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RETROFITTING HERITAGE BUILDING BY IMPLEMENTING SUSTAINABILITY CONCEPT IN MALAYSIA

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There are plenty of heritage buildings in Malaysia. Heritage buildings are normally very shabby yet historical, cultural value and aesthetic. Sustainability has a meaning of reducing the damage to environment and it is an environmentally friendly method to converse the environment. The aims of retrofitting heritage building by implementing sustainability concept are preserving the culture and history of heritage building and bringing a new vision to the building itself. Hence, retrofitting heritage building are encouraged to implement sustainability concept in Malaysia. For the reason that heritage buildings are mostly old, implementing sustainability concept to the building helps to extend building life somehow without damaging the culture of the building. Furthermore, sustainable design are encouraged to be implemented because it could bring benefits to environment such as slow down global warming, reduce emission, waste and pollution to the environment. Therefore, thermal, lighting and ventilation are the most important elements of sustainability which helps to improve the life of the building and surroundings. Sustainable design is a modern design in construction industry. Generation nowadays are not familiar with this concept even heritage building as well. Therefore, implementing sustainability concept to a heritage building are important because it will no longer extend to new generation. Sultan Abdul Samad Building is one of the heritage building in Malaysia. It is located on eastern side of Merdeka Square. The design of building was inspired by Moorish-style and it was built in 1897. The building was work for office purpose but it became a tourist attractions now. Moreover, implementing sustainability elements to building helps to diminish negative consequences on the environments and improve occupants health and comfort. It creates a better environment for new generation.

Keywords: Heritage building, Heritage sustainability, Retrofitting

1. INTRODUCTION

Retrofitting is a practice of reform an old structure or building into new space to improve the performance of the building. In some way retrofitting could be collaborate with technologies nowadays to perform a sustainability structure yet reducing the usage of energy and water (City Of Melbourne, 2020). The obstruction of implementing sustainability elements to retrofit heritage building is due to the materials are expensive and lacking of knowledge of sustainable development. Nonetheless there are still an opportunity to inspire the new generation to get the idea of retrofitting heritage building by implementing sustainability concept in Malaysia. This effort could be pass on to next generation at the same time conversing the culture of heritage building. Furthermore, sustainable design is an action of balancing the built environment and

social, environmental and economic goals (Green Thumb Design Studio, 2020). There are few elements to achieve the concept of sustainable building. Energy efficient, Thermal and Ventilation are the most common elements to implement into retrofitting a building (Tobias, 2004). Energy efficient including lighting such as natural lighting and artificial lighting (Tobias, 2004).

Whereas thermal is regarding to the insulation and glazing of the building and ventilation can classify into passive method and active method (Tobias, 2004). Retrofitting heritage building into sustainable building to achieve sustainability concept by implementing the elements. For example, technologies can be used to provide a useful and cost-effective environment (Mondal, 2020). Educating the new generation with the awareness of sustainability concept could help the earth to slow down the emission of greenhouse gasses (Michaelsenergy, 2019) . In the meanwhile the histories and culture of history building could be preserved and accomplished the new generation. Retrofitting heritage building through applying the sustainability concept is important as it could bring benefits to the environment meanwhile the building itself have a longer building life. For instance, it could manage climate change as reducing the uses of energy such as fossil fuel and natural gas (Rinkesh, 2020).

It is profitable to environment and cost as it could reduce the spread of global warming in the same time saving the cost from energy used (Michaelsenergy, 2019). Sultan Abdul Samad Building is one of the earliest Moorish-style heritage building in Malaysia. It was built in 1897. It was the superior courts of Malaysia, the Federal Court of Malaysia, the Court of Appeals and the High Court of Malaya before it turns into tourist attractions (Wong, 2008). It is located in Jalan Tun Perak which is across from Merdeka Square (Wong, 2008). It is facing the east side of Merdeka Square and the Royal Selangor Club, across from Jalan Sultan Hishamuddin as well (Wong, 2008). The location can be reached by using public transport (Wong, 2008).

2. SUSTAINABILITY ELEMENTS

This paper is to propose retrofitting a heritage building in Malaysia by implementing sustainability concept. The intention of implementing sustainability concept into buildings are moderately become popular nowadays despite the building itself is old and worn out especially heritage building, retrofitting a heritage building by implementing some sustainability concept has to be driven out by authorities to have longer building life meanwhile conserving the history of the heritage building. There are few elements regarding to sustainability concept such as thermal, lighting and ventilation.

3. THERMAL

First of all, thermal is one of the elements among the sustainability concepts. Thermal can be defined as a connection with heat as it is contributed by heat or temperature. Thermal can be allocated into insulation and glazing which could provide thermal comfort to occupants (Building, 2006).

Thermal Insulation

Thermal insulation transmit heat through building fabric (Building, 2006). A thick polyurethane foam can be applied on roof to prevent heat flow through roof to indoor. It is one of the types of insulation materials. There will be total of 4 layers about roof detail (Figure 1).

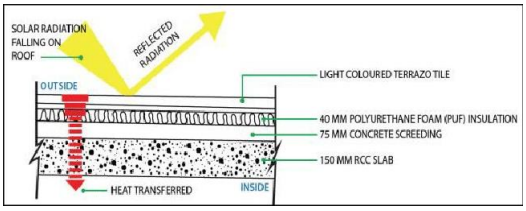

Figure 1: Roof Insulation Detail

A 150mm thickness of RCC slab will be at bottom which is direct contact with indoor environment (Bhanware, 2017). Followed by a 75mm concrete screed applied above RCC slab (Bhanware, 2017). Polyurethane foam (PUF) insulation will be placed at third layer with the thickness of 40mm (Bhanware, 2017). Light colour tile will apply on top of polyurethane foam insulation (Figure 2), the tiles is direct contact with outdoor environment (Bhanware, 2017).

Figure 2: Polyurethane Foam (PUF)

Polyurethane is also known as polyisocyanurate (Greenspec, 2020). It is a polymer which is collected by organic units (Greenspec, 2020). Polyurethane can produce different densities and hardness (Greenspec, 2020). It is suitable to be used on insulation for roofing and vertical walls (Greenspec, 2020). In addition, polyurethane insulation should be apply on the roof of Sultan Abdul Samad building (Figure 3). Heat will reflect back to atmosphere by insulation foam. It will prevent heat to penetrate into building as well.

Figure 3: Roof top of Sultan Abdul Samad Building

Thermal Glazing

Moreover, heat can be transmitted through the application of glazing as well. It has high performance on reducing the consumption of energy and pollution caused. Insulated windows also known as double-glazed windows is a perfect choices for developer to operate in construction site (Ayre, 2018). It helps to reduce thermal in interior space. Insulated windows have glasses separated between an air gap (Figure 4) in order to slow down heat transfer into building as well as contributing noise insulation (Gray, 2016). In the meantime, thicker gas fill in between is more effective to limit thermal conductivity (Ayre, 2018).

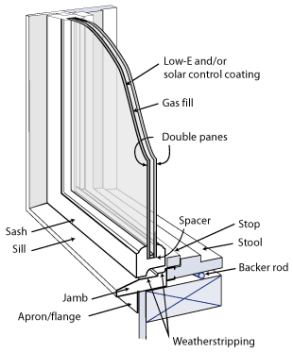

Figure 4: Cross section of Insulated Glass

For instance, low-emittance coating also known as low-e glass has a thin layers of metal or metallic oxide cover other the window glazing (Gray, 2016). An insulated window has a gap of gas fill between two layers of glass while the glass is coated with a layer of metallic oxide. Therefore, windows around Sultan Abdul Samad buildings especially corridor should be replaced with insulated window while the glass on window should be replaced by low-e glass (Figure 5). It perform a good thermal conductivity to the building. Occupants feel more comfortable when visiting the building.

Figure 5: Interior corridor in Sultan Abdul Samad Building

4. LIGHTING

Lighting can be considered as one of the sustainability elements as it is the core of the performance of a building, the building will not be functioned without light. In order to improve the performance of completing every tasks, a

sufficient and comfortable lighting should be provided to improve visibility to avoid the caused of distraction or discomfort (Wilson, 2018). Lighting can be classified as natural lighting and artificial lighting.

Natural Lighting

Natural lighting also known as day lighting is a natural sources coming from sun. It has a kelvin temperature around 5000 degrees kelvin and the colour of rendering has the index of 100 (Full Spectum, 2020). It is renewable as well as it will not bring affects to environment (Gray, 2020). The aim of daylighting design is to maximize the amount of natural light rays into building meanwhile without increasing indoor temperature and reducing direct glare rays into building to cause discomfort to occupants. Daylighting can access through windows, skylights, atriums, light shafts and translucent panels (Gray, 2020). Another way to utilize natural lighting is through reflected light (Williams, 2010). Reflected light diminish direct glare rays into buildings at the same time maintaining the indoor temperature as well (Williams, 2010). It allows light to reach areas which is lack of natural light. Coupled with the uses of light colour painted on interior walls and ceilings, light can reflected on wall to improve visibility (Williams, 2010). In Sultan Abdul Samad Building, there is a opening at the entrance lobby and atrium which allows natural light to light up the interior space (Figure 6).

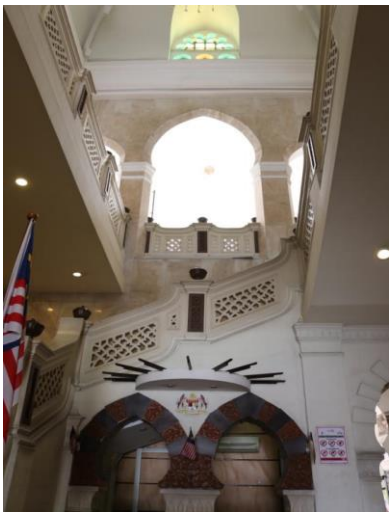

Figure 6: Main Entrance Lobby and Atrium of Sultan Abdul Samad Building

Artificial Lighting

Nevertheless, artificial lighting can be categorized by using technology to produce lights for occupants. Energy efficient light bulbs are advisable for buildings as it uses less energy compared to incandescent bulbs (Gray, 2020). Compact Fluorescent Lights (CFL) is a bulbs with phosphor coated on glass tube, filled with gas and small about of mercury which emanate same amount of light as incandescent bulbs but it is 50% cooler and it is 4 times more energy efficient compared to incandescent bulbs (Gray, 2020).

However Light Emitting Diode (LED) is a popular choice for users as it is more efficient compared to other bulbs. LED bulbs emit less heat to provide energy. LED luminaires for outdoor has longer life spend as it could last long about 50000 hours or more (Stouch, 2020). It required less power to distribute light because it do not have mercury content, lead or other materials. LED bulbs emit lesser carbon dioxide to atmosphere. Thus, LED luminaires are suggested to apply in Sultan Abdul Samad Building as it has large interior space which is more suitable to install LED luminaires on the corridor, indoor space and so on (Figure 7).

Figure 7: Artificial Light can be replaced by LED luminaires on Corridor

On the contrary, compact fluorescent lights released more heat to provide energy. High intensity discharge (HID) lamps are most efficient nowadays as it can save up to 75% of energy at the same time providing the same amount of light as incandescent bulbs. It is more suitable for outdoor areas and large indoor areas where lights are required to switch on for up to one hour due to the time taken to turn on the lights (Williams, 2010).

5. VENTILATION

Not only thermal and lighting, ventilation is also considered as one of the sustainability elements. Ventilation is a system moves air from outdoor to indoor spaces to provide a healthy air for occupants yet increase thermal comfort to occupant. Ventilation can be divided into active ventilation and passive ventilation.

Active Ventilation

Active ventilation is known as active system, using mechanical system to operate. Solar roof fan is one of the effective way to provide better ventilation within indoor area (Figure 8).

Figure 8: Solar Roof Fan

It could collect energy from sun then generate the ventilation fan to work. It brings more fresh air into indoor space while hot air is absorb out from attic (Solana Tec, 2018). It is encouraged to install on the roof of Sultan Abdul Samad Building as it could save energy yet bring fresh air into building (Figure 9).

Figure 9: Roof of Sultan Abdul Samad Building

Passive Ventilation

Passive ventilation is a system moves air in indoor spaces by natural process. For example, thermal buoyancy and air currents are the methods to ventilate indoor and outdoor air through building envelope openings and windows, doors, chimneys and so on (Mast, 2019). Thermal buoyancy system depends on different temperature between inside and outside of the building to maintain a proper ventilation in building (Moffitt, 2020). These method ventilate hot air to outdoors to provide a comfortable temperature in indoor spaces. In some such way it does not bring harms to environment as it uses natural resource to provide thermal comfort to occupants in the spaces.

6. CONCLUSION

Retrofit a heritage building by implementing sustainability concept bring advantages not only to building itself yet environment as well. It could lower the impact towards the environment. It reduces the emissions of gases which helps to slow down global warming and acid rain (Thomas, 2018). Reducing the pollution to create a better environment without damaging the mother nature. In addition, a better future for next generation is guaranteed as the actions are appropriated to slow down the melting of poles due to abnormal climate changes (Thomas, 2018). On the other hand, thermal insulation reduces heating bills and absorb noise as well (Agnt846, 2014). Polyurethane foam insulation can support -150 to +200 degree celcius of temperature (Construction, 2016).

Whereas insulated window helps on saving energy bills and improve security the material itself is tougher to break (Chief, 2016). Furthermore, natural lighting can decrease eyestrain and reduce electricity costs while for artificial lighting can change the beauty and mood of a room (MaintenX, 2018). Along with active ventilation, which is solar roof fan has no electrical costs and reduce air conditioning bill (Solana Tec, 2018). Buoyancy ventilation works better when outside is hot and it is sustainable and has steady air flow. To that end, retrofit a heritage building by implementing sustainability concept can extend building life which next generation could still be able to visit in future somehow

conserving the culture and historical knowledge to educate next generations.

However, although sustainability concept is a profitable choices to retro a heritage building but the costs of constructing the building is fairly high. Thermal ventilation is less effective in warmer climates (Bennett, 2019). Polyurethane foam insulation is defenseless to UV rays (Construction, 2016). Thermal glazing cannot be repaired as it uses seal method to hold the frame and glazing together (Chief, 2016). Insulated window cost higher as the installation construction is complicated (VRG, 2011). Likewise, natural lighting can cause the fading of colours on furniture. It will caused expensive heat cooling costs if it is not planned well (MaintenX, 2018). Artificial lighting contain UV and infrared radiation which will affect personal health (MaintenX, 2018).

Additionally, active ventilation brings in exterior air could bring addition workload for HVAC system (White, 2020). Passive ventilation system is less efficient if the temperature between outdoor and indoor are not consequential difference (Mast, 2019). Buoyancy ventilation system is less useful for windy days (Moffitt, 2020). In general, the cost for retrofit a heritage building is quite huge and it takes more time for construction. The building itself is old and it used traditional construction materials, building might not bear with the pressure could collapse easily.

In a nutshell, this paper is written in order to propose retrofitting heritage buildings in Malaysia should be operated especially implementing sustainability concept. Sustainable development are slowly becoming a popular ideas for construction and architects. In my opinion, there are a lots of heritage buildings in Malaysia which some of it are old and worn-out. Retrofit heritage building should be encouraged as it could bring the building life longer to prevent the histories and culture of buildings to be forgotten. Despite it might takes longer time to retrofit and construct, it is better to be conserved for future generations rather than being abandoned. Besides, it could bring benefits to country as it helps to improve tourism industry and indirectly improve economy Malaysia.

7. REFERENCES

Agnt846. (2014). Advantages and disadvantages of home insulation. Retrieved from http://agentur-tatewos.com/advantages-and-disadvantages-of-home-insulation/

Ayre, J. (2018). Insulated Windows 101 - Double Glazing, Triple Glazing, Thermal Performance, & Potential Problems. Retrieved form https://cleantechnica.com/2018/04/28/insulated-windows-101-double-glazing-triple-glazing-thermal-performance-potential-problems/

Bennett, L. (2019). Why Choose Natural Ventilation. Retrieved from https://www.bedsonreps.com/blog/posts/pros-and-cons-of-natural-ventilation-systems

Bhanware. (2017). Roof insulation details. Retrieved from https://www.researchgate.net/figure/Roof-insulation-details-Wall-insulation-Figure-7-External-wall-constructed-as-cavity_fig3_321476552

Building. (2006, October 13). Sustainability: Thermal Insulation. Retrieved from https://www.building.co.uk/data/sustainability-thermal-insulation/3075146.article

Chief. (2016). 9 Advantages and Disadvantages of Double Glazed Windows. Retrieved from https://connectusfund.org/9-advantages-and-disadvantages-of-double-glazed-windows

City of Melbourne. (2020). What is a building retrofit Retrieved from https://www.melbourne.vic.gov.au/business/sustainable-business/1200-buildings/building-retrofit/Pages/building-retrofit.aspx

Construction. (2016).Thermal insulation with polyurethane foam: reviews. Retrieved from http://construct-yourself.com/building-materials-and-constructions/construction-materials/thermal-insulation-with-polyurethane-foam-reviews.html

Full Spectum. (2020). What Is Natural Lighting And Why It Matters. Retrieved from

https://www.fullspectrumsolutions.com/pages/what-is-natural-lighting

Gray, J. (2016, February 6). Windows in Sustainable Design. Retrieved from http://www.sustainablebuild.co.uk/designwindows.html

Gray, J. (2020, February 7). Sustainable Lighting. Retrieved from http://www.sustainablebuild.co.uk/sustainablelighting.html

Greenspec. (2020). Insulation materials and their thermal properties. Retrieved from http://www.greenspec.co.uk/building-design/insulation-materials-thermal-properties/

Green Thumb Design Studio. (2020). Going Green. Retrieved from https://www.greenthumbdesignstudio.com/sustainable-design.htm

MaintenX. (2018). Natural Light vs. Artificial Light: Pros and Cons. Retrieved from https://maintenx.com/natural-light-vs-artificial-light-pros-cons/

Mast, A. (2019). Active Ventilation vs. Passive Ventilation. Retrieved from https://solarroyal.com/active-ventilation-vs-passive-ventilation/

Michaels Enerygy. (2019). The Lasting Benefits of Sustainable Design. Retrieved from https://michaelsenergy.com/briefs/the-lasting-benefits-of-sustainable-design/

Moffitt. (2020). BUOYANCY VENTILATION AND YOU. Retrieved from https://www.moffittcorp.com/buoyancy-ventilation/

Mondal, P. (2020). 5 Important Measures for Sustainable Development. Retrieved from http://www.yourarticlelibrary.com/environment/5-important-measures-for-sustainable-development/9912

Rinkesh. (2020). What is Sustainable Development?. Retrieved from https://www.conserveenergyfuture.com/what-is-sustainable-developmentanditsgoals.php

Stouch, T. (2020). New Trend in Outdoor Area Lighting. Retrieved from https://www.airbestpractices.com/sustainability-projects/lighting/new-trend-outdoor-area-lighting

Solana Tec. (2018). Roof Ventilation = Making your home comfortable. Retrieved from https://solanatec.com/solar-roof-ventilator-fan/

Thomas. (2018). ADVANTAGES AND DISADVANTAGES OF SUSTAINABLE DEVELOPMENT. Retrieved from https://www.lorecentral.org/2018/07/advantages-and-disadvantages-of-sustainable-development.html

Tobias, M. (2004, March 18). Elements of Sustainable architecture. Retrieved from https://www.ny-engineers.com/blog/elements-of-sustainable-architecture

VRG. (2011). Insulated Windows: Advantages and Disadvantages. Retrieved from https://www.replacementwindowsfordummies.com/articles/insulated-windows-advantages-and-disadvantages

White, B. (2020).Advantages & Disadvantages of Mechanical ventilation Systems. Retrieved from https://www.hunker.com/12556797/advantages-disadvantages-of-mechanical-ventilation-systems

Williams. (2010). Lighting. Retrieved from https://sustainability.williams.edu/green-building-basics/lighting

Wilson, J. (2018). Lighting Design for Health and Sustainability: A Guide for Architects. Retrieved from https://www.buildinggreen.com/feature/lighting-design-health-and-sustainability-guide-architects

Wong, P. (2008). Sultan Abdul Samad Building in Kuala Lumpur. Retrieved from http://www.kuala-lumpur.ws/attractions/sultan-abdul-samad-building.htm