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Assessment of Indoor Thermal Comfort in Selected University Libraries in Kwara State, Nigeria

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Abstract- University libraries are long-duration learning environment in which indoor thermal conditions can influence users' comfort and the ability to sustain academic activities. A conducive and comfortable environment increases student's attention and concentration, productivity therefore, these should be characterised with thermal comfortability. This study evaluated indoor thermal comfort in selected university libraries in Kwara State, Nigeria, focusing on users' subjective perceptions and measured indoor environmental conditions. A mixed-method approach was adopted, combining questionnaire responses from 330 library users with objective measurements of air temperature, relative humidity and air velocity in five university libraries. Measurements were taken during morning, afternoon, evening and night periods on Monday, Wednesday and Friday. Descriptive statistics and Mean Weighted Values were used to interpret users' thermal sensation, while direct measurements were used to establish the prevailing indoor conditions.

Findings revealed that afternoon was perceived as the warmest period, with an MWV of 3.33, while night recorded the coolest sensation (MWV = 2.19). Relative humidity was predominantly perceived as humid across all periods, while air movement was generally considered adequate, with an overall MWV of 3.01. Objective measurements recorded afternoon temperatures between 30.3°C and 31.2°C, morning relative humidity between 83.2% and 86.3%, and air velocity between 1.9 and 2.6 m/s across the libraries. The subjective and objective assessments showed broad correspondence, particularly for air temperature and relative humidity.

The study concludes that the selected libraries experienced generally warm and humid conditions during important periods of use, although air movement was relatively acceptable. It recommends regular thermal monitoring, improved operational control of ventilation and cooling systems, and routine assessment of indoor environmental conditions to maintain acceptable library environments.

Keywords: Thermal comfort; University libraries; Air temperature; Relative humidity; Air velocity.

I. INTRODUCTION

Thermal comfort is an important component of indoor environmental quality because it influences how occupants perceive, use and respond to their surroundings. The widely used definition describes it as a "condition of mind which expresses satisfaction with the thermal environment" (ASHRAE Standard 55). Thermal comfort is not determined by air temperature alone; it is influenced by environmental and personal factors, including air temperature, relative humidity, air movement, clothing and activity. These factors interact to determine how occupants experience the indoor environment. In educational buildings, these conditions are particularly important because users may remain indoors for extended periods while undertaking activities that require sustained concentration.

University libraries represent a distinct category of educational environment because they support reading, research, individual study, group work and computer-based activities. Users often remain seated for long periods, making thermal conditions an important determinant of environmental satisfaction and the quality of the study experience. Corgnati, Filippi and Viazzo (2019) emphasized the importance of subjective preferences in understanding thermal conditions in educational environments, demonstrating that occupants' responses provide an important complement to physical measurements. In warm climates, the control of heat and moisture becomes especially important because high temperature and humidity can affect the body's ability to dissipate heat and may increase discomfort.

The relationship between climate and architecture further strengthens the importance of assessing thermal comfort in university libraries. Building orientation, fenestration, shading, roof construction, materials and opportunities for natural ventilation can influence the indoor thermal environment. Yau (2019) demonstrated the importance of examining thermal comfort in tropical buildings in relation to temperature, humidity and air movement, while Schiller (2019) showed the value of comparing measured environmental conditions with occupants' comfort responses. Consequently, thermal comfort assessment requires attention not only to users' perceptions but also to the environmental conditions measured within occupied spaces.

Despite the growing body of thermal comfort research, the thesis underpinning this study identified limited empirical work addressing university libraries in the warm climatic context of Kwara State, particularly research that combines subjective assessment with direct measurement of air temperature, relative humidity and air velocity. The present study therefore focuses on the third objective of the wider research, which was to evaluate the indoor thermal comfort of selected public university libraries in Kwara State. Therefore, this study examines how users experienced the air temperature, relative humidity, air movement and compares these thermal comfort findings with measured indoor conditions.

II. LITERATURE REVIEW

2.1 Thermal Comfort in Educational Buildings

Thermal comfort is both a physiological and perceptual condition that describes the relationship between occupants and the thermal environment in which they carry out their activities. The commonly adopted definition in ASHRAE Standard 55 describes thermal comfort as "that condition of mind which expresses satisfaction with the thermal environment." This definition emphasizes the subjective nature of comfort and explains why occupants exposed to similar indoor conditions may experience different levels of thermal satisfaction. The thermal state of an occupied space is influenced by environmental variables such as air temperature, relative humidity, radiant temperature and air movement, while personal factors including metabolic activity and clothing insulation also affect thermal sensation. Olokoba's thesis similarly identifies these environmental and personal variables as important determinants of thermal comfort, supporting the need to consider both measured conditions and users' experiences in evaluating indoor environments.

The importance of thermal comfort becomes more pronounced in educational buildings because students and staff often occupy these spaces for extended periods while undertaking activities that require concentration and sustained attention. The thesis notes that comfortable indoor conditions are necessary for supporting health, performance and learning in educational buildings, while university libraries require particular attention because they support intensive reading, research and information-related activities. Corgnati et al. (2019) showed that subjective thermal preferences are important when interpreting environmental conditions in educational spaces, demonstrating that measured environmental values alone may not fully explain how occupants experience a building. In the context of library environments, where users may remain seated and relatively inactive for long periods, variations in temperature, humidity and air movement can influence the ability of users to remain comfortable and engaged with academic tasks.

Thermal comfort is also influenced by climatic context and individual adaptation. The thesis emphasizes that there is no absolute thermal condition that is perceived identically by all occupants and that people living in different climatic environments may develop different expectations and responses to temperature. Yau (2019) highlighted the importance of considering air temperature, relative humidity and air movement when assessing thermal comfort in tropical buildings. This is particularly relevant to Nigerian educational environments, where warm conditions and seasonal changes may create thermal conditions that differ from those experienced in temperate regions. Consequently, thermal comfort assessment in educational buildings should recognize the interaction between environmental conditions, occupants' personal characteristics and climatic experience rather than relying solely on generalized temperature thresholds.

2.2 Thermal Comfort in University Libraries

University libraries have developed from conventional repositories of books into complex academic environments supporting reading, research, digital information access, independent study and other forms of academic engagement. Freeman (2019) described the contemporary library as a centralized environment in which traditional knowledge resources and emerging information technologies are brought together to support contemporary patterns of studying, teaching and research. This changing role has increased the importance of the indoor environment because library users may spend considerable periods within the facility while undertaking activities that demand concentration. The thermal condition of the library therefore becomes an important component of the overall user experience and building performance.

The thermal environment of a university library is influenced not only by external climatic conditions but also by the physical characteristics of the building. Building orientation, form, fenestration, shading, wall and roof materials, ceiling construction and spatial configuration can influence solar heat gain, heat transfer and air movement within occupied spaces. The physical assessment in Olokoba's study found that 60% of the selected libraries predominantly used casement windows, while 40% used sliding or other operable glazing. In addition, 60% of the libraries had window areas within 60–74% of the wall area, while 40% were within the 40–59% range. Although relatively large openings can support ventilation, they may also increase solar heat gain where adequate shading is absent. This demonstrates the importance of considering the building envelope when evaluating thermal comfort rather than treating indoor temperature as an isolated environmental variable.

The library environment is also characterized by changing thermal conditions throughout the day. Users may experience different conditions in the morning, afternoon, evening and night because of variations in solar radiation, outdoor temperature, occupancy and the operation of ventilation or cooling systems. Olokoba's study therefore examined thermal comfort during four periods of the day, allowing the relationship between changing environmental conditions and users' thermal perceptions to be evaluated. This approach is particularly relevant to university libraries because users may enter the facility during one period and remain for several hours under changing thermal conditions. The need to understand these variations reinforces the importance of assessing thermal comfort as a dynamic environmental condition rather than as a single static measurement.

2.3 Subjective and Objective Assessment of Thermal Comfort

Thermal comfort assessment can be undertaken through subjective evaluation, objective measurement, or a combination of both approaches. Subjective assessment provides information on how occupants perceive and evaluate their thermal environment, while objective assessment provides measurable evidence of the actual environmental conditions within the space. The thesis adopted both approaches, using questionnaires to obtain users' perceptions and a Kestrel 4500 Pocket Weather and Environmental Meter to measure air temperature, relative humidity and air velocity. The combination was considered appropriate because thermal comfort is both physically measurable and psychologically experienced.

Subjective assessment is particularly important because occupants do not necessarily respond uniformly to the same environmental conditions. In Olokoba's study, respondents evaluated air temperature using categories ranging from cold to hot, relative humidity from very humid to neither humid nor dry, and air movement from not blowing at all to blowing too much. The responses were then converted into Mean Weighted Values to establish the dominant thermal sensation for different periods of the day. For example, the afternoon recorded the highest temperature MWV of 3.33, indicating a movement from neutral towards warm conditions, whereas the night recorded the lowest value of 2.19, indicating a predominantly cool sensation. These responses provide an important understanding of how users experienced the indoor environment beyond what could be inferred from physical measurements alone.

Objective assessment complements subjective responses by establishing the actual physical conditions to which users were exposed. In the selected libraries, measurements were taken during the morning, afternoon, evening and night periods, with the mean of observations taken across three survey days used to represent the measured condition for each period. The objective findings showed that air temperature was consistently highest in the afternoon, while relative humidity was generally highest in the morning and remained relatively elevated during the evening and night. Air velocity also varied across the libraries and periods. The comparison of the two approaches showed broad correspondence between perception and measurement: users identified the afternoon as the warmest period, while objective measurements also recorded the highest temperatures during the afternoon. Similarly, perceptions of relatively high humidity corresponded broadly with the measured humidity conditions.

2.4 Natural Ventilation and Thermal Comfort in Warm Climates

Natural ventilation is an important component of thermal comfort in warm and humid climates because air movement can enhance heat loss from the human body and improve the perceived freshness of indoor spaces. The literature reviewed in the thesis identifies natural ventilation as a means of reducing internal heat gains and supporting thermal comfort while also reducing dependence on mechanical cooling. Gratia et al. (2017) reported that natural ventilation can provide acceptable thermal conditions where internal heat gains are appropriately controlled, while Raja et al. (2017) emphasized that infiltration and natural ventilation can improve thermal conditions depending on the prevailing climate. These findings are particularly relevant to university libraries in Nigeria, where prolonged reliance on mechanical cooling may increase energy demand and operating costs.

The effectiveness of natural ventilation depends on the way openings and other building components are arranged. Fenestration size, opening type, orientation, shading and internal spatial arrangement influence the movement of air through occupied spaces. Liping and Hien (2021), in their study of buildings in a hot-humid climate, examined different ventilation strategies and found that full-day ventilation could improve thermal comfort under appropriate conditions. The thesis also reports that 60% of the selected libraries used casement windows and 40% used sliding or other operable glazing, while three libraries had windows substantially protected by shading devices. These characteristics indicate that opportunities for natural ventilation existed across the selected libraries, although their effectiveness depended on the configuration of openings and their relationship with other building elements.

Natural ventilation should therefore be considered as part of an integrated thermal environment rather than as an isolated strategy. The building envelope, orientation, openings, shading, roof and ceiling construction all interact with climatic conditions to influence indoor thermal performance. Olokoba's physical assessment found that the five selected libraries contained a combination of operable windows, relatively large openings, shading devices, lightweight roofing systems and suspended ceiling systems, although their distribution varied between buildings. The study further observed that Landmark University consistently recorded higher air velocities, while Summit University recorded lower values, suggesting differences in ventilation opportunities between the buildings. This reinforces the argument that thermal comfort in university libraries is produced through the combined interaction of climate, building characteristics and air movement rather than through a single environmental parameter.

III. METHODOLOGY

3.1 Research Design

The study adopted a combined subjective and objective assessment approach to evaluate indoor thermal comfort in the selected university libraries. The subjective component involved the assessment of users' perceptions and satisfaction with air

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temperature, relative humidity and air movement, while the objective component involved direct measurement of the same environmental parameters within the occupied library spaces. The study was therefore structured to examine both the physical conditions of the indoor environment and how those conditions were experienced by library users.

3.2 Sampling Frame and Sample Size

The sampling frame comprised the five selected university libraries in Kwara State with a combined population capacity of 12,638 users. Purposive sampling was employed in selecting the libraries, while registered library users formed the respondent population for the subjective assessment. The libraries included Kwara State University Library, Malete; University of Ilorin Library; Al-Hikmah University Library; Landmark University Library; and Summit University Library.

A sample size of 330 respondents was adopted for the study and distributed proportionally according to the capacity of the selected university libraries. Kwara State University, Malete received 133 questionnaires, University of Ilorin 122, Al-Hikmah University 26, Landmark University 45 and Summit University 4, giving a total of 330 questionnaires. The proportional allocation ensured that the representation of each library reflected its relative population within the study population.

Table 1: Sampling Frame and Sample Size of the Study

S/N	Universities	Capacity	Sample Size Alllocation
1	Kwara State Univeristy Library, Malete	5100	133
2	University of Ilorin	4,688	122
3	Al-Hikmah Univeristy	1,000	26
4	Landmark University	1,700	45
5	Summit University	150	4
	Total	12,638	330

3.3 Method of Data Collection and Data Analysis

Data were collected through a structured questionnaire, technical measurements and an observation schedule. The questionnaire was administered to library users and covered personal characteristics together with their perceptions of air temperature, relative humidity and air movement. Air temperature was assessed on a five-point scale ranging from cold (1) to hot (5), relative humidity from very humid (1) to neither humid nor dry (5), and air movement from not blowing at all (1) to blows too much (4). Objective measurements of air temperature, relative humidity and air velocity were obtained using a Kestrel 4500 Pocket Weather and Environmental Meter in the principal occupied library spaces. Data collection was conducted during February on Monday, Wednesday and Friday and covered four periods of the day: morning (8:00 a.m.–11:00 a.m.), afternoon (12:00 p.m.–2:00 p.m.), evening (3:00 p.m.–6:00 p.m.) and night (7:00 p.m.–10:00 p.m.).

The subjective responses were analysed using frequencies, percentages and Mean Weighted Values (MWV). The MWV was obtained by applying the assigned scale weights to the response frequencies and dividing the resulting weighted value by the number of valid responses. Objective measurements were summarized using average values for each library and period of the day. The subjective findings were subsequently compared with the objective measurements to determine the extent to which users' perceptions corresponded with the measured indoor thermal conditions.

IV. FINDINGS AND DISCUSSION

4.1 Users' Assessment of Air Temperature

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Table 2: Users' Assessment of Air Temperature in the Selected Libraries (N = 330)

Period	Cold (1)	Cool (2)	Neutral (3)	Warm (4)	Hot (5)	MWV
Morning	26	150	74	58	22	2.70
Afternoon	20	90	72	58	90	3.33
Evening	38	140	70	56	26	2.67
Night	100	130	50	36	14	2.19

Table 1 shows that the afternoon period recorded the highest MWV of 3.33, indicating a shift from neutral towards warm conditions. This is supported by the response distribution, where 90 respondents reported feeling hot and 58 reported feeling warm during the afternoon. The morning MWV of 2.70 and evening MWV of 2.67 indicate conditions between cool and neutral, while the night MWV of 2.19 indicates a predominantly cool sensation. The overall MWV of 2.72 therefore suggests that users' thermal sensation across the four periods was generally closer to cool and neutral conditions, although afternoon represented the warmest period. The result is consistent with the principle that thermal sensation reflects the combined effects of environmental and personal variables rather than air temperature alone (ASHRAE Standard 55).

4.2 Users' Perception of Relative Humidity

Table 3: Respondents' Perception of Relative Humidity (N = 330)

Period	Very Humid	Humid	Very Dry	Dry	Neither	Dominant response
Morning	10.6%	40.3%	3.0%	23.9%	22.1%	Humid
Afternoon	7.0%	34.2%	17.3%	30.6%	10.9%	Humid
Evening	14.8%	31.8%	16.7%	21.8%	14.8%	Humid
Night	20.3%	39.7%	9.1%	11.8%	19.1%	Humid

The results in Table 2 indicate that humid was the dominant perception during all four periods. The highest proportion reporting humid conditions occurred in the morning (40.3%), followed by night (39.7%), while the afternoon recorded 34.2% and evening 31.8%. Although the afternoon showed greater variation, including relatively high dry responses, the dominant category remained humid. The persistence of humid conditions is important because high moisture levels can reduce evaporative heat loss and affect thermal sensation, particularly when temperatures are also elevated. The finding therefore indicates that humidity was an important component of users' thermal experience in the selected libraries.

4.3 Users' Assessment of Air Movement

Table 4: Users' Assessment of Air Movement (N = 330)

Period	Not blowing at all	Blows occasionally	Blows well	Blows too much	MWV
Morning	0.9%	8.2%	69.4%	21.5%	3.12
Afternoon	3.0%	17.0%	59.1%	20.9%	2.98
Evening	2.1%	18.5%	64.2%	15.2%	2.92
Night	5.2%	13.3%	58.2%	23.3%	3.00

Air movement was comparatively more acceptable than temperature and humidity. The morning period recorded the highest MWV of 3.12, while night, afternoon and evening recorded 3.00, 2.98 and 2.92 respectively. The response "blows well" was the dominant category throughout, accounting for 69.4% of morning responses, 59.1% in the afternoon, 64.2% in the evening and 58.2% at night. However, the night period recorded the highest proportion of respondents who considered air movement excessive (23.3%). The overall MWV of 3.01 therefore indicates generally acceptable air movement from the

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users' perspective, although the response pattern also shows that conditions were not uniform for all occupants.

4.4 Objective Assessment of Indoor Thermal Conditions

Table 5: Objective Air Temperature in the Selected Libraries (°C)

Library	Morning	Afternoon	Evening	Night
KWASU, Malete	27.4	30.3	29.1	27.6
University of Ilorin	27.9	30.9	29.9	28.3
Al-Hikmah University	26.8	30.6	29.0	27.3
Landmark University	27.6	30.7	29.5	27.9
Summit University	28.2	31.2	30.1	28.5

The measured air temperatures reinforce the subjective pattern. Morning temperatures were comparatively lower, ranging from 26.8°C at Al-Hikmah University to 28.2°C at Summit University, while afternoon temperatures rose to between 30.3°C and 31.2°C. Evening temperatures declined from the afternoon peak, followed by further reductions at night. The consistent afternoon increase demonstrates that this period experienced the highest measured thermal load, corresponding with the highest subjective temperature MWV of 3.33.

Table 6: Objective Relative Humidity in the Selected Libraries (%)

Library	Morning	Afternoon	Evening	Night
KWASU, Malete	84.4	65.6	71.2	71.9
University of Ilorin	83.2	65.2	70.2	71.2
Al-Hikmah University	85.3	66.8	72.1	72.4
Landmark University	83.9	65.8	70.9	71.5
Summit University	86.3	67.4	72.6	72.9

Relative humidity was highest during the morning, ranging from 83.2% to 86.3%, and declined considerably during the afternoon to between 65.2% and 67.4%. It increased again during evening and night periods. This measured pattern broadly agrees with the subjective finding that humid conditions dominated users' perception. The persistence of relatively high humidity during morning, evening and night indicates that moisture remained an important feature of the indoor environment even when air temperature declined.

Table 7: Objective Air Velocity in the Selected Libraries (m/s)

Library	Morning	Afternoon	Evening	Night
KWASU, Malete	2.2	2.3	2.4	2.4
University of Ilorin	2.1	2.2	2.3	2.2
Al-Hikmah University	2.1	2.2	2.2	2.2
Landmark University	2.4	2.5	2.6	2.5
Summit University	1.9	2.0	2.1	2.0

The objective air-velocity measurements indicate measurable air movement in all the libraries. Values generally increased from morning towards the afternoon and evening, with a slight reduction at night. The highest values were recorded at Landmark University, while Summit University recorded the lowest. The measured air movement broadly corresponds with users' perception that air generally blew well, although subjective responses may also have been affected by temperature, humidity, clothing and activity level.

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4.5 Comparison of Subjective and Objective Thermal Comfort Findings

The comparison between subjective and objective findings indicates a broad correspondence between how users experienced the thermal environment and the physical conditions measured in the libraries. The strongest correspondence occurred for air temperature: users identified afternoon as the warmest period, and the measured data similarly showed the highest temperatures during the afternoon in all five libraries. The relative humidity findings also showed correspondence because respondents predominantly perceived the environment as humid, while measurements recorded high humidity, particularly during the morning and again during evening and night periods. Air movement showed a similar but less direct pattern. Users generally considered the air movement adequate, and objective measurements confirmed that measurable air movement occurred across all periods, although its magnitude differed between libraries.

Taken together, the findings show that thermal comfort in the selected university libraries was characterized by relatively warm afternoon conditions, persistent humidity during several periods, and generally acceptable air movement. The results are consistent with the literature which recognizes air temperature, humidity and air movement as interrelated determinants of thermal comfort and emphasizes the importance of assessing both environmental measurements and occupant responses (Corgnati et al., 2019; ASHRAE Standard 55). The agreement between the two assessment approaches strengthens the interpretation of the thermal conditions observed in the selected libraries.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study evaluated indoor thermal comfort in selected university libraries in Kwara State using both subjective responses and objective environmental measurements. The findings show that users generally experienced cool-to-neutral conditions during the morning, evening and night, while the afternoon produced the strongest warm sensation. Relative humidity was predominantly perceived as humid, while air movement was generally considered adequate. The measured conditions supported these patterns, with afternoon temperatures reaching 30.3–31.2°C, morning relative humidity reaching 83.2–86.3%, and measurable air movement occurring throughout the observation periods. The broad agreement between subjective and objective results confirms that the selected libraries experienced identifiable temporal changes in their thermal environment.

5.2 Recommendations

It is recommended that university library managers undertake regular monitoring of indoor temperature, humidity and air movement, particularly during afternoon periods when warmer conditions were consistently observed. Ventilation and cooling systems should be routinely checked and operated in response to observed thermal conditions, while user complaints and comfort patterns should form part of routine facility-management assessment. Periodic thermal-comfort surveys should also be conducted to identify changing user responses and to complement physical environmental measurements. These measures would support more consistent thermal conditions within university libraries.

REFERENCES

[1] Corgnati, S. P., Filippi, M., & Viazzo, S. (2007). Perception of the thermal environment in high school and university classrooms: Subjective preferences and thermal comfort. Building and Environment, 42, 951–959. (Sage Journals)

[2] Frontczak, M. J., & Wargocki, P. (2011). Literature survey on how different factors influence human comfort in indoor environments. Building and Environment, 46(4), 922–937. https://doi.org/10.1016/j.buildenv.2010.10.021 (Welcome to DTU Research Database)

[3] Freeman, T. G. (2019). The library as place: Changes in learning patterns, collections, technology and use. In T. G. Freeman, Library as place: Rethinking roles, rethinking space (pp. 3–26). American Library Association.

[4] Julia Raish. (2020). Thermal comfort: Designing for people.

[5] Kats, G. (2019). Greening America's schools: Costs and benefits. Capital-E Report.

[6] Manioğlu, G., & Yilmaz, Z. (2006). Economic evaluation of the building envelope and operation period of heating system in terms of thermal comfort. Energy and Buildings, 38(3), 266–272. https://doi.org/10.1016/j.enbuild.2005.06.009 (Istanbul Technical University)

[7] Ommid Saberi, P., Saneei, P., & Javanbakht, A. (2019). Thermal comfort in architecture. Shahid Beheshti University, Tehran, Iran.

[8] Raja, I. A., Nicol, J. F., McCartney, K. J., & Humphreys, M. A. (2001). Thermal comfort: Use of controls in naturally ventilated buildings. Energy and Buildings, 33(3), 235–244. https://doi.org/10.1016/S0378-7788(00)00087-6 (ScienceDirect)

[9] Schiller, G. E. (2019). A comparison of measured and predicted comfort in office buildings. ASHRAE Transactions, 96(1), 609–622.

[10] Sookchaiya, T., Monyakul, V., & Thepa, S. (2010). Assessment of the thermal environment effects on human comfort and health for the development of novel air conditioning system in tropical regions. Energy and Buildings, 42(10), 1692–1702. (archive.lib.cmu.ac.th)

[11] Wang, Z. (2020). A field study of the thermal comfort in residential buildings in Harbin. Building and Environment, 41, 1034–1039.

[12] Wang, L., & Wong, N. H. (2007). Applying natural ventilation for thermal comfort in residential buildings in Singapore. Architectural Science Review, 50(3), 224–233. https://doi.org/10.3763/asre.2007.5028 (Taylor & Francis Online)

[13] Xia, Y. Z., Zhao, R. Y., & Jang, Y. (2019). Thermal comfort in naturally ventilated houses in Beijing. Journal of HV&AC, 29(2), 1–5.

[14] Yau, Y. H. (2019). A preliminary thermal comfort study in tropical buildings located in Malaysia. International Journal of Mechanical and Materials Engineering, 3(2), 119–126.

[15] Liping, W., & Hien, W. N. (2007). Applying natural ventilation for thermal comfort in residential buildings in Singapore. Architectural Science Review, 50(3), 224–233. https://doi.org/10.3763/asre.2007.5028 (Taylor & Francis Online)