlying cause for users' comfort in homes that are designed on these principles. The paper investigates the connection between the principles of *Vaastushastra* and users' comfort in residential spaces. The core aspects of *Vaastushastra* are, *Panch Maha Bhutas* (5 elements) and *Vaastu Purush Mandala* (Cosmic Grid). The *Panch Maha Bhutas* are earth, fire, water, wind and space, which represent the elements of nature. Users' comfort in residential spaces is linked to four of the five senses, with taste being the exception. Homes in Dubai that are built on the principles of *Vaastushastra* were used to show the connection between the two theories. The result of the study shows the impact that each of these principles have on the residents' comfort and how the design of the house could be modified to improve comfort.

Keywords: *Vaastushastra*; comfort; homes; Dubai

1. Introduction

Vaastushastra belongs to a wider belief system of Hinduism and the latter explains how its followers should live their lives, the concepts of which are described in the *Vedas*. The *Vedas* are a body of knowledge that were written in the ancient language of Sanskrit, these describe the various rules that its disciples should follow. *Vaastushastra* is found in different parts of the *Vedas* but the main body of text is in the *Sthapatya Veda* which is a part of *Atharva Veda,* the fourth *Veda* (Bubbar 2005). Some aspects of Hinduism are still practiced till date, these include *Ayurveda* and *Homeopathy* which are alternative forms of medicine, *Yoga* and meditation which are alternative wellness techniques. *Vaastushastra* is based on the same core aspects as all these traditional practices. The *Panch Maha Bhutas* are a core aspect of Hinduism which are the five elements (*panch* meaning five) of nature and are the foundation of all creations (Sharma 2012). All practices of Hinduism refer to these five elements and it is imperative

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to balance these elements in any traditional practice. Each one of these five elements are related one of the five human senses; earth is connected to smell, fire is connected to sight, water is connected to taste, wind is connected to touch and space is connected to sound (Pegrum 2000).*Vaastushastra* emphasizes that five elements should be balanced in every built environment. According to Hinduism, the human body is made of these five elements and therefore the subconscious mind (or soul) connects to the balance or imbalance of these elements in the built space. If the five elements are balanced in the space then its occupants are likely to feel comfortable, positive and therefore flourish in such spaces. Since home is the most personal space to each individual and/or family, the paper will test the connections between homes that are built of the principles of *Vaastushastra* and the level of comfort experienced by the residents.

Indians have migrated to many parts of the world and taken their culture and beliefs with them. One such part of the world is the Middle East and United Arab Emirates (UAE) is the country where many Indians have migrated. UAE is a country in which majority of the population is expatriate and the Indian community is the largest group recorded at 38.2% (World Population Review 2019). Since there is such a large group of Indians in the UAE, many traditions that are followed by Hindus in India are seen in UAE, these include *yoga* centres, meditation centres, homeopathy clinics and ayurvedic centres. Many Indians who live in Dubai follow their traditional practices that were conducted by their familes in India and following *Vaastushastra* is one such tradition. Many Indians in Dubai will check whether the house they are planning to live in is compliant with the rules of *Vaastushastra* or not. If the house is not compliant, many of these people will not live in such a house. Since there is a large population of Indians in Dubai, it was possible to find homes that were built on the principles of *Vaastushatra*.

2. Principles of *Vaastushastra*

Vaastushastra constitutes of two parts- *Vaastu* which translates to dwelling or home which comes from the word *vas* which refers to dwell or to live and *shastra* which means the science of. The words come together to mean the science of dwelling spaces (Chakrabarti 1998). The principles of *Vaastushastra* weren't limited in their application; artists, artisans and architects study them in order to understand the basics principles of design. Since *Vaastushastra* is a part of the *Vedas* its concepts can be found in various manuscripts and each of these manuscripts come from different regions. All the manuscripts mention rules that are specific to the region that the manuscript belongs to, for example, *Manasara* and *Mayamatam* are followed in South India (Dagens 2000) and *Vishwakarma Prakash* is followed in North India. Original manuscripts of *Vaastushastra* lay out the principles that should be followed, these rules might appear to be conflicting when different manuscripts are compared. But these should not be seen as conflicting, but rather as adaptations that accommodate the climatic changes of the region. Each region of India has different manuscripts that they can refer to and the principles will reflect the specific climate of the region (Bubbar 2005).

The fundamental aspects of *Vaastushastra* that are followed through all the regions are, *Panch Maha Bhutas* and the *Vaastu Purusha Mandala*. The *Panch Maha Bhutas* are the five elements that the universe is made of, which are earth, fire, water, wind and space. These elements are placed on the *Vaastu Purusha Mandala* which is a cosmic grid. The basic grid of *Vaastu Purusha Mandala* is the 3x3 grid and each element has a specific location on the grid. The location of the element on the grid is based on the region in which it is applied (Bubbar 2005). Which means that for different parts of the world, different grids can be applied. Figure 1 below is a basic 3x3 grid which has the elements placed in the appropriate directions. The *Panch Maha Bhutas* link to the five senses where earth is connected to

smell, fire is connected to sight, water is connected to taste, wind is connected to touch and space is connected to sound (Pegrum 2000).

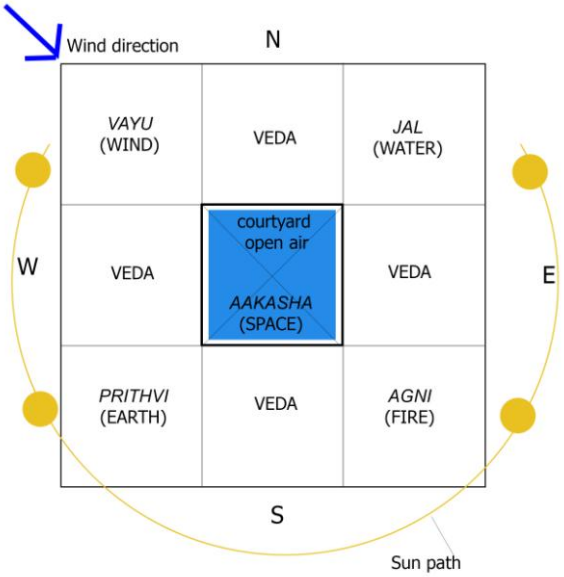


Figure 1 3x3 Mandala grid with 5 elements and nature (Source: Author)

Vaastushastra lays the principles of architecture which includes urban planning of towns and villages, also planning of buildings such as temples, palaces and homes, including locations of doors and design of furniture. Many ancient buildings in India are built on the principles of *Vaastushastra*, these range from temples to palaces, to homes of the upper class known as *havelis* and the homes of the common man. The ancient city Jaipur was planned on the principles of *Vaastushastra*, some modifications were made to the basic principles since the complete 3x3 grid wouldn't fit in the allocated space. Contemporary buildings that are associated to the principles of *Vaastushastra* are Jawahar Kala Kendra in Jaipur designed by Charles Correa and the IIT in Bombay (Chakrabarti 1998). When these elements are balanced in the built environment then the occupants of the space should feel comfortable in it. It is easier to evaluate users' comfort in residential spaces rather than in commercial spaces, therefore the selected case studies will be homes that conform to the principles of *Vaastushastra*.

Each element represents the characteristics of the corner in which it is placed. The northeast corner is representative of water. One possible reason for this association could be that the morning sun (which has the least amount of UV rays) shines on the water element placed in this corner. The water element should be placed outside the house, therefore being exposed to early morning sun rays. The combination of water and early morning sun rays makes this location ideal for meditation or any other morning activities such as yoga. Similarly, the southeast of the house is exposed to maximum heat gain and therefore is associated with the fire element. This paper will examine whether the southeast corner is warmer than the southwest corner, since the southwest corner should also be warm. The southwest corner is associated with the earth element and this link is hard to explain. The principles suggest that

the least windows are placed on this side and the walls are thicker, which makes the southwest side heavy which could be the possible association with earth. The northwest is linked to the wind because the wind direction is predominantly in the northwest direction in India. The house should be designed so that it always allows for air circulation by placing the windows, opening and corridors accordingly.

3. Comfort in Residential spaces

Comfort can be measured by thermal comfort, which relies purely on the temperature of any space to be maintained at a constant number or by adaptive thermal comfort which relies on how comfortable users' feel in a space and isn't reliant only on absolute temperatures. Adaptive comfort also relies on the fact that "comfort is a goal and not a product" (Nicol et. al.2012). The space should allow for the user to make required changes, so that they can feel comfortable. We rely on four of the five senses to feel comfortable in a space, these are touch, sight, smell and sound. In a residential space, sight, smell and sound are reasonably constant, or can be controlled by the occupant with the exceptions of street sound or ambient neighborhood sound and bad odors in the neighborhood. The sense of touch fluctuates the most in the house both on daily and seasonal basis. If the internal temperature is outside the comfort range, then air-conditioning or heating can be used to control the temperature. The use of air-conditioning or heating creates noise and stale air which can cause discomfort for the users. *Vaastushastra* stipulates that specific functions of the house should be located in specific corners of house, the explanation behind this is that the function matches the element that is located in that corner (Table 1). The approach to spread the functions in the house this way could be understood as an adaptive approach to designing the space.

Table 1 Link between direction, element and functional use of space

Direction	Element	Function	Suggested time of use	Comfort
Northeast	Water	Meditation	Early Morning	Adequate natural light and comfortable temperature
Southeast	Fire	Kitchen	Mid-Morning	Warmest space in the house therefore used for kitchen
Southwest	Earth	Master bedroom	Night	Cooler space since minimum windows are located here
Northwest	Wind	Bathroom	Various times	Wind direction allows for natural ventilation
Centre	Space	Courtyard/ empty		Allows for natural light and ventilation in the space.

There are three approaches to adaptive changes, and these are "behavioral, physiological and psychological". These three approaches link to three mechanisms for adaption, behavioral links to adjustment, physiological links to acclimatization and psychological links to habituation (Schweiker, et al. 2012). From these three, behavioral adaptation can be linked to *Vaastushastra.* This is because the principles of *Vaastushastra* suggest that the functions of the house are laid out to match the occupants'

routine which could be mapped against the comfort levels in various spaces of the house. The functions of the spaces are planned into the house so that they are placed in the appropriate direction as per *Vastu Purush Mandala* (Figure 1).

The paper uses quantitate and qualitative data to understand the comfort of the residents. Quantitative data was collected to measure temperature and humidity in four corners of the case study homes. Four corners of the house where studied because *Vaastushastra* suggests that the comfort of these four corners varies. Since the case studies were based in residential spaces, it was assumed that the levels of light, sound and smell wouldn't change drastically on a daily basis. For the qualitative data the residents were asked to answer a questionnaire in which they were asked about their comfort in terms of quality of light, sound, smell and ambient temperature experienced in the house.

4. Understanding *Vaastushastra* through users' comfort

This paper will address key principles of *Vaastushastra* that are primarily linked to residential design. Each of these principles will be understood in terms of its links to users' comfort and adaptable comfort. An investigation was carried out in a traditional home in Kerala found that the internal temperatures of the house are maintained at comfortable levels.

> "investigation has revealed that when the outside ambient temperature is below normal, the building system tries to maintain the indoor air temperature at a higher but comfortable level and when the outside temperature is above normal, the indoor temperature is maintained at a lower but comfortable level." (Dili 2009)

1. **Orientation of the house**. According to the principles the house should be aligned either along the north to south axis, or along the east to west axis. When the house is aligned to the cardinal directions, it impacts the placement of windows and openings which in turn has an impact on the user's ability to adapt the space to suit their comfort.
2. **Placement and size of windows.** *Vaastushastra* mentions the ideal locations for windows; for arid climates the maximum number of windows should be placed on the north and east side, with no windows placed on the south and minimum windows placed on the west. Similar to the concepts of passive design, the north side of the house is recommended to have maximum windows because this doesn't cause excessive heat gain and therefore a comfortable internal temperature can be maintained. Because of the geographic location of Dubai, the angle of the sun can cause heat gain and therefore it is advised that there are minimum or no windows in the south.
3. **Proportions of the house**. The proportions of the house are stipulated in *Vaastushastra* and the proportion system is known as *Shad Varga* formula. The recommended geometry of the house is square or rectangular with specific proportions. The length and width of the house are linked, so that the placement of the windows and openings allow for natural light and air circulation which can allow the space to be adaptive to the users' needs.
4. **Proportions of the rooms in the house**. Similar to the overall geometry, the rooms of the house should follow the principles of *Shad Varga* formula. Similar to the principles of passive design, the geometry of the rooms allows for air circulation which helps to maintain users comfort. The rooms in the house should be either square or rectangular with recommended proportions which allows for adequate air circulation to support users comfort.

5. **Placement of windows on south and west side with the use of solar shading**. Any windows on the south side of the house should have appropriate shading devices. Based on the geometry of the house and its orientation, windows can be placed on the south and west if required. Based on the geographic location of the house, the overhang for the south and the west can prevent excessive heat gain if it is calculated correctly.

5. Methodology

Two methodologies were used to understand the link between *Vaastushastra* and users' comfort. The first methodology was to find five case study homes in Dubai that were built on the principles of *Vaastushastra* as discussed above. The second methodology was to understand users' comfort in these houses. Firstly, by using quantitative data of temperature & humidity and secondly qualitative data by using questionnaires. The quantitative data was collected twice in the year, once in the summer and once in the winter. The data was collected twice in the year because Dubai has two seasons in the year, summer and winter. The first method is to understand the sense of touch in these homes. This sense is associated with temperature, humidity and the how the furniture and finishes of the space feel to the user. Since the furniture and finishing of the space remained the same for the duration of the study, the investigation was on the temperature and humidity recorded in the space. Loggers were placed in four corners of the house, to note the difference in temperature and humidity in the four sides. The four sub-cardinal corners were selected for the study, this would establish the connection with the four elements.

The second methodology was to understand how the users' felt in the space, by asking questions that related to all four senses. Sometimes the way the users' feel in a space is different from the actual temperatures that are recorded. Even though the optimum internal temperatures are defined by CIBSE Arid 2014 the users might feel comfortable at different temperatures or might need other factors to feel comfortable. Since these are residential spaces, the light, sound and smell weren't recorded through empirical measurements, but the users were asked how the they felt about these factors in the house.

6. Case study homes in Dubai

6.1 Climate in Dubai

The climate in Dubai is hot and humid, which is similar to the climate of Rajasthan. The latitude of both cities is similar, which makes the sun angle similar in both places which is the reason for using the principles applied in Rajasthan to homes in Dubai. The average highest temperature recorded in Dubai in the summer is 41°C and the lowest is 30°C and in the winter the average highest temperature is 23°C with the lowest at 14°C. Five homes were selected as case studies, the size of these homes ranges from 250m^2 to 500m^2. The houses that were selected adhered to some of the principles of *Vaastushastra*. Homes that adhered to different principles of *Vaastushastra* were selected so that the impact of each of the principles could be understood. Table 2 shows all the principles and lists which houses followed which of these principles.

6.2. Discussion of 5 case studies

Orientation of the houses is a key feature in *Vaastushastra*; therefore, all the houses were aligned either to the north-south axis or to the east west axis. Geographic location of the house should determine

whether the axis should be aligned to north- south or east- west. Similar to the strategy of passive design for hot climates, *Vaastushastra* mentions that homes in hot climates should have the length of the house oriented with the east west axis (extension 2014). Overall, the recommended proportion of house should be square or rectangular.

Case study 1 follows all the principles of Vaastushastra except two, both are about the proportions of the house. In this house, the overall plan is not a rectangle, there is a cut in the plan. One of the rooms is not a rectangle or square in shape, it has a cut which makes the plan a polygon in shape. The variation in the room shape could cause a change in the temperature recorded in the room. In case study 2 all the rules are followed except that there is one small window on the south elevation which doesn't have a shading device. The windows on the west have shading devices. This study helps to understand the impact of a south side window. Case study 3 follows most of the rules, except that there are windows on all sides of the house and that the south and west windows don't have any shading devices. This house will show the impact of large openings all around the house that don't have recommended shading. Case study 4 and 5 are oriented so that the length of the house is aligned to the east and west. In case study 4 there are windows placed on the south and west side and the windows on the south don't have shading. Whereas in case study 5 the only variation is that there are windows on the west of the house, but these have a large overhang covering the openings. Table 2 shows the criteria that were included in each house.

Table 2 Criteria of selecting the houses

	Case Study 1	*Case Study 2*	*Case Study 3*	*Case Study 4*	*Case Study 5*
Orientation of the house	✓	✓	✓	✓	✓
Proportion of the house	x	✓	✓	✓	✓
Ideal location of windows in the house	✓	✓	×	✓	×
Proportion of the rooms in the house	x	✓	✓	✓	✓
Placement of windows on South and West side with the use of solar shading	✓	x	×	×	✓

7. Case study findings

7.1 Climate in Dubai

Temperature loggers were placed in four corners of the house which are northeast, southeast, southwest and northwest. The four corners of the house were selected to place the data loggers, firstly because *Vaastushastra* mentions that the elements are associated with four of these corners. Secondly, the corner of the house is likely to be the corner of a room, whereas if pure cardinal directions where

taken these could sit in between two rooms. The loggers where placed for a duration of 14 days during the summer and winter months. Table 3 shows the average temperature variations during the summer months and table 4 shows the average temperature variations in the winter months. The trend seen in all the temperatures below are that the northeast is the coolest side and the southeast is the warmest.

Table 3 Case studies recording during the summer

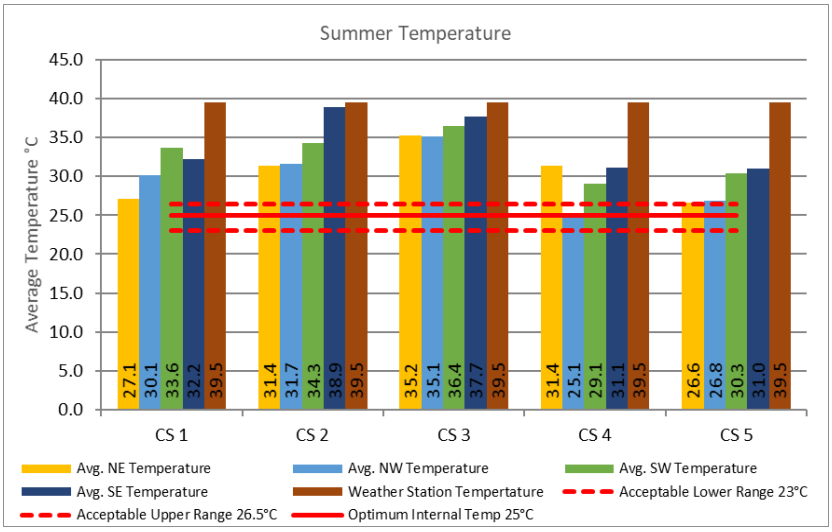
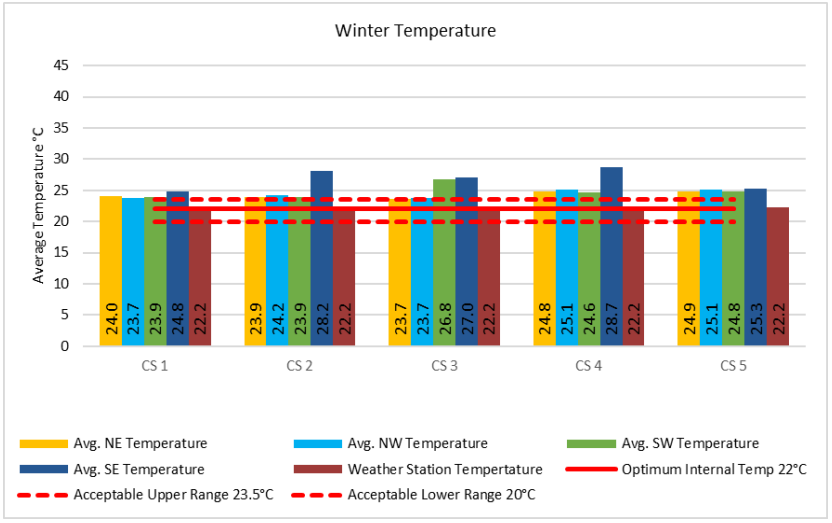


Table 4 Winter recording of the case study homes



7.2 Findings from users' questionnaires

The key factors that are used to understand the satisfaction of residents includes many other aspects such as safety, infrastructure and others (Amerigo and Aragones 1997). The questionnairre was

designed based on the criteria that were lited by Brunsgaarda, et al. (2012). In the questionnaires the users were asked which space they used the most in the house. This helped to understand which rooms the residents were using the most. If they were using the cooler spaces in the house, they would find the house comfortable; but if they were using the warmer spaces in the house, they would feel uncomfortable.

The data collected from the users' questionnaires supports the temperature findings in each house. In both Case study 1 and 2, the occupants are usually comfortable in the house because they use the northwest or northeast space which is the most which is the coolest. There are minimal issues with sound because air-conditioning is largely used during the summer months. Both homes are located in quiet residential spaces, so there isn't too much street sound. Since the houses have openable windows there are minimal problems about smell. The only concern that the occupants had was about natural daylight because they used artificial light during the day.

In case study 3, the users needed air-conditioning in the house throughout the year. They used the southeast and southwest spaces of the house which are the warmest spaces in the house. But in this house the overall temperature is much higher than in the other houses, so the occupants are bound to feel warmer. With the use of air-conditioning the noise level in the house is high which isn't comfortable. The house has openable windows which helps to ventilate the space and therefore the smell in the house is not an issue. Occupants of the house don't use any artificial light during the day.

Case study 4 the house has no windows in the northwest, so even though it is the coolest side it isn't used during the day. In both case study 4 and 5, the occupants use the southeast and southwest rooms, which are the warmest in the house. Since they spend time in the warm spaces, they rely on air-conditioning which makes the house noisy. The windows allow for natural ventilation which eliminates stale air in the house. The occupants don't rely on artificial light too much during the summer.

8. Conclusion

The findings of the research support that homes designed on the principles of *Vaastushastra* are comfortable for the users. There are two aspects to comfort, one only refers to measurable temperature comfort (thermal comfort) and the other refers to the feeling of comfort (adaptive comfort). Case studies 4 and 5 are examples of the former, in which we see that these homes achieve comfortable temperatures, but the occupants are complaining about high temperatures in the house, which requires use of air-conditioning and prevents an overall comfort for the residents. Even though the architecture is designed based on the principles of *Vaastushastra*, the internal spaces aren't designed accordingly. In these homes, the internal spaces can be redesigned so that the house can be comfortable for the users.

Case studies 1 and 2 are examples where the users are comfortable in the house, even though the recorded temperatures of the house are high. These are examples of adaptive comfort because the occupants use the cooler part of the house. In case study 1, the geometry of the house doesn't follow the proportions of *Vaastushastra*, which causes the anomaly of higher temperature in the southwest. This example shows the impact that irregular geometry has on the temperature of the house. Residents of the house are comfortable in this house because they use the cooler spaces of northeast and northwest. If the overall geometry of the house is changed, it will create an even more comfortable space. In case study 2, the house aligns with the cardinal directions, but the length is aligned to the north south axis, which isn't suitable for hot climates. The occupants are comfortable in the house

because they use the cooler spaces of northeast and northwest. If the orientation of the house is changed, the users will feel even more comfortable in the house.

In case study 3, the recorded temperatures of the house are high, and the users of the house feel uncomfortable. Due to high temperatures in the house, the air-conditioning is utilised all the time and similar to case study 4 and 5 the residents feel uncomfortable due to high levels of internal sound. The house is oriented along the north south axis but should have been oriented around the east west axis. There are windows on all sides of the house and the windows on the south and west don't have overhangs, which allows for internal heat gain.

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