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Original Research Article

Physical comfort in Statiko Coffee Shop, Wonosobo, Indonesia

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ABSTRACT: This research aims to analyze the environmental conditions inside and outside the Statiko Coffee Shop, Wonosobo, Indonesia, with a focus on noise, light intensity, air temperature, and humidity. Measurements were carried out at certain time intervals starting from 15:00 to 23:00. The collected data shows significant variations in each observed parameter. Indoors, noise levels varied, light intensity was recorded, air temperature fluctuated, and humidity ranged from 78.0% to 85.0%. Outdoors wider variations in noise, light intensity, air temperature, and humidity were seen. The results of this research show the importance of good understanding and design regarding ventilation and environmental management to create comfort for visitors in a coffee shop. This information can be used as a basis for designing an effective ventilation system and maintaining good indoor air quality, as well as considering external environmental influences such as noise and light intensity. Further research is needed to provide more specific recommendations for optimizing the environment at the Statiko Coffee Shop, Wonosobo, Indonesia.

KEYWORDS: thermal; voice; comfort; building; architecture

1. Introduction

Rising air temperatures are affecting many countries around the world. Global warming is getting higher and higher. Buildings contribute to worsening global warming through the use of cooling equipment. Buildings are infrastructure to accommodate human activities, so they require comfort. Global warming creates thermal discomfort for human activities. Thermal comfort in a building is related to the comfortable temperature for humans in each area. The comfortable temperature for humans in locations with low air temperatures is different from locations with high air temperatures[1]. Humans in low-temperature areas have a lower comfortable temperature than humans in high-temperature areas. Human adaptation to air temperature varies so that the comfortable temperature for humans in an environment also varies. Predicting comfortable temperatures is needed so that humans can predict thermal comfort needs in buildings[2]. Predicting comfortable temperatures can be done using various methods. Using statistical analysis can provide a prediction model for the air temperature that will occur. Predictive models can be used in building design. The prediction model will make it easier for architects to estimate thermal comfort needs from outside air temperature[3].

Uncomfortable buildings can cause people inside to become stressed and make people sick. Buildings that make occupants sick are called sick building syndrome (SBS). Indoor air is one of the essential factors in buildings that is related to sick building syndrome. Good indoor air exchange will

maintain clean air in the room. Ventilation is an essential factor in meeting indoor air quality. Good ventilation can remove dirty air particles to create clean air[4]. Clean air quality will support the thermal comfort of buildings. Clean air makes the air cooler. Clean air will also maintain indoor humidity. Thermal comfort in a room is related to the air temperature and air humidity in the room. The wind factor in the room is not too influential because the wind conditions do not blow too hard. The relationship between outdoor air temperature, humidity and wind is very close in creating thermal comfort. Environments with extreme conditions adapt buildings by creating additional elements to create thermal comfort[5].

Building elements have a role in creating thermal comfort. Research in high-temperature and high-humidity areas found that building layout influences creating thermal comfort for residents. Air temperature and air speed are analyzed using simulation methods, producing findings about building arrangement patterns that can create thermal comfort. Several layouts were analyzed and resulted in parallel layouts forming a ventilation corridor. The parallel layout can channel the wind well so that residents get fresh air[6]. The combination of architectural elements and adaptive thermal comfort is an essential factor in creating building thermal comfort. Wall material is one element in changes in air temperature and air humidity. Residents in the highlands and lowlands experience different air temperatures and air humidity in different seasons[7]. Differences in location make the air temperature and air humidity different, so building elements must be adapted to environmental conditions. An architectural element that is often discussed in thermal comfort research is the building envelope. Locality is one of the factors in determining the building envelope. The effect of using local building envelopes will create sustainability in architecture[8].

The relationship between indoor air temperature, air humidity and the content of substances in the air is very close in creating thermal comfort indoors. Research conducted in naturally ventilated schools shows variations in the results of the three variables. The CO_2 content in the air does not very much, but air temperature and humidity have significant variations. Using VENSIM simulation software to analyze the data shows a high correlation between variables. CO_2 concentrations cannot be predicted when they reach 1500 ppm. Air temperature and humidity are variables that cannot be separated when discussing thermal comfort, although other factors add to the discussion[9].

The strategy for creating thermal comfort through variable air temperature and air humidity is one of the points in various thermal comfort research. Research in Beirut, Lebanon City, carried out a strategy of changing soil albedo, replacing old buildings with new ones and adding vegetation to create thermal comfort. The strategy used will improve the urban environment to make it more comfortable. The research used a simulation method and found that vegetation was the best strategy compared to the other two. The decrease in air temperature occurs in the afternoon and radiation temperature during the day. The search for strategies for creating thermal comfort through research on air temperature and humidity is still relevant and essential[10].

The strategy to reduce air temperature will cause problems when using modern materials, which cause air temperature to increase. Extensive use of glass in a building gives the impression of a modern building, but also a need to pay attention to the structure of its adhesion to other materials. Research on the use of modern materials, which have problems with increasing temperatures in adhesion between materials, is one of the concerns in creating thermal comfort in buildings. Structural errors will also have an impact on the continuity of the building. Building structures need to pay attention to occupant safety to create occupant comfort[11].

Apart from thermal comfort, sound comfort is required by buildings used for learning activities. Learning activities require peace from noise, so building design also requires sound comfort. Visual, thermal and acoustic factors can influence the psychology of building occupants. Research findings show that visual, thermal and acoustic comfort influences 41.5% of human psychological recovery[12]. People who need room comfort related to these three factors are willing to pay for technology that can provide room comfort. The research results show that people under forty want comfort even though they have to provide compensation payments[13]. The three comfort factors can be called physical comfort, which is also related to the health of the interior. Gender differences influence responses to physical comfort. Designing buildings with certain functions related to gender needs to pay attention to differences in response[14].

Learning activities also require sufficient lighting, so the light intensity needs to be planned so that it is sufficient for carrying out learning activities. The function of the building influences the use of indoor lighting. Building functions that influence design require careful lighting planning so that the building can function well[15]. Building design is not only related to space design but also related to building elements such as windows. Current developing technology can provide additional features to Windows. The development of information technology can make building elements increasingly sophisticated. Using intelligent windows in buildings can create visual and thermal comfort for occupants[16]. Using windows to create visual and thermal comfort can create energy savings. Modelling is one way to research windows in energy-saving[17]. Lack of lighting in the room means it is not optimal in providing comfort for its occupants[18].

One building that requires sufficient lighting, low noise and comfortable thermals is a cafe. Currently, using cafes as a place to study has become a trend for young people in Indonesia. Learning activities require a calm atmosphere, sufficient lighting and comfortable thermal conditions. A calm atmosphere is not without sound, but some do not interfere with learning motivation. Calm sounds can be accompanied by certain music, increasing learning motivation. The research aims to investigate the physical comfort of the Statiko Coffee Shop, which consists of lighting, noise and thermal in creating user comfort.

2. Method

The research was conducted at the Statiko Coffee Shop in Wonosobo Regency, Central Java, Indonesia. Statiko Coffee Shop is a two-story building on the side of a secondary road, so it is relatively quiet (**Figure 1**). Store opening hours are 15:00–23:00. There are more visitors at night. Visitors want a calm shop atmosphere and can chat with other visitors calmly. Some visitors also use the shop for learning activities.

Figure 1. Front view of Statiko Coffee Shop.

The method used in this research is divided into four stages: the research preparation stage, data collection stage, data analysis stage, and data analysis results presentation stage. At the research preparation stage, the researcher determines the research topic, chooses the research object, determines the appropriate theory for what he wants to research, and looks for references by conducting a literature study. This type of research is exploratory, descriptive research, namely measuring the thermal temperature conditions of a room in a coffee shop building. This measurement aims to measure, observe and detect the room's temperature and natural lighting, which impact the comfort of coffee shop users.

The measurement time is once every 30 min from 15:00 (coffee shop opening hours) to 23:00 (coffee shop closing hours). The tools used for measurements include: 1) lux meter, also known as a light meter, is a tool for measuring light intensity (other than photometers). This equipment consists of a light sensor of photocell material and a screen; 2) multi-function Environment Meter brand Krisbow KW06-291, to measure temperature (°C) and humidity (%); 3) cell phone for clock timer detection on the cell phone to see the time of each measurement; and writing tools, which are used to record measurement results.

3. Results and discussion

The area in the Statiko Coffee Shop has a fish pond, which adds to the room's coolness. Plants are arranged along the pool's edge, and some are in the middle. The inner area around the pool has chairs and a dining table used for eating. The dining area by the pool is not too big, so there are few visitors along the pool. A larger dining area is located in the area after the pool. An area of around 20 m^2 can be used by more visitors (**Figure 2**).

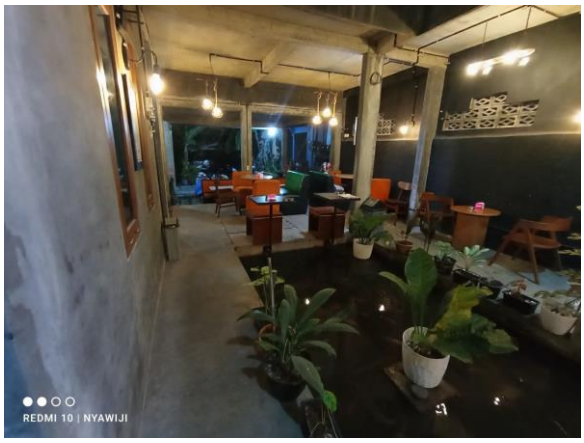


Figure 2. Statiko Coffe Shop indoor.

Noise levels in the room varied, with some hours showing higher noise levels while others were quieter than others. This condition can be influenced by outside traffic, equipment used, and customer visits. The light intensity is similar. Wind speed does not indicate movement because the inside area is protected from the outside area. Air temperature ranges between 24.2–26.1 °C. The air temperature is relatively low, considering that Wonosobo is a mountainous area with cool temperatures. Air humidity is relatively low, ranging between 78%–85% (**Table 1**).

Based on the recorded light intensity data, it can be concluded that the light intensity in the coffee shop varies during the hours observed (**Figure 3**). Although units are not given in the table, the data reflects differences in lighting levels in the room at certain times. The importance of light intensity in a coffee shop room can influence the atmosphere and comfort of visitors. Good lighting can create a pleasant atmosphere and improve the visitor's experience when enjoying coffee and the atmosphere in

the coffee shop. Therefore, it is essential to pay attention to lighting arrangements in the design and management of a coffee shop in order to create a comfortable and attractive atmosphere.

Table 1. Indoor measurement.

Hour	Noise	Light intensity	Wind velocity	Temperature	Humidity
15:00	Noisy	10.9	0	24.7	78
15:30	A bit noisy	10.7	0	25.3	78
16:00	Not noisy	10.7	0	26.3	79
16:30	Noisy	10.2	0	25.5	81
17:00	Not noisy	10.3	0	25.6	84
17:30	A bit noisy	9.4	0	25.1	85
18:00	Not noisy	9.6	0	26.1	84
18:30	Not noisy	8.6	0	25.6	84
19:00	Not noisy	10.2	0	24.2	83
19:30	Not noisy	9.1	0	25.0	84
20:00	Noisy	9.2	0	24.8	85
20:30	Noisy	9.6	0	24.8	84
21:00	A bit noisy	9.1	0	24.2	85
21:30	Not noisy	9.1	0	24.2	85
22:00	Not noisy	9.1	0	24.2	85
22:30	Not noisy	9.0	0	24.2	85
23:00	Not noisy	9.0	0	24.2	85

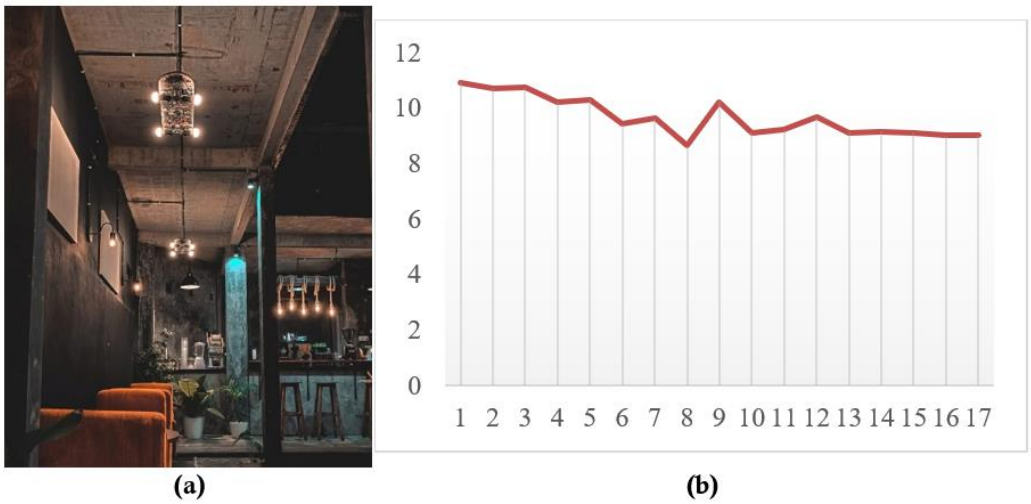
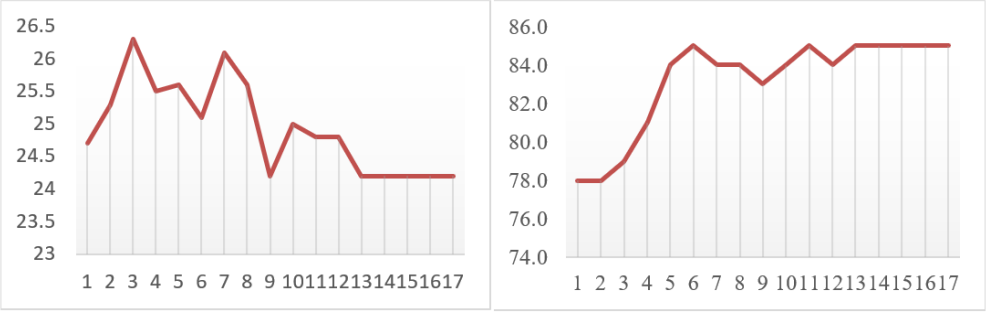


Figure 3. (a) Indoor lighting; **(b)** indoor lighting measurement results.

The wind speed in the room shows a value of 0 at all measurement hours. This condition can be explained by wind speed being generally insignificant in closed spaces such as coffee shops. The indoor air temperature showed observable fluctuations, with a temperature range between 24.2 ℃ to 26.3 ℃. These fluctuations may be influenced by external factors such as outdoor weather conditions and temperature regulation through indoor cooling or heating systems. Indoor air humidity also shows significant variations, with humidity values ranging from 78.0% to 85.0% (**Figure 4**). High humidity levels can be associated with weather conditions such as rain and cloudy skies, which can provide comfort for

visitors, especially in areas with climates that tend to be dry.



(a) **(b)**

Figure 4. Indoor measurements, **(a)** air temperature; **(b)** air humidity.

The recorded weather information shows variations between rainy, cloudy and sunny weather. Outdoor weather conditions can affect indoor air conditions, and this factor needs to be considered in ventilation settings to maintain visitor comfort (**Table 2**).

Table 2. Outdoor measurement.

Hour	Noise	Light intensity	Wind velocity	Temperature	Humidity
15:00	Noisy	138.0	0	25.3	75
15:30	A bit noisy	115.0	0	25.5	79
16:00	Not noisy	116.0	0	25.1	80
16:30	Noisy	19.5	0	25.7	83
17:00	Not noisy	13.7	0	24.9	86
17:30	A bit noisy	9.5	0	24.6	89
18:00	Not noisy	9.2	0	24.2	85
18:30	Not noisy	7.2	0	24.2	85
19:00	Not noisy	7.0	0	24.0	86
19:30	Not noisy	7.1	0	23.8	86
20:00	Noisy	7.0	0	23.8	86
20:30	Noisy	5.5	0	22.7	87
21:00	A bit noisy	5.3	0	22.2	87
21:30	Not noisy	5.2	0	21.5	87
22:00	Not noisy	5.5	0	20.0	87
22:30	Not noisy	5.3	0	18.0	88
23:00	Not noisy	5.2	0	18.0	88

Noise levels around the outdoor area vary, with some hours showing higher noise levels, while at other times, it is quieter. Traffic, nearby activities, and equipment use can influence the noise level. Outdoor light intensity shows significant differences in observation hours (**Figure 5)**. Although the units are not mentioned in the table, the data reflects variations in lighting levels around the coffee shop at certain times. The right light intensity can influence the atmosphere and mood of visitors outside the room.

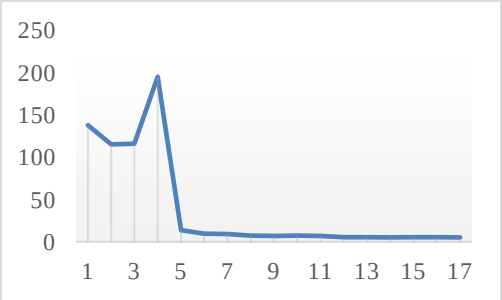
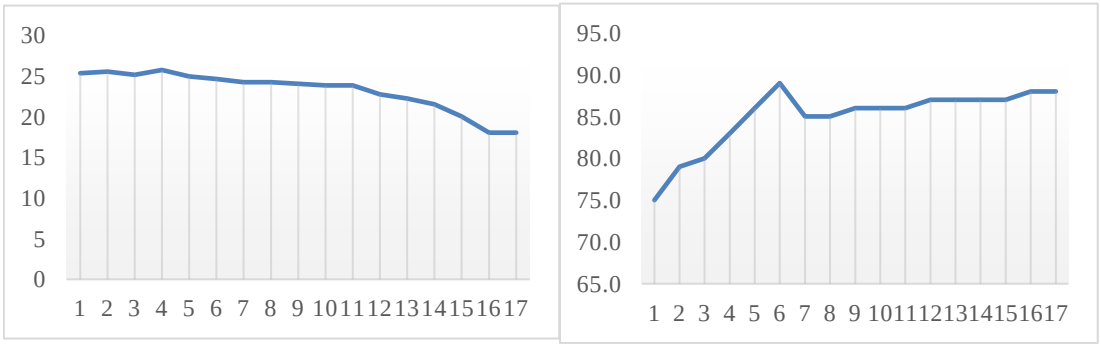


Figure 5. Outdoor light intensity.

The wind speed around the area is not recorded in the table, with all observation hours showing 0. This condition can be explained by outdoor wind speed being insignificant or unmeasurable at certain hours. Outdoor air temperature showed observed fluctuations, with a temperature range ranging from 18 ℃ to 25.7 ℃. These temperature fluctuations can be influenced by factors such as season, weather and the influence of the surrounding environment. Outdoor humidity also shows significant variations, with humidity values ranging from 75.0% to 89%. Different humidity levels can be associated with weather conditions, where higher humidity may occur during rain or overcast conditions (**Figure 6**).



(a) **(b)**

Figure 6. Outdoor measurement, **(a)** air temperature; **(b)** air humidity.

The relationship between noise and air temperature measurements differs between indoor and outdoor spaces. Noise has nothing to do with air temperature but can influence the thermal sensation of building users[19]. Using fewer lights will result in significant energy usage and hotter temperatures. The energy used becomes more wasteful. Using more lighting will make the building look attractive but will waste energy. Lighting control system strategies can reduce energy savings due to visual comfort[20].

4. Conclusion

Based on observations, there are variations in noise, light intensity, air temperature and humidity inside and outside the Statiko Wonosobo Coffee Shop. Indoors, noise levels varied, light intensity was recorded, air temperature fluctuated, and air humidity ranged from 78.0% to 85.0%. Outdoors, we also see variations in noise, light intensity, air temperature and humidity over a broader range. These changing environmental conditions show the importance of good understanding and design regarding ventilation and environmental management in creating comfort for visitors in coffee shops. This information can be a basis for designing an effective ventilation system, maintaining good indoor air quality, and considering external environmental influences such as noise and light intensity. In this context, further research and in-depth analysis are needed to provide more specific recommendations for optimizing the environment at the Statiko Wonosobo Coffee Shop.

Author contributions

Conceptualization, HH and NAA; methodology, HH and NAA; validation, HH, SRPM and DAM; formal analysis, HH, SRPM and DAM; investigation SRPM and DAM; resources, SRPM and DAM; data curation, SRPM and DAM; writing—original draft preparation, HH and NAA; writing—review and editing, HH; visualization, NAA; supervision, HH and NAA; project administration, NAA; funding acquisition, HH. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

References

1. Ali LA, Mustafa FA. The state-of-the-art knowledge, techniques, and simulation programs for quantifying human visual comfort in mosque buildings: A systematic review. *Ain Shams Engineering Journal* 2023; 14(9): 102128. doi: 10.1016/j.asej.2023.102128
2. Asif A, Zeeshan M, Jahanzaib M. Indoor temperature, relative humidity and CO_2 levels assessment in academic buildings with different heating, ventilation and air-conditioning systems. *Building and Environment* 2018; 133: 83–90. doi: 10.1016/j.buildenv.2018.01.042
3. Bai Y, Jin H. Effects of visual, thermal, and acoustic comfort on the psychological restoration of the older people in a severe cold city. *Building and Environment* 2023; 239: 110402. doi: 10.1016/j.buildenv.2023.110402
4. Berto R, Tintinaglia F, Rosato P. How much is the indoor comfort of a residential building worth? A discrete choice experiment. *Building and Environment* 2023; 245: 110911. doi: 10.1016/j.buildenv.2023.110911
5. Chen K, Kang J, Ma H. Evaluation of healthy indoor acoustic environments in residential buildings by the occupants: A mixed-method approach. *Building and Environment* 2023; 246: 110950. doi: 10.1016/j.buildenv.2023.110950
6. Hermawan H, Prianto E, Setyowati E. Indoor temperature prediction of the houses with exposed stones in tropical mountain regions during four periods of different seasons. *International Journal of Civil Engineering and Technology (IJCIET)* 2019; 10(5): 604–612.
7. Hermawan H, Švajlenka J. The connection between architectural elements and adaptive thermal comfort of tropical vernacular houses in mountain and beach locations. *Energies* 2021; 14(21): 7427. doi: 10.3390/en14217427
8. Hermawan H, Švajlenka J. Building envelope and the outdoor microclimate variable of vernacular houses: Analysis on the environmental elements in tropical coastal and mountain areas of Indonesia. *Sustainability* 2022; 14(3): 1818. doi: 10.3390/su14031818
9. Hermawan H, Prianto E, Setyowati E, et al. The thermal condition and comfort temperature of traditional residential houses located in mountainous tropical areas: An adaptive field study approach. *International Journal on Advanced Science, Engineering and Information Technology* 2019; 9(6): 1833. doi: 10.18517/ijaseit.9.6.3560
10. Jaafar H, Lakkis I, Yeretzian A. Impact of boundary conditions in a microclimate model on mitigation strategies affecting temperature, relative humidity, and wind speed in a Mediterranean city. *Building and Environment* 2022; 210: 108712. doi: 10.1016/j.buildenv.2021.108712
11. Jiang Y, Wu C, Teng M. Impact of residential building layouts on microclimate in a high temperature and high humidity region. *Sustainability* 2020; 12(3): 1046. doi: 10.3390/su12031046
12. Kalender-Smajlović S, Kukec A, Dovjak M. The problem of indoor environmental quality at a general Slovenian hospital and its contribution to sick building syndrome. *Building and Environment* 2022; 214: 108908. doi: 10.1016/j.buildenv.2022.108908
13. Lee SJ, Song SY. Energy efficiency, visual comfort, and thermal comfort of suspended particle device smart windows in a residential building: A full-scale experimental study. *Energy and Buildings* 2023; 298: 113514. doi: 10.1016/j.enbuild.2023.113514
14. Lotfabadi P, Hançer P. Optimization of visual comfort: Building openings. *Journal of Building Engineering* 2023; 72: 106598. doi: 10.1016/j.jobe.2023.106598
15. Marchione F, Chiappini G, Munafò P. Effect of temperature and relative humidity on the shear performance of double-lap adhesive joints between steel and glass adherends. *Journal of Building Engineering* 2022; 45: 103546. doi: 10.1016/j.jobe.2021.103546
16. Mesloub A, Alnaim MM, Albaqawy G, et al. The visual comfort, economic feasibility, and overall energy

consumption of tubular daylighting device system configurations in deep plan office buildings in Saudi Arabia. *Journal of Building Engineering* 2023; 68: 106100. doi: 10.1016/j.jobe.2023.106100
17. Özbey MF, Turhan C. A novel comfort temperature determination model based on psychology of the participants for educational buildings in a temperate climate zone. *Journal of Building Engineering* 2023; 76: 107415. doi: 10.1016/j.jobe.2023.107415
18. Peng Y, Antanuri N, Lau SK, et al. Experimental assessment of thermal and acoustics interactions on occupant comfort in mixed-mode buildings. *Building and Environment* 2023; 238: 110342. doi: 10.1016/j.buildenv.2023.110342
19. Takebayashi H. Effects of air temperature, humidity, and wind velocity distribution on indoor cooling load and outdoor human thermal environment at urban scale. *Energy and Buildings* 2022; 257: 111792. doi: 10.1016/j.enbuild.2021.111792
20. Vanage S, Dong H, Cetin K. Visual comfort and energy use reduction comparison for different shading and lighting control strategies in a small office building. *Solar Energy* 2023; 265: 112086. doi: 10.1016/j.solener.2023.112086