©2019 International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

TuEngr Group

International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

PAPER ID: 10A19D

WHAT WILL HAPPEN AFTER THE ADAPTIVE REUSING THE BUILDING? AN ASSESSMENT OF INDOOR VISUAL COMFORT OF HERITAGE OFFICE BUILDINGS

Rani Prihatmanti [a*] and Azizi Bahauddin [a]

[a] *School of Housing, Building & Planning, Universiti Sains Malaysia, MALAYSIA*

ARTICLEINFO

Article history:
Received 24 May 2019
Received in revised form 18 September 2019
Accepted 26 September 2019
Available online 25 October 2019

Keywords:
Adaptive reuse; Visual comfort; Indoor lighting; Visual discomfort; Room light level; UNESCO World Heritage Site; Occupants' satisfaction.

ABSTRACT

This paper studies the visual comfort of five heritage office buildings that have been adaptively reused. These buildings are located within the UNESCO World Heritage Site in George Town, Penang. The changes applied to the interior space have created a problematic condition for the occupants' visual comfort. A set of questionnaires focusing on visual comfort and lighting quality was distributed to the respondents of the studied buildings, followed by the building observation and indoor light level measurements. The findings revealed that the indoor light level is below the standard for the working spaces. This resulted in the visual discomfort for the workers, such as glare. The view of nature also very limited due to the permanently blocked doors and windows from the existing buildings. This study shows that inappropriate adaptive reuse practice is significantly affecting the occupants' visual comfort satisfaction of the studied buildings, therefore it decreases the working performance as well as their productivity.

Disciplinary: Architectural Sciences and Management.

1. INTRODUCTION

The impact of the indoor environment towards the occupants' satisfaction has been studied since the past decade and it has been proven that the indoor environment is significantly affecting the occupants' productivity and efficiency of their activities (Kamaruzzaman et al. 2018; Kim et al. 2013; Bluyssen et al. 2011). Human beings are the main concerns of sustainable development, where they are entitled to a healthy and productive life to live in harmony with nature. Roulet (2006) stated that besides its aesthetic value, a building should be healthy, functional, low energy, environmentally friendly, and universally designed. Therefore, a building should provide a good indoor environment for its occupants. A good indoor environment is one of the objectives of sustainable architecture. This is because the occupants' satisfaction is considered as the most-readily assessed indicator for

*Corresponding author (R. Prihatmanti). Email: raniprani417@gmail.com

sustainable factors in the built environment.

The crucial factor of sustainability in the built environment focuses on the occupants' satisfaction which addresses the ability of the indoor environment to support healthy, comfortable, and productive occupants. Moreover, occupants' health and well-being are considered as the ultimate goal of Indoor Environmental Quality (IEQ), which consists of four major parameters: thermal quality, lighting quality, noise quality, and Indoor Air Quality (IAQ). These elements are compulsory to be considered in any green building assessment criteria. According to Bluyssen et al. (2011), exposure to the IEQ stressors could cause both short and long term effects on the building occupants. This is also agreed by Kamaruzzaman et al. (2011) that green and high-performance building is better in terms of providing a healthier indoor environment for the occupants.

In this research, the office was chosen as the case study due to the importance of social, technological, and financial progress. An office is also considered as the most visible index for economic activities. Bluyssen et al. (2011) highlighted the associations between occupants' health and productivity with the indoor stressors inside an office environment. The employees are required to be healthy and comfortable in order to fulfill the productivity level as well as economic demand. This condition needs to be taken into consideration since Malaysian office workers spent most of the time working indoors.

In a working environment, the amount of light is a crucial matter. Light is not merely for illuminating the interior, but it is also significantly affecting the health and well-being of the workers themselves. A study conducted by Bommel & Beld (2003), an adequate amount of light leads to better work performance, better safety, fewer work errors, and absenteeism level is lower. In fact, not all workplaces provide adequate lighting. This condition is commonly happened in building with a high ceiling as in the heritage buildings. In the past, buildings were built to be adaptable with the local climate by having large openings and high ceilings as a mean of natural ventilation method as well as for harvesting the daylight. However, the Earth is currently facing the global warming phenomena, particularly in the urban where the Urban Heat Island (UHI) occurs. This condition creates a warmer temperature in the urban and air conditioning systems were installed in order to achieve a thermally comfortable working space. Unfortunately, this has resulted in a significant reduction in terms of the amount of light that enters the building due to the blocked windows and openings. The visual connection with the outdoor also disconnected. This condition commonly occurred in buildings that have been undergone major changes in terms of its function or known as an adaptively reused building. Despite the changes in the building, occupants' visual comfort should not be neglected. Hence, this research studies the impact of the adaptively reused buildings towards the indoor lighting quality as assessed by the occupants' satisfaction level.

2. LITERATURE REVIEW

2.1 ADAPTIVE REUSING HERITAGE BUILDING

As mentioned previously, this research focuses on the adaptively reused buildings which are located in George Town, Penang-Malaysia. Being listed as the UNESCO World Heritage Site in 2008, some of the buildings were adaptively reused in order to maintain its occupancy which could prevent the building from being abandoned and dilapidated. According to the Burra Charter (Australian ICOMOS Inc., 1999), adaptive reuse could be defined as a modification of a place to suit the existing purpose and compatible in uses, which involves no change to the culturally significant fabric. The changes must be significantly reversible or change with a minimal impact on the building itself. Moreover, adaptive reusing heritage buildings is beneficial in terms of increasing the quality of life and the property value of the building. This is also agreed by Henehan & Woodson (2004) that adaptive reusing heritage buildings could be a source of historic, cultural, and visual fabric, besides keeping the entire area occupied and vital.

Despite the positive impacts of adaptive reuse, there are also adverse impacts that occurred in the building. Based on the previous study by Prihatmanti & Bahauddin (2014), the alterations conducted on the building potentially could affect the quality of the indoor environment. The air quality inside the workplaces was unacceptable according to the standard. Low ventilation rate inside the studied buildings causing stagnant air. It was also discovered that damp stain and mould were present in studied buildings as a result of high humidity and moisture level. A high level of dust was also discovered due to the maintenance irregularities.

2.2 OCCUPANTS' VISUAL COMFORT

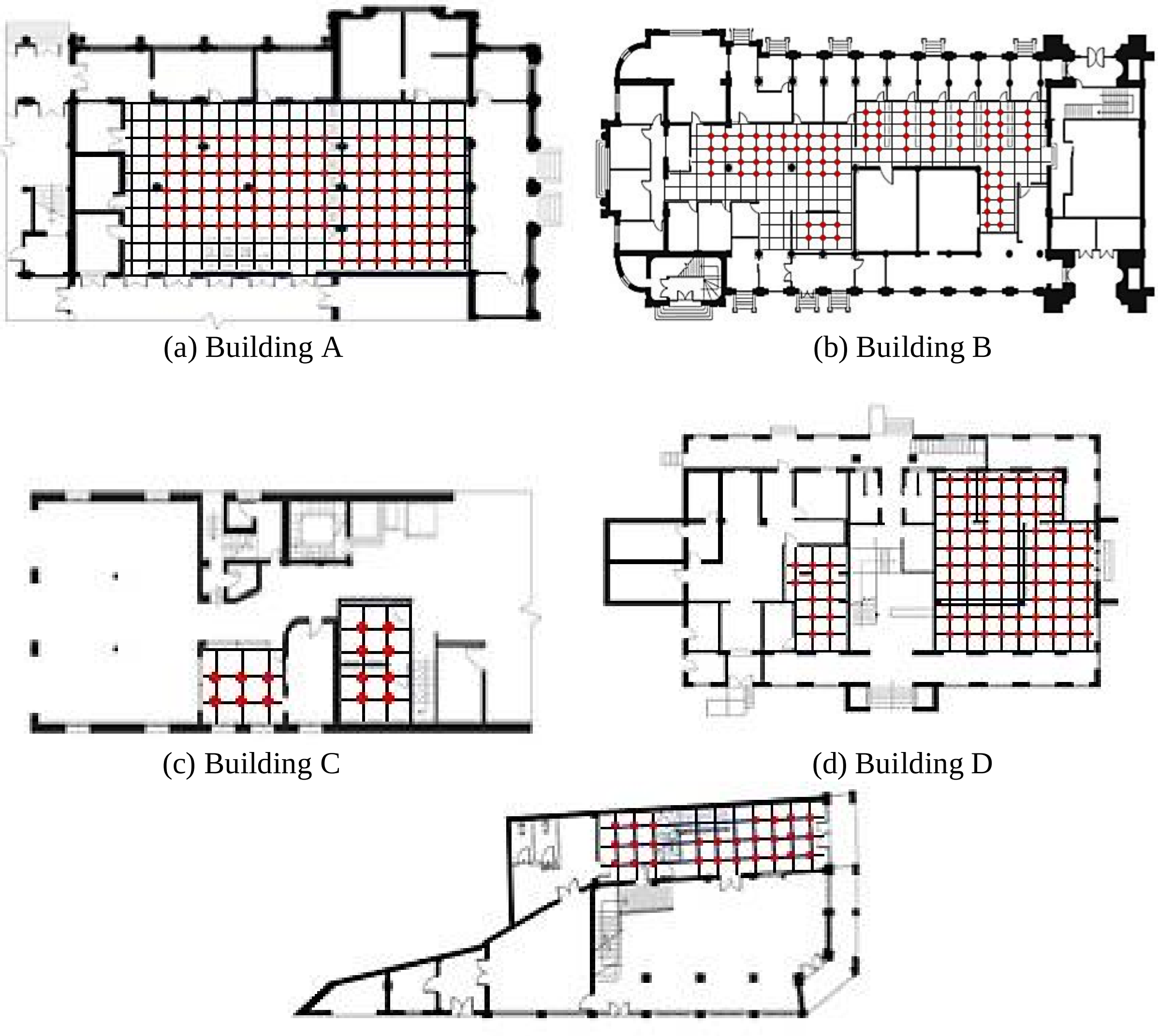
Another study conducted by Susan & Prihatmanti (2017) in adaptively reused school buildings resulted that the amount of daylight also falls below the benchmark. In a working environment, Veitch et al., (2011) also agreed that lighting appraisals could influence work engagement through aesthetic judgments and mood. By providing a satisfactory working environment will contribute to employee working behaviors which are important to support client decision making. Providing light level according to the standard (300-500 lux) may increase the overall productivity by 8 percent (Bommel & Beld, 2003).

Besides the sufficient amount of light, visual comfort could be achieved by the presence of nature, such as trees, indoor plants, and other forms of vegetation. A view of greeneries and the direct effect of sunlight could buffer the negative impact of job stress on intention to quit and to recover from mental fatigue. Nature also brings positive impacts to human's cognitive level, and psychology and physiology well-being (Lohr et al., 1996; Larsen et al., 1998; Leather et al., 1998; Shibata & Suzuki, 2001, 2002, 2004; Bringslimark et al., 2007). Another study by Adachi, Rohde, & Kendle (2000) and Chang & Chen (2005), nature is able to reduce the stress level, discomfort symptoms, as well as for mood and emotions improver. Although the building has been adaptively reused, the visual relationship between humans and nature must be maintained. (Bringslimark et al., 2009) agreed that by viewing natural elements, it will bring psychological benefits to the viewer. Thus, the presence of nature in the indoor environment needs to be re-established

3. RESEARCH DESIGN AND METHODOLOGY

3.1 BUILDING SELECTION CRITERIA

This research measured the quality of the indoor environment in an adaptively reused building within the UNESCO World Heritage Site in George Town, Penang. There are many potential buildings to be investigated, however, only five were selected in this study which all of them were constructed between the year 1900-1920. In order to maintain the anonymity, the studied buildings were labelled as Building A, B, C, D, and E. The building selection criteria are (1) must be located within the UNESCO World Heritage Site (Core or Buffer Zone), (2) gazetted under the Category 1 or 2 heritage building according to the Malaysia National Heritage Act, (3) has been adaptive reused into a new function, (4) the office layout must be an open plan office type, (5) fully air-conditioned, (6) the building occupants (respondents) are the full-time employees.



(a) Building A

(b) Building B

(c) Building C

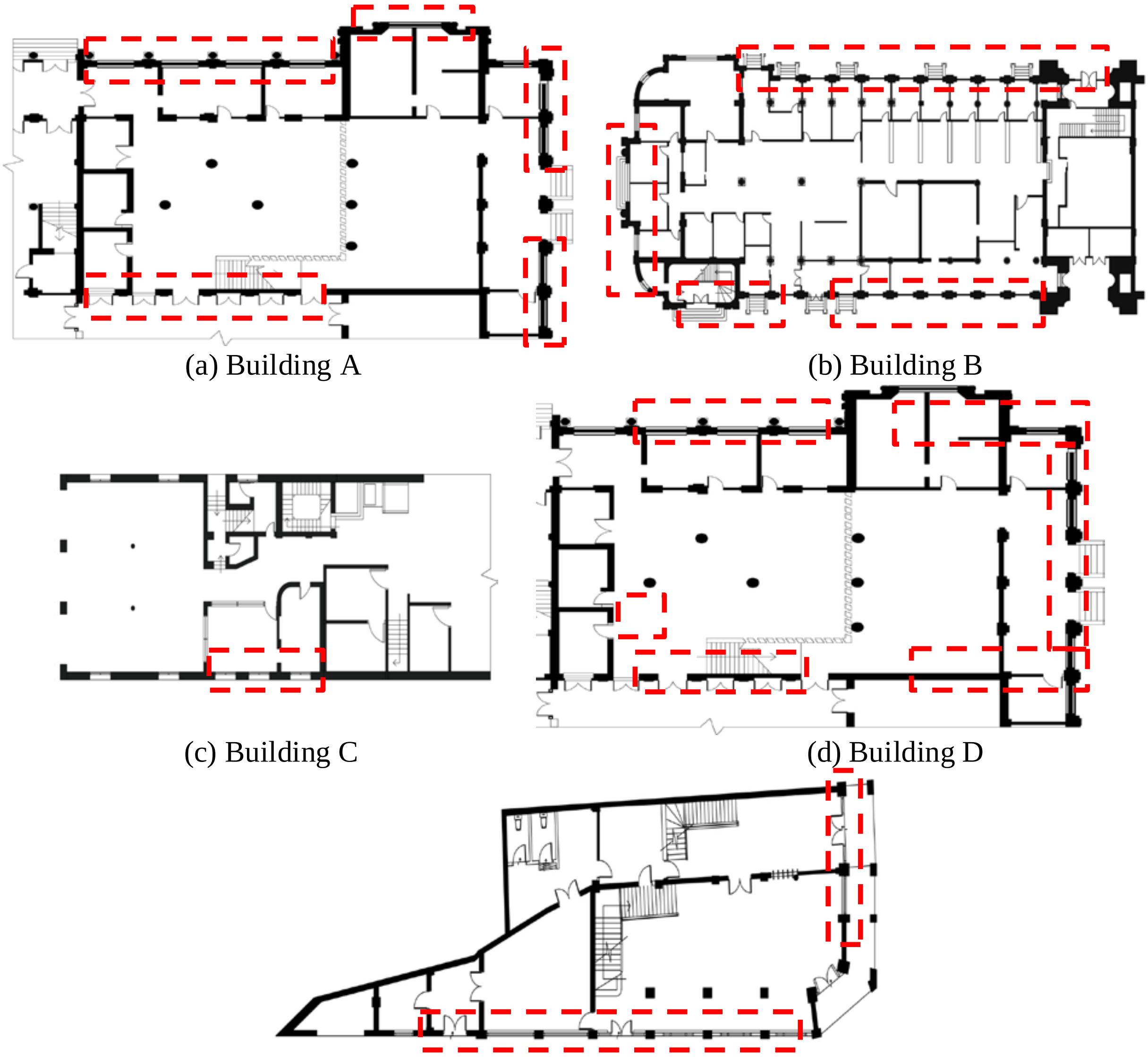
(d) Building D

(e) Building E

Figure 1: The Sampling Grid (building plan not to scale).

3.2 VISUAL COMFORT PARAMETER

The indoor light level is measured to provide the actual environmental condition of the studied buildings. This variable was also included in the Malaysia Green Building Index (GBI) for Non-Residential Existing Building (NREB): Historic Building Tool to capture the factors that influence occupants' satisfaction based on the compliance as a part of the IEQ standards. The GBI-NREB: Historic Building tool is used to ensure the adaptively reused buildings will remain relevant in the future. The benchmarks used in this research is from the Malaysia Green Building Index (Malaysia Green Building Confederation, 2018), and Guidelines in the Office by the Department of Occupational Safety and Health (1996). The light level was measured at one time by using a hand-held direct reading light meter (Meterman LM631) focusing only on the open-plan office. To capture the whole condition, the measurement was taken in every 1.2 m^2 grid of the studied space and in desk height. The sampling points are illustrated in red dots (Figure 1 a-e). The Mean light level was obtained by adding the number from each grid.



(a) Building A (b) Building B

(c) Building C (d) Building D

(e) Building E

Figure 2: The layout of the Studied Buildings (not to scale)

3.3 OCCUPANTS' PERCEPTION OF THE LIGHTING QUALITY

To capture the occupants' perception towards the IEQ condition, self-administered questionnaires were distributed by hand to the respondents of the studied buildings. The results obtained from the questionnaire survey could identify the specific items that require adjustment and improvement to provide a better indoor environmental quality for the occupants (Kamaruzzaman et al., 2011). In this research, the questions were adopted and adjusted from the Occupant Indoor Environmental survey of Centre for the Built Environment (CBE), UC Berkeley focusing on the assessment of the visual comfort based on the indoor light level as well as the overall occupants' satisfaction by using 5-point Likert Scale from Strongly disagree (-2), Disagree (-1), Neutral (0), Agree (+1), and Strongly agree (+2). To avoid any misinterpretations, the questions were translated into the Malaysian language and reliability test of the translated questionnaire was conducted with a score of 0.8.

4. RESULT

4.1 VISUAL OBSERVATION AND DOCUMENTATION

According to D. Kincaid (2002), there are four characteristics of physical changes in building adaptation: low, low-medium, medium-high, and high change. In this research, Buildings A and C are considered as the low-change. The external buildings were maintained according to the original design but minor modification on the interior. Building B, D, and E is categorised as the medium-high change. The external building fabrics were maintained, but the building structure was modified and reorganised the interior space. The medium-high change category is similar to the criteria for the Category 2 heritage building according to the Malaysia National Heritage Act (Act 645).

Figure 3: The Condition of the Working Spaces in the Studied Buildings.

Figure 4: Limited Indoor Vegetation in Building A.

Building documentation and walk-through inspection were also conducted to capture the overall building condition as well as to identify the presence of indoor vegetation and view of nature. From the observation, it shows that all buildings were converted into office spaces and the layouts are in open-plan type. Since these buildings have been adaptively reused, the majority of the windows and doors were permanently closed due to the installation of air conditioning devices. The dotted lines in Figure 2 (a) to (e) represent the closed doors and windows due to the installation of the air conditioning system. Unfortunately, as illustrated in Figure 3 there was limited access to view nature in all studied buildings. Three potted indoor plants only founded in Building A (Figure 4).

4.2 RESPONDENT'S DEMOGRAPHIC PROFILE

Due to the limitation of the number of occupants who are working in the selected buildings, only 110 respondents have participated in this survey. However, only 101 results are valid. All of the respondents are full-time employees that work form 9 a.m. until 5 p.m. Based on the result tabulated in Table 3.1, it shows that the female respondents (52.5%) are slightly higher compared to the male respondents (47.5%), and more than half (55.4%) of the respondents are considered as the productive age, between 26 and 39 years old (55.4%). Most of the respondents (41.6%) are working for more than 5 years and 71.3% of them have been working between 7-12 months in their current workplace.

Table 1: Respondent's Demographic Profile

Profile	Sub-profile	Total (n (%))
Gender	Male	48 (47.5%)
	Female	53 (52.5%)
Age group	<25 years	15 (14.9%)
	26-39 years	56 (55.4 %)
	40-55 years	26 (25.7 %)
	>55 years	4 (4.0 %)
Working duration at present workspace	<1 year	23 (22.8 %)
	1-2 years	16 (15.8 %)
	3-5 years	20 (19.8 %)
	>5 years	42 (41.6 %)
Working duration at present workspace	<3 months	8 (7.9 %)
	4-6 months	11 (10 %)
	7-12 months	72 (71.3 %)
	>1 year	9.9 (10.9 %)

4.3 VISUAL SATISFACTION LEVEL

In this modern world, office work involves a variety of visual tasks at once, paper-based and computer-based tasks. To enhance their productivity level, the general illumination should meet the amount of light required for occupants in their workplace. Inappropriate adaptive reuse practice in the studied buildings have proven that the light levels are below the standard (200-400 lux) for office work (Table 2). This is mainly caused by covering the windows and openings due to the installations of the air conditioner after being adaptive reused. Moreover, the ceiling height in Building A, B, and D are 6 meters high, and Building C and E are 4.5 meters. Due to the ceiling height problems, the lighting armatures in all buildings were suspended up to 3 meters from the floor finish level in order to provide adequate illumination levels to the working plane. However, this condition does not improve the indoor light level.

Table 2: Visual Comfort Level

Parameter	Mean (per building)					Benchmark *DOSH Malaysia (1996), GBI NREB (2018)*
	A	B	C	D	E	
Light level (lux)	180	114	154	158	121.5	*200-400*

According to the occupants' satisfaction survey result in Table 3, Building A has the lowest mean number for satisfaction in the indoor amount of light (M=2.82, SD=1.02) and also the satisfaction in the visual comfort (M=2.79, SD=0.99). This is supported by the survey result that the lighting quality in Building A does not significantly enhance their working performance (M=2.93, SD=0.90). Although glare was discovered during the observation, this condition does not lead the occupants of

Building E to decrease their work performance (M=3.54, SD=0.66).

In overall, the variable ‘Perception towards the excessive light level’ has the lowest Mean number for all buildings (Building A (M=2.54, SD=1.07), Building B (M=2.64, SD=1.02), Building C (M=2.44, SD=1.01), Building D (M=3.00, SD=0.84), and Building E (M=2.31, SD=0.63). This indicates that the occupants perceived fewer light levels in their working space. Compare to the rest, based on the survey, the employees of Building A were mostly dissatisfied with the lighting quality in their current workspace.

Table 3: Visual Comfort Satisfaction Level

Variables per Building		N	Mean	SD
Satisfied with the amount of light	Building A	28	2.82	1.02
	Building B	36	3.44	1.03
	Building C	9	2.89	1.05
	Building D	15	3.00	.97
	Building E	13	3.69	.63
	Total	101	3.19	1.01
Satisfied with the visual comfort	Building A	28	2.79	.99
	Building B	36	3.14	.90
	Building C	9	3.00	1.22
	Building D	15	3.00	.76
	Building E	13	3.54	.88
	Total	101	3.06	.95
Perception towards the excessive light level	Building A	28	2.54	1.07
	Building B	36	2.64	1.02
	Building C	9	2.44	1.01
	Building D	15	3.00	.84
	Building E	13	2.31	.63
	Total	101	2.60	.97
Lighting quality enhances work	Building A	28	2.93	.90
	Building B	36	3.36	.93
	Building C	9	3.00	1.22
	Building D	15	3.27	.70
	Building E	13	3.54	.66
	Total	101	3.22	.90

5. DISCUSSIONS

Good lighting can be defined as having the right amount in the right place. This means that it is essential to have good lighting so that work can be clearly seen and it is comfortable to the eyes. In all circumstances, lighting should be adequate to prevent poor visibility and discomfort. The factors that contribute to the quality of good lighting and the occupants' satisfaction on the studied buildings are the ceiling height, the amount of the artificial lightings installed, the number and position of the openings, the availability of internal window shade to control the glare, and the selection of interior fabrics. To increase the illuminance level, treatment in the ceiling, wall, and floor is suggested. Material with a certain reflectance number could increase the illuminance level without causing glare to the occupants (Susan & Prihatmanti, 2017). There are also recommendations by Choi, Aziz, & Loftness, (2010) in order to maintain the working space physically comfortable, such as separating the task and ambient lighting at each workstation.

Indoor vegetation could be another consideration to improve the quality of the indoor environment since plants are known to be beneficial physically and physiologically (Tudiwer &

Korjenic, 2017). Many types of indoor plants could absorb certain pollutants and purify the air, such as *Sansevieria trifasciata var. laurentii*/Mother-in-law's tongue, *Epipremnum aureum*/money plant, *Nephrolepis exaltata*/Boston Fern., *Spathiphyllum*, *Dracaena*, *Pandanus amaryllifolius*/Fragrant pandan, and many others. Panyametheekul et al., (2018) also stated that live foliage and houseplants with wrinkled and hairy leaves are capable to be an indoor sink for particulate matter. If space is limited, vertical planting, such as a living wall, is possible to conduct. Besides providing visual contact of the natural element on the interior, the living wall also helps to improve the microclimate of the indoor environment and reduce energy consumption. However, there are important factors need to be considered before applying greeneries. Those are the location, availability of air and light for photosynthesis process, appropriate temperature, plant species, and the regularity of the maintenance (Almusaed, 2011; Charoenkit & Yiemwattana, 2016; Prihatmanti & Taib, 2017).

6. CONCLUSION

This study has contributed important findings regarding the condition of the heritage buildings after being adaptively reused into a new function. According to the findings, it shows that the indoor light level is below the standard for an office, which has to fall between 200 to 400 lux. A critical concern must be taken into account in terms of heritage building conservation, by focusing on the indoor environment, including the occupants' satisfaction. Despite its limitations on the conservation guidelines, the quality of the indoor environment should not be neglected and must comply with the standard given, such as the GBI-NREB and from the DOSH Malaysia or any other international standards. In the future, this research could provide new insight for the designers regarding the perceptions of occupants in relation to building performance based on indoor lighting and visual comfort, particularly on adaptively reused heritage buildings. To improve the visual satisfaction of the occupants, indoor vegetation can be applied in order to enhance the physical and psychological quality of the indoor environment.

7. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding authors

8. ACKNOWLEDGEMENT

The authors gratefully acknowledge the financial support from the Universiti Sains Malaysia under the Fellowship scheme of Institute Postgraduate Studies and Research University Grant no. 1001/PPBGN/639050.

9. REFERENCES

Adachi, M., Rohde, C. L. E., & Kendle, A. D. (2000). Effects of floral and foliage displays on human emotions. HortTechnology, 10(1), 59–63.

Almusaed, A. (2011). Biophilic and Bioclimatic Architecture: Analytical Theraphy for the Next Generation of Passive Sustainable Architecture. Denmark: Springer.

Australian ICOMOS Inc. (1999). The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance. Victoria: Australia ICOMOC Inc. https://doi.org/363,690994 ICO

Bluyssen, P. M., Janssen, S., van den Brink, L. H., & de Kluizenaar, Y. (2011). Assessment of wellbeing in an indoor office environment. Building and Environment, 46(12), 2632–2640. https://doi.org/10.1016/j.buildenv.2011.06.026

Bommel, W. W. J. M. van, & Beld, G. J. van den. (2003). Lighting for work: visual and biological effects. The Netherlands: Philips Lighting.

Bringslimark, T., Hartig, T., & Patil, G. G. (2007). Psychological benefits of indoor plants in workplaces: Putting experimental results into context. HortScience, 42(3), 581–587. https://doi.org/<p></p>

Bringslimark, T., Hartig, T., & Patil, G. G. (2009). The psychological benefits of indoor plants : A critical review of the experimental literature. Journal of Environmental Psychology, 29(4), 422–433. https://doi.org/10.1016/j.jenvp.2009.05.001

Chang, C., & Chen, P. (2005). Human Response to Window Views and Indoor Plants in the Workplace, 40(5), 1354–1359.

Charoenkit, S., & Yiemwattana, S. (2016). Living walls and their contribution to improved thermal comfort and carbon emission reduction: A review. Building and Environment, 105, 82–94. https://doi.org/10.1016/j.buildenv.2016.05.031

Choi, J., Aziz, A., & Loftness, V. (2010). Investigation on the impacts of different genders and ages on satisfaction with thermal environments in office buildings. Building and Environment, 45(6), 1529–1535. https://doi.org/10.1016/j.buildenv.2010.01.004

D. Kincaid. (2002). Adapting buildings for changing uses. Guidelines for change of use refurbishment. London: Spon Press.

Henehan, D., & Woodson, R. D. (2004). Building change-of-use: renovating, adapting, and altering commercial, institutional, and industrial properties. New York: McGraw-Hill.

Kamaruzzaman, S. N., Egbu, C. O., Mahyuddin, N., Ahmad Zawawi, E. M., Chua, S. J. L., & Azmi, N. F. (2018). The impact of IEQ on occupants' satisfaction in Malaysian buildings. Indoor and Built Environment, 27(5), 715–725. https://doi.org/10.1177/1420326X16689493

Kamaruzzaman, S. N., Egbu, C. O., Zawawi, E. M. A., Ali, A. S., & Che-Ani, A. I. (2011). The effect of indoor environmental quality on occupants' perception of performance: A case study of refurbished historic buildings in Malaysia. Energy and Buildings, 43(2–3), 407–413. https://doi.org/10.1016/j.enbuild.2010.10.003

Kim, J., Dear, R. De, Cândido, C., Zhang, H., & Arens, E. (2013). Gender differences in of fi ce occupant perception of indoor environmental quality (IEQ), 70.

Larsen, L., Adams, J., Deal, B., Kweon, B. S., & Tyler, E. (1998). Plants in the workplace the effects of plant density on productivity, attitudes, and perceptions. Environment and Behavior, 30(3), 261–281. https://doi.org/10.1177/001391659803000301

Leather, P., Pyrgas, M., Beale, D., & Lawrence, C. (1998). Windows in the Workplace: Sunlight, View, and Occupational Stress. Environment and Behavior, 30(6), 739–762. https://doi.org/10.1177/001391659803000601

Lohr, V. I., Pearsons-Mims, C. H., & Goodwin, G. K. (1996). Interior Plants May Improve Worker Productivity and Reduce Stress in a Windowless Environment. Journal of Environmental Horticulture, 14(2), 97–100.

Malaysia Green Building Confederation. (2018). Non-Residential Existing Building (NREB): Historic Building Tool. Kuala Lumpur. Retrieved from http://new.greenbuildingindex.org/Files/Resources/GBI Tools/GBI NREB Historic Building Tool Final.pdf

Panyametheekul, S., Rattanapun, T., & Ongwandee, M. (2018). Ability of artificial and live houseplants to capture indoor particulate matter. Indoor and Built Environment, 27(1), 121–128. https://doi.org/10.1177/1420326X16671016

Prihatmanti, R., & Bahauddin, A. (2014). Indoor Air Quality in Adaptively Reused Heritage Buildings at a UNESCO World Heritage Site , Penang , Malaysia, 19(1), 69–91.

Prihatmanti, R., & Taib, N. (2017). Improving Thermal Comfort through Vertical Greeneries in Transitional Spaces for the Tropical Climate : A Review. GSTF Journal of Engineering Technology (JET), 4(3), 116–123.

Roulet, C. (2006). Architectural education for sustainable design A proposal for improving indoor environment quality. In The 23rd Conference on Passive and Low Energy Architecture, Geneva, Switzerland, 6-8 September 2006 (pp. 6–8).

Shibata, S., & Suzuki, N. (2001). Effects of Indoor Foliage Plants on Subjects' Recovery from Mental Fatigue. North American Journal of Psychology, 3(3), 385–396.

Shibata, S., & Suzuki, N. (2002). Effects of the foliage plant on task performance and mood. Journal of Environmental Psychology, 22(3), 265–272. https://doi.org/10.1006/JEVP.2002.0232

Shibata, S., & Suzuki, N. (2004). Effects of an indoor plant on creative task performance and mood. Scandinavian Journal of Psychology, 45, 373–381.

Susan, M. Y., & Prihatmanti, R. (2017). Daylight characterisation of classrooms in heritage school buildings. Planning Malaysia, 15(1).

Tudiwer, D., & Korjenic, A. (2017). The effect of an indoor living wall system on humidity, mould spores and CO2-concentration. Energy and Buildings, 146, 73–86. https://doi.org/10.1016/j.enbuild.2017.04.048

Veitch, J. A., Stokkermans, M. G. M., & Newsham, G. R. (2011). Linking Lighting Appraisals to Work Behaviors. Environment and Behavior, 45(2), 198–214. https://doi.org/10.1177/0013916511420560

Rani Prihatmanti is a Senior Lecturer at the Interior Architecture Department, Ciputra University, Surabaya, Indonesia. Her research focuses on the Indoor Environmental Quality (IEQ) and the impact to the building occupants. Currently she is pursuing her PhD in Architecture Programme at the School of Housing, Building and Planning, Universiti Sains Malaysia (USM), Penang, Malaysia, majoring on skyrise greenery and thermal comfort in semi-outdoor space.

Professor Dr. Azizi Bahauddin is Professor in Interior Design at the School of Housing, Building and Planning, Universiti Sains Malaysia (USM), Penang, Malaysia. His research area focuses on the qualitative method on design and culture, particularly on phenomenology and ethnography.