
The Awareness on Daylighting and Thermal Comfort among Designers' in Malaysia

Introduction

"We shape our buildings; thereafter they shape us", said Winston Churchill (Schoenberg, 2017), who was once a British prime minister. Nowadays, architecture is strongly defined as an object of design, being judged on how it looks like. However, architecture is much more than that, it shapes humans' lifestyle and most importantly, humans' health. According to World Health Organization (WHO), there are 30% of new as well as remodeled buildings worldwide that received numerous of complaints due to bad indoor air quality in 1984 (Buck, 2017), which relates to the symptoms of Sick Building Syndrome (SBS). The definition of SBS itself is when building occupants are experiencing health issues and uncomfortable feeling after spending some time in a particular building (Evans, 2018). Experts believed that the complaints are made due to the oil embargo in 1973, which had lowered the standard of outdoor air ventilation to 5 cubic feet per minute (cfm) per person from 15 cfm per person (Buck, 2017). This automatically worsens the indoor air quality as the air inside the space become more stagnant.

Thus, laws and regulations were created worldwide, including Malaysia, in order to avoid issues like sick building syndrome. It is made for designers, architects as well as interior designers to follow in order to achieve a proper standard of a building. Under Part 39(1) of Uniform Building by Laws 1984, the Malaysian law is written as the following:

(1) Every room designed, adapted or used for residential, business or other purposes except hospitals and schools shall be provided with natural lighting and natural ventilation by means of one or more windows having a total area of not less than 10% of the clear floor area of such room and shall have openings capable of allowing free uninterrupted passage of air of not less than 5% of such floor area (International Law Book Services, 2015).

Daylighting

Daylighting has a lot of benefits for human. According to Moxon (2012), natural daylighting promotes health and wellbeing of building occupants, by providing vitamin D, as it is said that human's primary source of vitamin D comes from the sun via ultraviolet (Sahota, 2014). In the year 2000, 90% of children who are living in New York and Boston are suffering from rickets, which is a bone deforming disease that is related with the softening and weakening bone, caused by the lack of vitamin D in the body. This disease can cause delayed growth, muscle weakness, as well as pain in the spine, pelvis and legs. Hence, the lacking of vitamin D intake results in negative impact towards humans health (Mayo Clinic, 2016).

Despite the diseases caused by deficiency of vitamin D, high exposure of sunlight could also be dangerous for human. In United States, skin cancer is the most common type of cancer, as it affects around one out of five person at the age of 70. It is believed that the cause of it is due to the excessive exposure to the sunlight, which leads to the skin being overly exposed towards UV (Ultraviolet) radiation. UV radiation can cause damage to the skin that results in defects, which will multiply and form malignant tumors (Kaufman, 2018). Therefore, to find balance in

sunlight exposure is crucial in order to avoid both the lacking and excessive exposure of sunlight that can lead to various diseases.

Based on a research done in 2002, it has also been proven that office workers have higher productivity when they are working in a windowed office compared to those who are working in an interior or closed office space. Referring to the chart above, the employees in a windowed office spent more time on the computer as well as paperwork compared to the workers who are working in a closed office. On the other hand, the workers who work in a closed office have less working occupancy and spent more time talking (Figueiro, 2002). Therefore, these findings concludes a notable result of productivity between the workers in a windowed office and interior office. Besides office, a research on the relationship between daylighting and productivity in schools is also conducted in 1999. The research found out that there is indeed a significant and consistent positive effect of daylighting towards students in 3 different schools. These outcomes include better results, mood and behaviour of the students who were studying in a classroom exposed to daylight (Heschong Mahone Group, 1999). Hence, based on the research findings, it has been proven that natural daylight have positively impact humans health, well-being, as well as productivity.

Not only daylighting has benefits on humans, but it also help to better illuminate the interior space, as the sun is a rich source of natural lighting for illumination in architecture (Francis, 2015). It is also said that about one-third of electricity used in most buildings is used for artificial lighting (Robertson, 2014). Hence, it is even more crucial to integrate natural daylighting inside a building as a way of enlightening the space as well as a way of conserving the energy.

Thermal Comfort

It is believed that people spent 87% of their time indoor in 1992 (Klepeis, 1992). Hence, a comfortable space for people to do their activities is imperative, especially concerning the thermal comfort of the space. Thermal comfort itself is achieved by ensuring the temperature in the space is not too hot or even over-cooled. There is a lot of thermal comfort factors and they are divided into two category, environmental factors and personal factors. Under environmental factors, there is air temperature, radiant temperature, air velocity, and humidity (HaSE, 2015).

The first environmental factor is air temperature. It is defined as the temperature of the air that surrounds the body, while on the other hand, radiant temperature is talking about the heat that radiates from a certain heat source, such as ovens, dryers, hot surfaces as well as sunlight. The third point of environmental factors is air velocity, which explains the speed of air moving in the space and help to cool the environment. Air velocity also help to reduce a built-up odour in the space, thus avoiding human discomfort when they are in the space, and the last environmental factor is humidity. Humidity itself represents the amount of water vapour in the space. High humidity is recommended in tropical climate like Malaysia, as it causes the evaporation of sweat, which is said to be the main method of heat reduction in the space (HaSE, 2015).

Besides environmental factors, thermal comfort is also heavily affected by personal factors, which are human factors. The first factor is clothing. If the environment is considered as hot or warm, it is important to not wear too many layers clothing as it will cause heat stress, hence it discomforts the person wearing it. However, in places with colder temperature, to wear clothings that can provide enough insulation is crucial in order to avoid illness such as frostbite or hypothermia. Aside from clothing, the type of ongoing activity in the space also matters. The

heavier the activity means more heat is being produced, which will then lead to the need of mechanical cooling system for heat-loss purpose. A person's physical characteristics also play an important role in determining one's thermal comfort in the space, which include their weight, age, sex and many more (HaSE, 2015).

In creating windows and openings, it is important to consider these two factors, which is daylighting and thermal comfort. The relationship of both aspect is heavily affiliated with windows and openings. When daylight penetrates into the space, it will brighten up the space and help to save electricity by reducing the energy. Furthermore, as previously mentioned, daylight also has the ability to improve humans health and productivity inside the space. However, on the other side, heat are gained through the sunlight that comes into the space, which makes it harder for the space to achieve thermal comfort. Therefore, it is important to keep a balance in creating windows as well as openings in order to achieve both thermal comfort and daylighting sufficiency inside the space.

There is a lot of ways in preventing glare from daylighting as well as over-heated space to achieve thermal comfort. The first prevention can be done by providing shading devices in the design. It is also important to consider the sun orientation in order to determine the location of the windows and openings. With the right positioning, a space can be sufficiently illuminated with daylight without having any glare. In order to avoid high temperature, another solution that can be taken is by having the window glazed to prevent ultraviolet radiation in the space.

Daylighting and Thermal Comfort in Malaysia

Malaysia is located near the equator, whereby it has tropical climate with uniform high temperature and humidity. The temperature in Malaysia ranges between 20oC to 30oC throughout the year (Ashraf, 2018). The global illuminance levels in Malaysia is said to be generally high, exceeding 80000 lux in the afternoon when the solar irradiation is at its peak. However, during the months when there are less solar irradiation, the illuminance level still can reach up to 60000 lux (Zain-Ahmed, 2002). As Malaysia's tropical climate is more stable compared to other countries with cold environment, there are also less considerations in creating windows and openings, which creates flexibility for ventilation purpose.

As it is considerably hot in Malaysia, in consequence, active cooling appliances such as air conditioner is being widely used. It is believed that the energy consumption in a house is mostly consumed on mechanical cooling, which is 47% of the total bill (Desjardins, 2016). According to TNB (Tenaga Nasional Berhad), the highest electricity demand ever recorded is at 17,175 MW on March 9 in 2016, which is the second week of the month, beating the previous record that is 16,901 MW on June 6 in 2014. The demand of the energy has been climbing since Monday, the first day of the week (The Star, 2016). It is believed that the peak of electricity consumption is due to the hot weather, therefore causing higher temperature. The following figures are the comparison of the weather on the second week of the month, which has the highest electricity consumption, with its previous and following week.

As seen on the figures above, it indicates that the second week of the month is indeed hotter compared to its previous and following week. As a result, the researcher believes that the cause of the peak of electricity consumption is due to the overwhelming heat gain in Malaysia.

In order to further learn about the condition of daylighting and thermal comfort in Malaysia, the researcher researcher have found a total of 21 journals, consisting of 11 journals about daylighting and 10 others regarding thermal comfort. All of the journals are based in Malaysia. The journals compilations are listed as below: Based on the compilation of daylighting journals, it is found that only 3 out of 11 journals stated that the case study of the building have provided sufficient daylighting in the space. Meanwhile, there are 6 out of 10 building case studies in Malaysia that do not achieve a standard of thermal comfort. These results are then combined and the majority of the result of journal research shows that more than half of the case studies found do not provide sufficient daylighting or thermal comfort for the building occupants in Malaysia.

Discussion

According to studies, it show that 90% of the impact of a building or product is determined by the earliest design decisions like the form, fenestration and etc (Hosey, 2016), which leaves to the designers as the creators to make the call. Thus, the end result of the building project will accord to the early decisions of the designers, whether is it good or is it bad, because the building speaks of its designer.

It is important for designers, naming architects and interior designers, to follow building regulations and guidelines in order to achieve a better environment quality. Not only to follow the law, but it is also important for the designers to have the understanding and awareness of the importance of daylighting and thermal comfort inside a space. Hence, all buildings can comply with the proper standard of buildings law. However, the majority result of the journal research do not achieve a good standard of daylighting and thermal comfort according to each of the journal's conclusion.

Designers should design buildings that are appropriate according to the law, which in Malaysia is written in the book Uniform Building by Law 1984. Interior designers and architects hold a very important role in creating a better space and environment for the society to live in. Despite all the journals written by all the researchers in previous charts, all of the building case studies are already built and to rebuild them is not advisable. Ibrahim Thaw, Deputy Executive Director of the UN Environment Program once said that buildings represent a third of global emissions and a third of energy as well as materials consumed worldwide (Condliffe, 2015). Hence, for energy conservation, it is very crucial for designers to fulfill their responsibility in the society by learning from past projects and mistakes in order to build an even better space to accommodate people in the future.

Conclusion

In conclusion, more than half of the buildings in the literature review archive has failed to achieve both proper daylighting and thermal comfort, which in general leads to the lack of awareness and understanding of the daylight and thermal comfort importance among designers community in Malaysia. Therefore, designers need to take further considerations of in designing and building spaces in the future, especially concerning daylighting sufficiency and thermal comfort achievement.