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ENGINEERING PERCEPTION TOWARDS VAASTHU SHASTRA, SPECIAL ATTENTION ON ALIGNMENT OF OPENINGS IN A DWELLING

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Abstract: Although the contemporary era is full of the marvels of modern practices of building constructions, the shadows of customs and beliefs of building construction are still followed in various levels. These types of beliefs play a prominent role in residential and mini-commercial building construction and commonly visible in countries like Sri Lanka, India and China. In this study, one of the selected traditional belief in building construction, "Not having three or more aligned openings along the same row" was considered and the engineering perception of the belief was investigated by means of fluid dynamics simulations carried out with Autodesk Flow Design, Computational Fluid Dynamics (CFD) software. The results of the simulation conveyed that, the wind entered the house in one end, moved through aligned openings as a rapid flow making the air distribution to other parts of house less than 15% of total flow, but when the openings were not aligned (staggered openings) there was adequate air circulation to other spaces of the house. Finally, it was proven that the traditional belief, "Not having three or more aligned openings along the same row" is technically rational and there is an engineering significance of it. Hence, the considered belief is worth to be used in real-world applications.

Keywords: Residential Buildings; Three or More Aligned Openings; Customs and Beliefs; Computational Fluid Dynamics; Vaasthu Shastra; Feng-Shui

1. Introduction

Not only human beings but also all living beings from the tiniest insect which hardly can be seen with the naked eye to the gargantuan creatures use safer places to live, being protected from adverse climate changes and enemy attacks. With the passage of time, the power of thinking of human beings gradually increased and that power of thinking made them superior to every other being and the master of all other beings (Morris, 1996, 1999; Nehru, 1930). Eventually, people got nourished with knowledge and attitudes gained from nature and developed their sheltered places of living to well-prepared places much suitable for living. Eventually, these places were called houses which were the places always suitable for humans to live comfortably and places that ensured an excellent balance between people and nature which brought peace, happiness, health, wealth and prosperity to the inmates of the house (Patra, 2006).

The house which is the dwelling of human beings is the most important place of any family. It is not the place where people spend many hours of the day, for instances doctors spend more than half the day at hospitals, engineers spend weeks, months and years at their working sites and professors spend much time in the universities, but any of these places are not houses of any of previously mentioned professionals (Amarasooriya, n.d.; Patra, 2006). House is the place where people spend the most precious times of their lives with beloved family members. Because of that, people take much care when they build houses which are as sacred as shrines to the inmates of the house (Acharya, 1946; Silverman, 2007). People who make great efforts to make their dream home a better place much suitable for the ways and means of the family members have been using various types of knowledge resources such as Civil Engineering and Architectural knowledge and traditional customs and beliefs in building construction (Mak & Thomas Ng, 2005; Ranjeet.P, Narshima Rao.D.V.S., & Md. Akram Ullah Khan, 2016; Wattage Jeewa Bhanumathie, 1995). As a result of the development of science and technology, people commonly use Civil Engineering and Architectural concepts for construction activities. These concepts refer to the designation of space and creating and constructing the space needed for creating the day to day lives of people easy and the science of construction and designing the built environment (Koranteng, Afram, & Ayeke, 2015; Ulusoy & Kuyrukcu, 2012). Although the science and technology gloom in a high standard in contemporary time, the shadows of traditional customs and beliefs can be seen in most of the fields like building constructions, town and country planning, medicine etc. Likewise, people have not totally abandoned the customs and beliefs in building construction which consist of different branches like ancient Architecture, Astronomy, Vaasthu Shastra and Feng-Shui (Guptha, 2015; Mak & Thomas Ng, 2005; Ranjeet.P et al., 2016; Wattage Jeewa Bhanumathie, 1995). These beliefs in building construction which initiated from experiences obtained through daily activities of ancestors, highly affected the lives of the people and spread through the society. They were lasting for years, remain with slight changes proving that they have mixed with society (Fernando W.L.R., 1998; Gamage M.M., 2015). Almost all the customs and beliefs in building construction have been influenced by and based on Vaasthu Shastra, Feng-Shui and religious considerations of the society (Koranteng et al., 2015; Ranjeet.P et al., 2016). vaasthu shastra which belongs the period 1500-1000 BC is an ancient Indian knowledge as well as a science of Architecture, planning and designing (Patra, 2006). The word Vaasthu originally derived from the keyword "vas", the meaning of dwell or dwelling place. Likewise, the term Vaasthu conveys a place of human dwelling more than a single household life (Amarasooriya, 2001; Arya, 2000; Patra, 2009). Feng-Shui is an ancient Chinese wisdom literally means "wind and water", influences the layout and the design of cities and buildings (Huang, 2012; Koranteng et al., 2015). The concept of Feng-Shui born in China spread in western countries and it can be seen all around the world now (Mak & Thomas Ng, 2005). Though some beliefs lasted for years, some have been labelled as superstitions and have been rejected by the society (Weerasinghe K.A.B., Janaka K.G., & Galappaththi M.P., 2011). The superstitious influence in these beliefs can be part of cosmology and myths such as para-religious and religious practices of beliefs embraced by people and they are scared of those things thinking that not obeying and not practising them will bring terrible results ending in death (Chakrabarti, 1998; Glazer, 1978; Ofori, Tod, & Lavallee, 2016; Rudski, 2003). A number of customs and beliefs can be found in the building construction field and they are mainly used in small-scale building construction like houses rather than in large-scale construction like multi-storey buildings. (Koralage Dayarathna, 2010; Ranawaka Leelananda A.R., 2015; Weerasinghe K.A.B. et al., 2011). The most important thing is not "what other people believed" but "what are the meanings and backgrounds of the beliefs and how they can be used in the real world". Some people get both money and time wasted by being slaves of those beliefs, being slaves of any belief get scared by their occult nature should not be done. The most ideal thing is understanding the rationality of those beliefs and using them in practical situations.

Although a number of Architectural and Sociological studies have been carried out regarding the customs and beliefs in building construction (Glazer, 1978), hardly any Engineering studies have been done. This study investigates the impacts of three or more aligned openings along the same row, in terms of Engineering technology based on CFD simulations.

2. Objectives

The primary goal of this study is to explore the engineering significance of not having three or more openings along the same row. The specific objectives of this study are as listed below;

I. To find the reasons for not having three or more aligned openings in dwellings

II. To obtain the popularity and the reasons for admitting the selected belief among the main stakeholders of building construction

III. To access the impacts on indoor air circulation due to the alignments of three or more openings along a row

3. Methodology

I. A literature review was carried out to figure out the reasons for not having three or more aligned openings in dwellings

II. A questionnaire survey was carried out to investigate the contemporary status of the belief among stakeholders of building construction

III. CFD simulation by Autodesk Flow Design software was used to analyse the impact on indoor air circulation due to the alignment of openings, as shown in figure 1

4. Results

4.1. Results of the Literature Review

According to the literature available, the most important reasons for not having three or more aligned openings in houses were sorted out. They are as listed below;

- Disturbs the indoor air circulation of the house
- Reduces the strength of the main wall
- Violates the privacy of the inmates of the house
- Brings economic loss to the family
- Brings adverse repercussions to the family members

Among the above reasons, the first two have a direct Engineering influence while third depends on general understanding and day to day life experiences. The last two have been influenced by traditional customs beliefs. The very first reason was selected for further analysis by means of a questionnaire survey.

4.2. Results of the Questionnaire Survey

Results were extracted from the collected results of the questionnaire, based on the sample of 210 individuals containing 75 Civil Engineers, 45 Architects, 30 Astrologers (Vaasthu experts), 30 Carpenters and 30 Masons. View of non-aligned and aligned openings are as shown in figure 1

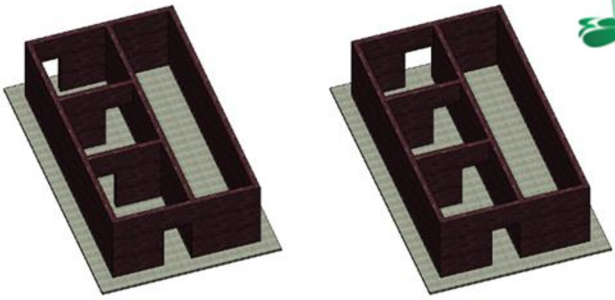

Figure 1: View of non-aligned openings and aligned openings

Results depended on the answers which were given by selected five categories of stakeholders. Some have selected more than one reason for not having three or more aligned openings. Each and every response was counted. The final results of the questionnaire survey are as illustrated in figure 2.

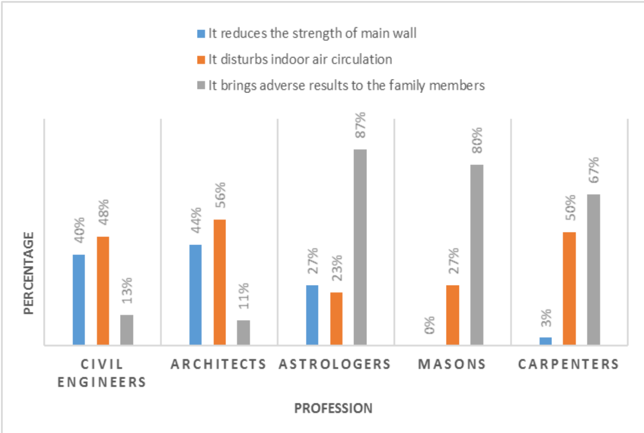

Figure 2: Reasons for accepting not having three or more aligned openings

With respect to total respondents 81% have opted not having three or more aligned openings in dwellings. Civil engineers and architects who have a proper theoretical knowledge and practical experiences of building construction, astrologers who are rich with Vaasthu and Feng-Shui concepts and masons and carpenters who do not have a proper educational status but have the practice of building structures, see the reasons for not having three or more aligned openings from different angles based on their own insight. Civil Engineers and Architects have looked at the scenario with respect to the engineering aspects, but Astrologers, Masons and Carpenters have used traditional beliefs which have been nourished with Vaasthu and Feng-Shui concepts.

The responses of the stakeholders of building construction clearly show that only the majority civil engineers and architects correspond with the beliefs of building construction compatible with rational Engineering explanations. The main reason for not having three or more openings, the violation of indoor air circulation, opted by majority of Civil Engineers and Architects was selected for further analysis by means of Engineering Technology.

4.3. Results of the CFD Simulation

The ventilation effects inside the house due to the aligned and non-aligned openings were analyzed with fluid dynamics simulation. For that, 3D models were analyzed using Autodesk Flow Design software, based on the Navier-Stokes equation (equations have been mentioned in Appendix I). The analysis was done with respect to four wind speeds of 1m/s, 4m/s, 6m/s and 14m/s. the selected wind speeds were in between the minimum and maximum wind speeds which affect Sri Lanka ('Colombo, Sri Lanka 14-day weather forecast', 'Wind Colombo - Wind speed Sri Lanka - Weather Online', 'World Weather - Local Weather Forecast'). Four different arrangements of models were analyzed with respect to four different wind speeds. The arrangements of the models were models with 3m, 4m and the 7m gap between every two openings and a model with four openings with a 4m gap between each two openings with different opening arrangements.

The speeds of the flow lines are illustrated with separate colours in flow design software. For the study, 1m/s, 4m/s, 6m/s and 14m/s wind speeds conditions were considered, for an instance, only two extreme figures of 1m/s and 14m/s wind speeds have been inserted. Views of indoor air circulation when the gap among the openings are 3m with respect to the wind speeds of 1m/s and 14m/s are shown in figure 3 and figure 4.

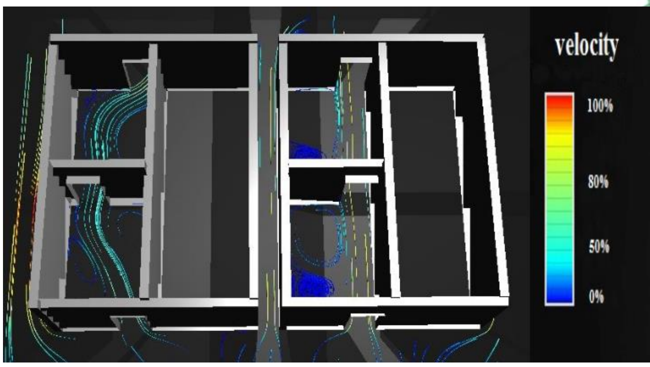

Figure 3. Indoor air circulation due to 1m/s wind speed

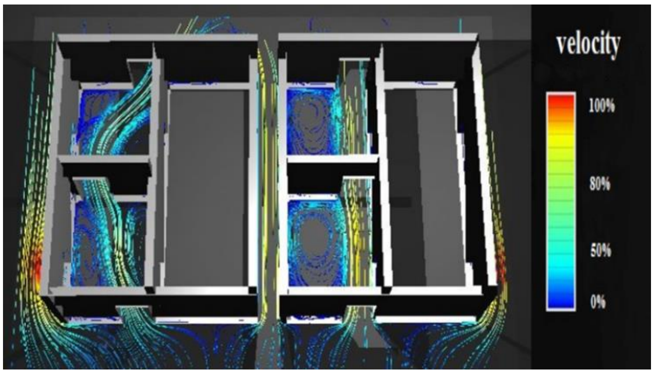

Figure 4: Indoor air circulation due to 14m/s wind speed

- When the openings are aligned in a row, flow lines rush through the openings with a high speed and flow lines with considerable wind speed hardly circulate through other spaces of the house. Therefore, those places become less ventilated
- When the openings are not aligned, flow lines get obstructed with the walls in between and circulate with turbidity. It allows the circulation of flow lines with more than about 50% of original wind speed to other spaces of the house. In this case, flow lines circulate through other spaces of the house as well as through the openings and keep the whole house properly ventilated
- When wind speeds approach high values, some amount of flow lines circulate through other spaces even when the openings are aligned, but it is not a situation which can be compared with air circulation when the openings are not aligned

- When there are more than four openings, the results get clearly verified. Flow lines with considerable speed can be seen in every part of the models when the openings are not aligned. But when the openings are aligned, even the few flow lines which can be seen in the spaces of the house contain zero speeds. Flow lines of 4m/s affecting a model with four openings are shown in figure 5

Figure 5. Indoor air circulation due to 14m/s wind speed

5. Conclusion

The study was done to explore the Engineering significance of not having three or more aligned openings in a dwelling with respect to the indoor air circulation. Questionnaire results obtained with respect to set of 210 stakeholders of house construction confirmed that 81% are obeying not having three or more aligned openings. In there two rational reasons for the selection was emerged; they were disturbing the indoor air circulation and reducing the strength of the main wall.

When there are three or more aligned openings along a row, the wind enters the house from one end of the house, blows through the openings with high speed as a rapid flow without any interruption. Because of that, the distribution of air flow to other spaces of the house become improper and whole house becomes insufficient in terms of ventilation. Numerically, the air distribution to other spaces become less than 15%. But when the openings are staggered, the wind entering the house from one end blows with many interruptions and it provides proper air circulation to every space inside the house. The technically rational conclusion of the Computational Fluid Dynamics (CFD) analysis is that having three or more aligned openings along the same row disturbs the proper air circulation inside the house and creates ventilation issues by not exposing the spaces inside the house to the fresh air flows.

Therefore, it is better to avoid having three or more aligned openings when placing openings inside a house. Further research must be done in order to investigate any structural effects, temperature variation within the buildings during daytime and night etc. to conclude whether this belief has a high impact in building construction. With respect to the simulations done in this study, the engineering significance of not having three or more aligned openings along the same row with respect to the indoor air circulation was clearly proved. This traditional belief contains an engineering significance and is worth to comply with and is ideal to be used in building construction.

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Appendix I

- Navier-Stokes equation

$$\frac{\partial u}{\partial t} = -(u \cdot \nabla)u + \nabla \cdot (\upsilon \nabla u) - \frac{1}{\rho}\nabla \rho + f$$

Where, υ = kinematic viscosity (constant), ρ = density (constant), f = external force (such as gravity)

X-component

$$\rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + \upsilon\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}\right) = -\frac{\partial p}{\partial x} + \mu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right) + \rho g_x$$

Y-component

$$\rho\left(\frac{\partial \upsilon}{\partial t} + u\frac{\partial \upsilon}{\partial x} + \upsilon\frac{\partial \upsilon}{\partial y} + w\frac{\partial \upsilon}{\partial z}\right) = -\frac{\partial p}{\partial y} + \mu\left(\frac{\partial^2 \upsilon}{\partial x^2} + \frac{\partial^2 \upsilon}{\partial y^2} + \frac{\partial^2 \upsilon}{\partial z^2}\right) + \rho g_y$$

Z-component

$$\rho\left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + \upsilon\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}\right) = -\frac{\partial p}{\partial y} + \mu\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right) + \rho g_z$$

Radial component

$$r: \rho\left(\frac{\partial u_r}{\partial t} + u_r\frac{\partial u_r}{\partial r} + \frac{u_\phi}{r}\frac{\partial u_r}{\partial \phi} + u_z\frac{\partial u_r}{\partial z} - \frac{u_\phi^2}{r}\right) = -\frac{\partial p}{\partial r} + \mu\left[\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial u_r}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2 u_r}{\partial \phi^2} + \frac{\partial^2 u_r}{\partial z^2} - \frac{u_r}{r^2} - \frac{2}{r^2}\frac{\partial u_\phi}{\partial \phi}\right] + \rho g_r$$

Tangential component

$$\phi: \rho\left(\frac{\partial u_\phi}{\partial t} + u_r\frac{\partial u_\phi}{\partial r} + \frac{u_\phi}{r}\frac{\partial u_\phi}{\partial \phi} + u_z\frac{\partial u_\phi}{\partial z} - \frac{u_r u_\phi}{r}\right) = -\frac{1}{r}\frac{\partial p}{\partial \phi} + \mu\left[\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial u_\phi}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2 u_\phi}{\partial \phi^2} + \frac{\partial^2 u_\phi}{\partial \phi^2} + \frac{2}{r^2}\frac{\partial u_r}{\partial \phi} - \frac{u_\phi}{r^2}\right] + \rho g_\phi$$

Axial component

$$z: \rho\left(\frac{\partial u_z}{\partial t} + u_r\frac{\partial u_z}{\partial r} + \frac{u_\phi}{r}\frac{\partial z}{\partial \phi} + u_z\frac{\partial u_z}{\partial z}\right) = -\frac{\partial p}{\partial z} + \mu\left[\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial u_z}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2 u_z}{\partial \phi^2} + \frac{\partial^2 u_z}{\partial z^2}\right] + \rho g_z$$