

Façade Design Efficiency on Extent Sunlight Penetration in Neo-Minimalist Style Apartments in Penang, Malaysia

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This research aims to study the sunlight penetration performance on the front façade of selected apartments with Neo-Minimalist architectural style. The selected case studies are two front façade of apartments buildings located at the Penang Island east coast latitude 5° 25' 0" N and longitude 100° 19' 0" E, the east part of Penang has been under great developing progress in the last 10 years. Minimalist architectural style is very popular and preferable by architects and people in this region. The two selected case studies are Baystart condominium, Bayan Lepas and Bayswater Resort condominium, Gelugor. The study uses sun tool software to simulate and calculate the extent of sunlight penetration. The simulation will be conducted with oriented the building as the sun rays are perpendicular to the building's façade, and then compare the results of sunlight penetrations between the two buildings and the used of architectural elements. The study finds that the sunshade elements and the recessed wall with balcony which are used in the minimalist style facade design make the buildings efficient to prevent the unwanted sunlight which causes overheating and over brightness inside the building, and that is the one of the reasons behind the popularity of the minimalist architectural style.

Keywords: Sunlight extent penetration; Façade; Neo-minimalist

Introduction

This research is to study the penetration of the sunlight on the neo-minimalist architectural style house façade. Neo-minimalist style is selected because of the popularity of this architectural style during the last ten years in Malaysia [1]. The research is trying to highlight and point to the problems caused by the direct sunlight penetration to the indoor living areas in the highrise apartments buildings and the effects of the solar radiations on the buildings' façade in the tropical region. The study will be able to guide the architect and designers to have better ideas and better using of sunshading elements on façade designs.

Designing without the consideration of the sustainability is important in addition to the Design faults are the main reasons of the poor façade design which is unable to provide enough shading area and blocking the solar radiations. Thus the reason behind this research is to generate empirical findings and contributions which lead to the architectural design.

All the results and measurements in this study will be evaluated using computer simulation software. The study is limited to the neo-minimalist architectural style apartment located in Penang which is considered to be one of the most important cities in Malaysia. It epitomizes the present and future direction of housing industry in Malaysia. Using the least element number to get the maximum effect is considering the recognition of the neo-minimalist architecture style. The main purpose of this study is to measure the shading elements efficiency in this architectural style apartment. As solar radiation is one of house façade exposing to the direct sunlight problems, the sun energy will cause overheating for the indoor spaces [2,3]. It generates extra heat gains inside the house which causes warm temperature to the indoor area; as a result, it creates uncomfortable thermal condition to the occupants. A report by Centre for Environment, Technology and Development, Malaysia (CEDT) (2005) the consumption of electricity as stated in *Malaysian Urban Household Energy Consumption Patterns* is about 32.4% on air-conditioning and fan for cooling of the total electricity bill, which is initiate problems in indoor heat gains due to unnecessary direct sunlight exposure to the houses in Malaysia. A study

on high rise apartment is crucial as apartments are the most popular house types which represent 73% of the total unit houses [2].

Having a guideline for an excellent façade design is one of the important considerations in a tropical region like Malaysia, good passive façade design is to avoid intensity of solar radiation is necessary and transfer the direct sunlight into heating inside the living area [4,5]. It generates extra heat gains inside the house which causes warm temperature to the indoor area. As a result, this creates uncomfortable thermal condition to the occupants [3].

Conclusion

As mentioned earlier the study is limited to two neo-minimalist residential apartment buildings in the south coast of Penang Island, Malaysia to be the case studies of this research. Both of the case studies are considered to be high cost apartments with different locations in the city of Penang. The first selected case study is BayStar eleven stories

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day time, the simulation will be done when the sunlight rays are perpendicular to the building's facade (the east facade during the morning hours and the west facade in the afternoon and evening hours), then the survey will be able to discuss the efficiency of facade's shading design [6]. The study will be limited to the changing of the sun path to get the perpendicular of the sunlight to the east (90°) and west (270°) (Table 1 and Figure 3) in order to get the results at the maximum exposure level, and also the other limitation is that there are at certain times and dates that the sun path's azimuth is not possible to have perfectly at 90° [7,8]. In these cases, the closest azimuths nearest to 90° will be used when the simulation is made from 8:00 AM to 6:00 PM which are listed in Table 1.

All locations, times, dates and orientations data will be keyed in the sun tool software in order to get the corresponding positions and orientation to the sunlight penetration simulations and calculate the percentage of the facade shading area (Figure 4), and then the facade's dimensions such as depth of exterior shading device, height, wall's width and sill height will be keyed in the sun tool software. The software

will be able to do the simulations after drawing the facade section and enter all required data.

Experimental Methodology

To measure the extent of sunlight penetration inside the room, the sun tool software will be used as illustrated in Figure 5. However, a parallel line to sunbeam of the upper window wall must be drawn if the overhang shading device is longer than the upper window wall (Figure 6). The brown line represents the real extent of the sunlight penetration, which is only occurs in the early morning and then the rest

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- Façades with good shading
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The results show that Baystar minimalist facade has better shading performance at all simulation hours except for the first hour of the day.

Conclusion

The study finds that the early morning and late evening hours show the maximum level of sunlight extent penetration in both of Baystar and Arab Y building's facades because of the very small angle of the sun rays and the sun position in the sky at these hours, the results show that both case studies have similar sunlight extent behavior in most of the simulation hours. However the simulations find that the neo-minimalist architectural style has a very good shading performance during most of the day time. The research will with all and other



shading elements are very effective in neo-minimalist style to prevent the extent of sunlight penetration from getting inside the house. It is deeply expected for the first and last hour of simulation because of the angle of sun position.

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1. Arab Y, Hassan AS (2012) Day lighting analysis of pedentive dome's mosque design during summer solstice with case studies in Istanbul, Turkey. International Transaction Journal of Engineering, Management, Applied Sciences and Technologies 3: 167-183.

2. Arab Y, Hassan AS (2015) The sunlight shading performance in traditional style apartment: Case study of Putrajaya, Malaysia. American Transactions on 4: 119-128.

3. Bakhlah MS, Hassan AS (2012) The study of air temperature when the sun path direction to ka'abah: With a case study of Al-Malik Khalid Mosque, Malaysia. International Transaction Journal of Engineering, Management, Applied Sciences and Technologies 3: 185-202.

4. Feriadi H, Wong NH (2004) Thermal comfort for naturally ventilated houses in Indonesia. Energy and Buildings 36: 614-626.

5. Hassan AS, Arab Y (2014) The extent of sunlight penetration performance on traditional style's apartment Façade in Putrajaya, Malaysia. Modern Applied Science 8: 132.

6. Hassan AS, Arab (2013) The essence of design with light: Single pedentive dome mosque in Turkey and Bosnia Herzegovina during winter solstice. In: From Anatolia to Bosnia: Perspectives on Pedentive Dome Mosque Architecture. Penang: Universiti Sains Malaysia Press.

7. Hassan, AS, Arab Y, Bakhlah MSO (2015) Comparative study on sunlight penetration between post modern and Neominimalist. Advances in Environmental Biology 9: 51-54.

8. Hassan AS, Ramli M (2010) Natural ventilation of indoor air temperature: A case study of the traditional malay house in Penang. American Journal of Engineering and Applied Sciences 3: 521-528.

9. Mazloomi M, Hassan AS, Bagherpour PN, Ismail MR (2010) Influence of geometry and orientation on fank insolation of streets in an arid climate city. American Journal of Engineering and Applied Sciences 3: 540-544.

10. Statistics Do (2003) General report of the housing census, Putrajaya, Malaysia: Department of statistics Malaysia Press.

11. Landry M, Breton P (2009) Daylight simulation in auto desk 3ds max design-Advanced concepts. Autodesk Inc.