Recent Trends in Civil Engineering and Built Environment Vol. 1 No. 1 (2020) 88–94

RTCEBE

Homepage: http://penerbit.uthm.edu.my/periodicals/index.php/rtcebe
e-ISSN : 2773-5184

Adjustable Folding Aluminium Louvres Application on'Hop (B): Nob Marina Quay'

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DOI: https://doi.org/10.30880/rtcebe.2020.01.01.007
Received 20 August 2020; Accepted 09 December 2020; Available online 13 December 2020

Abstract: Natural Ventilation is one of the factor of enhancing the indoor air quality in building. Unfortunately, most buildings nowadays are still depending heavily on mechanical ventilation and air conditioning for their daily operations which cause a lot of energy consumption. Based on previous studies, there are mechanisme and systems studied and invented to enhance building natural ventilation especially for tropical area. Therefore, this design studyaims to proposed an application of an adjustable folding aluminium louvres in the 'HOP (B) : NOB' Marina Quay in Pulau Pinang. The application may maximize the effect of natural ventilation for the building's indoor spaces via cross and stack effect ventilation.At the same time, the installation of the adjustable folding louvres may also enhance the façade quality while giving sun shades to the building. The findings of this design study indicate that although natural ventilation is needed in a building, controlling the direction and strong winds inside the building is also essential in order to give the right intensity to the application of natural ventilation in 'HOP (B) : NOB' Marina Quay.

Keywords: Natural Ventilation, Adjustable Folding Aluminium Louvres

1. Introduction

Natural ventilation is the process of allowing fresh air into a building from the outside. With good air movement through natural ventilation, the fresh air flow helps to force the warm, stuffy and dirty air inside the building out through the openings provided [1]. There are two types of natural ventilation that occur naturally in buildings. There is either wind-based ventilation (also known as cross ventilation) or Buoyancy-driven ventilation (also known as stack-effect ventilation) [2]. Good

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understanding on how the ventilation system work is essential in building design process in order to provide a good indoor natural ventilation flow.

However, because of the hot climate that Malaysia have, the building design must also consider about the heat glare and excessive sunlight penetrating inside the building. Usually when designing a building that uses natural ventilation, designers tend to neglect about the importance of avoiding excessive heat and glare inside the building [3].As a result, indoor environment of building in tropical area is commonly heated up causing uncomfort thermal situation.

Therefore, this design study was carried out to propose a design element application for tropical building in solving the problem. The study was done on a Marina Quay yatch port building called 'Hop (B): Nob' proposed in TanjungBungah, Pulau Pinang. Figure 1 shows the location of the site project. The application of Adjustable Folding AluminiumLouvres was designed on the building as the feature to allow natural ventilation flow while at the same time provides shades for the openings in order to gain a good indoor air environment to the building.

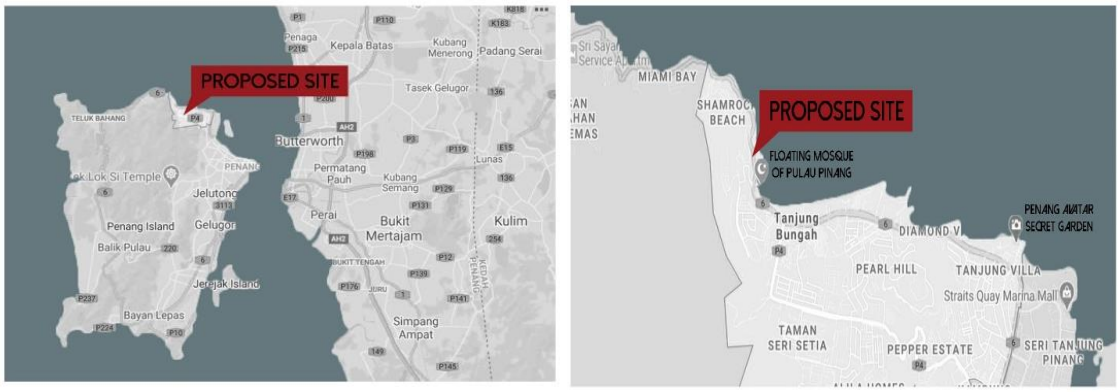

Figure 1: The Site Location

As the site is located in Penang island nearby the sea, it is exposed to the strong wind and sea breeze. The condition is seen as a good potential in providing the building with sufficient wind flow for the natural ventilation. However, the site is also exposed to excessive direct sunlight that may cause the surrounding overheated situation. Therefore, the building design shoud be able to exploit the site potential while solving the problem occurs.

As for this design study, the objectives are underlined as follows;

i) To understand the factors of excessive glare and heat on tropical buildings.
ii) To design an adjustable timber louvres to enhance the natural ventilation in 'HOP (B) : NOB' Marina Quay building.

This design study is focusing on cross and active natural ventilation. It focused on the passive design element of the building to enhance the natural air movement. At the same time, the design solution is expectednot to neglect the importanceof avoiding excessive glare and heat by using a suitable mechanism.

2. Background Study

Based on fundamental flow equations describing mass balance, energy conservation and momentum, a consistent solution is derived for natural ventilation by thermal buoyancy in a room with two openings and with uniform temperature.The two opening will allow the indoor cross ventilation to happened, even though it may cross the floor level. The phenomenon is caused by the

difference of air pressure. The solution is a reliable tool for analysing and designing natural ventilation systems where thermal buoyancy is the dominating driving force [1],[2],[3].

Meanwhile for sun shading, it is vital to help in controlling the temperature and climate conditions inside buildings. Some buildings use sunscreens and sunshades, both of which are efficient ways to manage the amount of sunlight entering a building and provide interior sun control. Some might be part of the buildings themselves like window coping, horizontal panels and even roof overhang. Some might use an additional building elements such as metal canopies and awnings that block unwanted light and able to enhance the façade outlook at the same time [4],[5].

2.1 Case Study

2.1.1 Sunray

Figure 2: View of the Sunray building and interior [6]

Sunray Woodcraft Construction Pte Ltd. main building is located in Singapore. It is classified as factory building designed by DP Architects. The building was completed in 2014. The building house the new headquarters of Sunray Woodcraft Construction. It is one of the first to be completed as part of the newly positioned International Furniture Hub in SungeiKadut, Singapore. The design is contemporary and a fresh look of a light industrial factory type. The layout optimize the working area efficiently [6].

Factory production and warehouse spaces are cladded with yellow horizontal aluminium louvres. The design supply maximum amount of natural ventilation and light while remaining shaded from the sun and protected from rain as shown in Figure 2. Deep recesses between boxes create intuitive points of entry and exit for each box while allowingnatural light to penetrate deeper into the floor plate.

2.1.2 Surry Hills Library and Community Centre

This project is located in the heart of Surry Hills, an inner-city suburb of Sydney. The surrounding community is characterised by a diversity of age, income and cultural backgrounds. It is classified as library and community centre building. It was designed by Francis-Jones Morehen Thorp and was completed in 2009. The building consists an approximately 2497sqm of floor area [7]. The architectural context of the surrounding varies between residential apartments, terrace housing, shops and commercial/industrial premises, andvary in the scale though their predominantly Victorian architectural style.

Figure 3: The front façade of Surry Hills Library and Community Centre [7]

Figure 4: The shading devices louvres [7]

The environmental green friendly design initiatives include a thermal labyrinth for passive filtering and tempering of the air, solar-tracking timber louvre system, automated fabric shading, mixed mode ventilation, extensive photovoltaic array, geothermal cooling bores, green roof, rainwater collection and recycling, and sustainable material selection [7].

Through their computerised building management and control system (BMS), the operation monitors and records both electrical and hydraulic systems to maximise the environmental efficiency of the building and identify system faults. It also automatically monitor and control the internal environmental conditions of the building. The system also adjust the ventilation and sunshade louvres throughout the day to control heat load, light and share, and switching lights on and off when required [7].

3. Design Development

Based on the site analysis, the 'HOP (B) : NOB' Marina Quay is design to the orientation that utilized most of its land. Within 4500sqm built up area, the main openings that were planned to capture the natural ventilation at most are focused to be facing the sea breeze direction.The adjustable folding aluminiumlouvres are proposed at areas exposed to outside area facing the sea breeze direction. As the direction is facing North-West, the afternoon and evening sunlight is expected to be excessive as shown in diagram in Figure 5. Therefore the application of the adjustable folding aluminium louvres is best to be on that particular wall and openings of the side as shown in Figure 6.

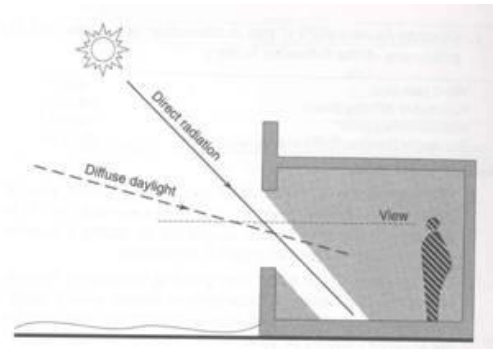

Figure 5: The effect of sunlight towards the openings proposed

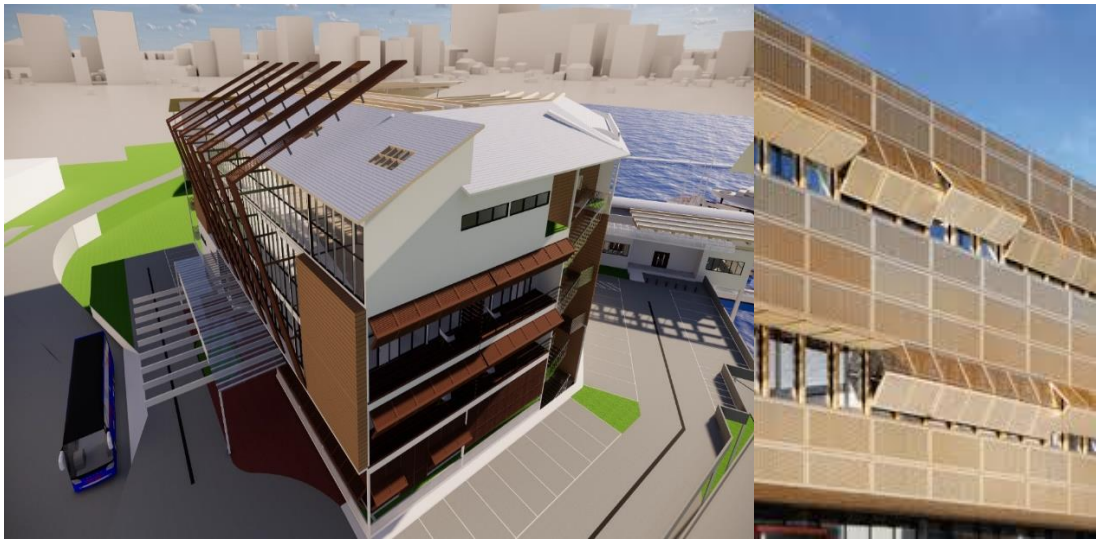

Figure 6: 'HOP (B) : NOB' Marina Quay proposed design showing the side to be applied with the Adjustable Folding AluminiumLouvres

Be the shading device is in the shape of louvres, it still can allow the air flow to slip into the building while closed. The louvres shape may varies. In the construction industry market nowadays, besides being flat, there are also S shaped louvers that may completely blocked view but still allows air flow. There are also aerodynamic shaped louvres that allow rapid air movement flow. At the same time, partly closed openings may also reduced any noise pollution from autside as shown in Figure 7.

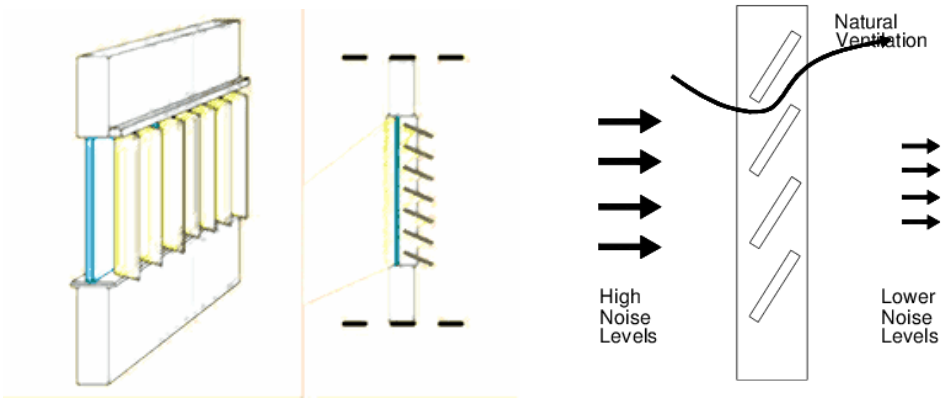

Figure 7: Louvres allowing natural air flow while reducing the noise impact

It is proposed so that the folding aluminium louvres could be adjusted according to the need of wind to be blown inside the building and the need of natural lighting while maintaining and controlling the sun and heat glare from the outside. As used in Case Study 2.1.2, the adjustable folding aluminium louvres is also best to be automatically operated based on the surrounding weather condition. Technically the diagram of the design are as shown in Figure 8.

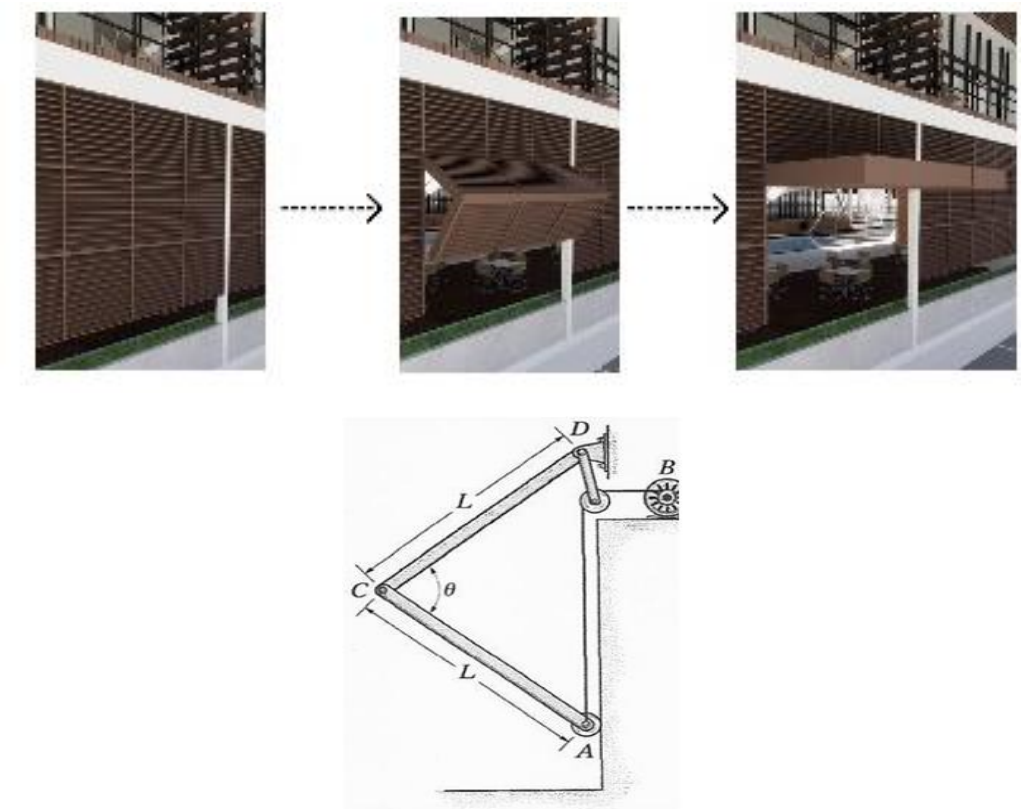

Figure 8: The Working Mechanisme of Adjustable Folding Aluminium Louvres

4. Conclusion

The application of the folding adjustable timber louvres in 'HOP (B) : NOB' Marina Quay proves that passive design elements itself may not be enough to determine the effectiveness of natural ventilation performance in buildings, especially in the context of a hot and humid tropical climate, where active ventilation systems may be needed, such as the folding adjustable timber louvres itself. Even though, the louvres may functioned passively, it is best to be operated actively using mechanical system automatically. However, the system is not actually new in the industry. Along the way, studies and schematic similar approach of design application is also happening in architecture industry via the term of architecture kinetic façade [8],[9]. Looking positively, by using this system, the uses of mechanical ventilation systems such as fans and air-conditioned units could be reduced. This folding adjustable timber louvres may not onlyallowing and controlling the wind breeze inside the building but also protect and control the amount of natural lighting inside the building while avoiding excessive heat glare and heat gain from the outside.

Acknowledgement

This design study was made possible by the course of Architecture Studio 6 (BFR32208)under the Architecture Programme of UniversitiTunHussein Onn Malaysia. The authors would also like to thank the Faculty of Civil Engineering and Built Environment, UniversitiTun Hussein Onn Malaysia for its support.

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