Colour Light And Wellbeing: A Case Study Of M Mall O2O George Town, Penang Island

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Abstract. Contrary to popular belief, the brightest light or the most colourful light makes good lighting design. However, what makes a good lighting design in interior space is an impeccable composite of art and science. With the application of good lighting design, it can produce an impressive result from enhancing the aesthetic of architectural elements to conveying the right type of ambiance of the interiors. This research intends to address the crucial issues regarding the ways in which lighting designers can communicate the benefits of good lighting and to create a better awareness to users. The objectives of this paper are to outline and explore the features of good and poor lighting design in M Mall O2O based on the lighting design language and profession. The results of this research are mainly qualitative in nature, supported by the professional lighting designers on the definitions of good lighting, personal observation and visual data which were taken in George Town, Penang Island. The case studies on good and poor lighting portrayed in this mall were used as examples to scrutinize the issues raised herein. To achieve the optimum lighting design, a joint approach of focusing on the artistic flair brought forth by lighting and more scientific effort on the calculation levels of lights is crucial. Different functionality requires a different amount of attention on either approach. In conclusion, a good lighting design must be able to enhance the atmosphere and also enrich the quality of the interior architecture. Apart from that, a good lighting design should have good distribution of brightness levels, contrast and different colour temperatures to enhance characters of the interior spaces without neglecting the health and wellbeing aspects.

1. Introduction

Lighting is one of the important aspects of an interior space as it provides light, cast and brightness to the users in order to carry out the daily activities. In case, it has the ability to change the mood of a space just as it does the perceived size of a space. Lighting is defined as the use of various light source which has a particular quality, to achieve some aesthetic or practical effect while illuminating a scene. Light can be obtained through the natural daylighting as well as the artificial lighting. The source of all daylights is the sun, that brings in or captures the daylight in an interior space with an opening requirement such as windows and skylight. In particular, the aim of having a daylighting design in a building is to maximize visual comfort or reduce energy usage. Thus, artificial lighting is introduced to tackle this problem. The artificial lighting refers to the light source supplied by man-made equipment which emits light and heat. Both natural daylighting and artificial lighting are fundamental and act as the key element for architecture and interior design. Lighting fixtures, usually associated with interior design, light fixture or luminaire, are electrical devices that use electric lamp to create artificial light. Contemporarily, lighting is utilized for both aesthetic and function purposes. For aesthetic purpose, it is used as decorative lighting especially for an interior design and also on a building “skin”. The main reason for using this artificial light is it can become an eye-catching interior and also create a soothing environment. Simultaneously, in terms of functionality aspect, lighting is required by the users to perform the tasks. Nevertheless, with the rise in awareness of health aroused among the global society, people have started to link lighting with health. Also, they have started doing research and investigated how lighting can be influential to one’s health. Thus, all types of research have been done by inventors, they also cooperate with scientists to acquire sufficient knowledge on lighting for the scientific aspect. Eventually, the findings display various health issues
caused by poor lighting, directly or indirectly, such as skin cancer, eyestrain and headache. By studying light ergonomics, we will be able to know how lighting can be an important factor in providing a healthy interior for an individual.

2. Objectives
The objectives of this research are:
i. To understand the basic principles, knowledge, and requirements of interior lighting relating to health and well-being.
ii. To identify the good and poor lighting based on the observation and findings for future design references.
iii. To understand types of lighting existed and their pros and cons.

3. Research Method
This research refers to the previous studies as to support the latest research findings. Qualitative data were collected, each with its own merit in strengthening the study and to support the scenarios, which are further supported by visual evidence. The observation covers 500 shop lot from ground floor to third floor from 11:00 a.m. until 10:00 p.m. Five researcher were focusing on the social interaction that stimulate the shoppers on what has happened and is happening related to the artificial and natural light. Results of the discussion and analysis will be analysed globally, and this will be beneficial for future in-depth studies on light and health in the context of Malaysian domestic health.

4. Functions of Lighting in Build Environment
In ancient time, lighting was provided by fire, sunlight, torches and candles. Lighting was primarily produced for people to lighten up their living places, for religious activities, or to carry out daily activities such as reading, yet it was not served to function for buildings, roadways or any other aesthetical aspects. As time passed by, the technology of artificial lighting has been developing, hence the first electrical lamp (carbon-arc lamp) was introduced by Sir Humphrey Davy, an English chemist. Nowadays, the functions of lighting vary following the various types of lighting features. Lighting is the foundation of our vision, it also serves as the most important aspect of interior spaces. It provides visual comfort to the users, enhances the mood of a space, gives an illumination effect and even ensures users’ safety in a dark or hard-to-see environment. Undeniably, lighting plays an important role in our daily life. Furthermore, natural lighting, or daylighting, becomes the hot topic in lighting design for its economical and health issues. The utilization of natural lighting can lead to substantial energy saving. Artificial lighting consumes high amount of electricity, so the use of daylighting can help reduce the energy used for electric/electrical lighting by 20 to 60 percent. According to scientists at the Lighting Research Centre (LRC) in Troy, N.Y., daylighting could increase occupants’ productivity and comfort effectively and provide mental and visual stimulation which are necessary in regulating our circadian rhythms [6]. However, excessive daylighting designs will subject users to glaring problems as well as thermal stress. Further related issues will be discussed in this paper. Hence, artificial lighting and daylighting are important in our life. Designers have the responsibility to choose the suitable lighting design to fit the function of a space. One of the most important factors that every designer should consider is the visual comfort of users in order to increase the productivity and their quality of life.

5. Light and Health
Light is important for humans’ health. Light, or light radiation, not only affects our visual cortex but also our alertness, wellbeing and performance [2]. Our circadian rhythm and circadian clock are genetically fixed, but they are regulated to a certain extent by our surroundings, such as light. The photoreceptor cells in human eyes- Retina are sensitive towards light. These cells have a nerve connection to the biological clock and the pineal gland located in the brain, which is responsible for the regulation of hormones in our body. In other words, there is a direct relationship between light,
body timing and hormones. Cooper and Breiling [4] have listed the benefits of light to human’s health and wellbeing as:

1- Light is a “186,000 MPS (300,00 KPS) nutrient.
2- Light has “drug-like-effects” on hormones and neurotransmitter which affects every cell in the body.
3- Bright light can synergize medications in the treatment of the Seasonal Affective Disorder, major depression and Alzheimer’s disease.
4- Light “lights’s up” people’s brains and their lives with both instant and long-term effects.
5- Light and darkness time every major biochemical reaction in our body such as sleep-wake fullness, appetite, mental efficiency, immunity and energy.

Further to this, there are a few bodily processes such as the sleep-wake rhythm, the rhythm in body temperature and the rhythm in which certain body hormones produced are influenced by the light-dark rhythm of the Earth. Biological rhythms that repeat approximately every 24 hours are called circadian rhythms. It is important for us to be exposed to the light and to receive an adequate light dose in order to keep the body clock in sync with the 24-hour day rhythm. Our hormonal secretion is under the influence of the light-dark rhythm. The cortisol, or also known as energy hormone, increases during daytime and decreases at night but remains at a sufficiently high level to maintain blood sugar level and alertness. The level of melatonin, or the sleep hormone, decreases during daytime to reduce sleepiness, but rises at night to facilitate sleep. Hence, excessive exposure to the light will lead to circadian disruption which will affect our sleeping quality, physiological functions and neuro-behavioural performance. Moreover, the sensitivity of the photoreceptor cells in human’s eyes enable us to make use of lighting for therapeutic purpose especially for those with disturbances in their biological clock Photoreceptor Cells [7]. For examples, therapies for certain forms of sleep disorder, seasonal affective disorder (SAD) and jet lag or sleep-wake rhythm problems [3].

Besides that, the sun which is the main lighting source of the earth, has brought a lot of advantages to humans as well as flora and fauna. The sunlight is necessary for plants to carry out photosynthesis process. Glucose is produced during photosynthesis then provides energy to the plants. Animals eating the plants will indirectly consume the glucose produced to survive. For humans, the exposure to the ultraviolet-B radiation in the sun rays causes skin to create vitamin D which helps to build strong teeth and skeletal health [8]. The low level of vitamin D can lead to rickets in children and bone diseases such as osteoporosis and osteomalacia. The exposure to the sunlight also increases the level of serotonin which helps in boosting mood. Thus, those who are suffering from depression are suggested to expose themselves to the sunlight as they will be able to absorb more sunlight thus increases the serotonin level in their bodies. However, the excessive exposure to sunlight is harmful to our health and can even become fatal. It can quicken the aging process as well as the reddening of the skin, pigmentation development and skin cancer.

6. Findings and Discussions
The M Mall O2O opened in October 2015, which then became the latest shopping mall present in Georgetown. The interior of the mall was supposedly aimed to provide a new experience to visitors. It contains several attractions: the first wax museum on Penang Island, nationally themed “street” at different levels and various artistic decorations. Once entering the shopping mall, the main walkway is directed by well decorated ceiling. Artificial lighting fixtures are used in ceiling decoration. The types of lighting used are of at different intensities and temperatures. Some of the types of lighting are less bright as to create a relaxing and comforting atmosphere, beautifying the products displayed in the shops. In this case, lighting is important for enhancing the mood of the shops and hence is able to promote the sales. Recessed down lights found is at a slightly poor quality level as most of the time glares are produced. The lighting source used is a mix of light emitting diode (LED) and florescence lamp. The lighting’s colour temperatures range from 3000K to 3500K. Furthermore, glares are produced in the shops due to the high intensity of the lighting source. As polished lighting-coloured
marble floor finishes are used, the internal reflection index would increase and sometimes would create glares, making the occupants’ eyes uncomfortable. Besides, different colours of lighting sources with different wavelengths are used to decorate the interior. It creates a chaotic vibe and would probably irritate the eyes of the occupants (Figure-1).

However, the overall ambiance of the shopping mall on the ground floor is delightful and effectively promotes the mood of visitors. A welcoming effect is successfully established through its lighting. The first floor of the M Mall is a level full with decorative lighting. The ceiling is decorated with artificial lighting fixtures ranging from florescence tube lamps to LED light strips. The walkways are directed by the ceiling design and manage to provide a cozy ambiance for the shoppers. Once entering the first floor, the mood is directed by the decorative ceiling and walls. Translucent acrylics are used to create a story line of fairy tales along the walkway – plastered on the ceiling and the wall. With the aid of the florescence tube lamps (colour temperature less than 2700K) which were installed, the aesthetical value of the walkway is enhanced. The lighting and shadow effects stimulate and attract the shoppers, especially the children.

At the same time, at the same level, another space with different ceiling design was found. The ceiling design directed the shoppers along the walkways effectively. Recessed down lights with colour temperature less than 2700K have been installed by the operators. However, some of the parts of the ceiling are tried to be accentuated by the installation of cool white LED light strips. This brings nonsensical clashes on the ceiling. The colour temperature of the LED light strips is rather high (4000K - 5000K) and contains more blue lights which make them look brighter compared to warmer, white LED light strips.

Nevertheless, the head room of the first floor collides with the Universal Building by Law. It is low and is very dangerous for the visitors as they might hit the ceiling if they are taller than others. Moreover, the distance of the lighting fixtures installed are too close with the visitors’ eyes. This might lead to the irritation to the eyes and hence might reduce the mood of the shoppers. Glares produced by the excessive artificial lighting fixtures installed may tire the eyes and emotionally affect the visitors (Figure-2). The amount of lighting fixtures used should be reduced in order to give the visitors a better shopping experience. LED light strips may be a good choice but a warmer colour temperature is better to reduce a high contrast. Besides, the usage of florescence tube lamps which are being switched on all the time will cause the occupants - the shoppers as well as the workers – to be exposed in excessive UV radiation emission. In a prolonged period of time, the visitors might easily experience fatigue and dizziness. In addition, the themed “streets” placed the shoppers in a Wonderland. There are also fanciful decorative lighting applied to create a reverie ambiance. There are attempts to mix daylighting with lighting installation in the interior spaces, however, the outcome seems to exhibit incongruity. Pendant lights, florescence tube lights and recessed down lights are used for the interior. Fluorescence tube lights with different colours are installed, emphasizing the big decorative elements across the ceiling, at the same time guiding the shoppers. The random light colour used for the lighting fixtures looks orderless and this might make the shoppers confused with its purposes.

Daylighting, which is good for health, is introduced through the big floor to ceiling windows. However, the improper filtration of daylighting leads to failure as it is unable blend well with the artificial lighting installed. One of the shop-selling sport equipment was identified to display this problem.
During daytime, the recessed down lights are switched on although it is functionless in terms of enhancing the brightness of the interior and this activity consumes a lot of energy. In this case, the recessed down light becomes a waste during daytime. The light should be only switched on when there is no daylighting or if the daylighting intensity is too low. The spacious floor and broad ceiling windows in the shop should be able to bring in sufficient amount of daylighting to the interior during daytime as well as enable the workers to carry out their professional routine and the shoppers to enjoy their shopping. Furthermore, tracking lights may be switched on to promote the products by attracting shoppers. With the lighting and shadow effects created, the products will look interesting and will be able to give more excitement and enjoyment of shopping within consumers.

The researcher therefore has synthesized that the phenomenon of artificial and natural light at M Mall has triggered customer’s emotion and visual perception through (Table-1):
Table 1. Phenomenon of artificial and daylight in M Mall

| S. No. | Issues |
|--------|--------|
| 1      | Design tools & techniques (high intensity, high contrast, directionality, colour). |
| 2      | Excessive color light by making an impression of the ceilings and architectural elements. |
| 3      | Enhancing interior spaces by highlighting columns, ceilings, walls and decorative elements. |
| 4      | Creating drama through interior themes using colour light. |
| 5      | Great impact on the visual and eyes from the general lighting of the fresco and decorative ceilings |
| 6      | Improper filtration of daylighting |

7. Conclusion
In conclusion, through this case study, designers should be able to understand what lighting is about and how it can affect people’s health. Designers should understand ways to exhibit good lighting for interior space. The placements and types are important aspects of interior design as they work together with colour sections, space, and furniture selection. Depending on the types of the bulb, the light emitted may be of a warm or cold colour, and this may affect the overall feeling of a room. Good designers should not be selfish by considering just the aesthetical factor, for an instance, by placing light everywhere around the town and rural areas without consideration. In terms of the health aspect, the effects of light on human health as well as on the other living things need to be prioritized. Lastly, without proper lighting, interior spaces cannot be experienced the fullest. Good lighting assures warm, inviting yet functional interiors.

References
[1] Boivin DB, Czeisler CA, et. Al (1996), “Dose-Response Relationships for Resetting of Human Circadian Clock by Light,” Nature 379:540-542.
[2] Bommel, Wout van. (2005). Biological effect of Lighting. ELDA + Light Focus 2005. 14-15 April 2005 in Milan, p. 5.
[3] Circadian Rhythms Fact Sheet. https://www.nigms.nih.gov/Education/Pages/Factsheet_CircadianRhythms.aspx accessed on 22 February 2017.
[4] Cooper, P. and Breiling, B., Light Meditation and Introductive Overview. PLDC 1st Global Lighting Design Conference, 24-27 October 2007 in London, p. 30.
[5] Funk, Rischard. Benefit and risks of light entering the eye. PLDC 1st Global Design Conference, 24-27, October, 2007 in London, United Kingdom.
[6] Lighting Research Center. http://www.lrc.rpi.edu/ accessed on 22 February 2016.
[7] Photoreceptor Cells (Photosensitive Cells). https://www.ncbi.nlm.nih.gov/pubmedhealth/PMHT0024257/ accessed on 22 February 2017.
[8] Sunlight and Vitamin D: A Global Perspective for Health. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3897598/ accesses on 22 February 2017.