Evaluating Thermal Comfort in Tropical Architecture: A Comparative Study of Shading and Ventilation Strategies in The Corner House (Manila) and The Commons Thonglor (Bangkok)

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Abstract

Tropical architecture is an approach that adapts built environments to regions with high temperatures, humidity, and rainfall, employing passive strategies such as shading and ventilation to achieve thermal comfort while minimizing energy use. This study evaluates the effectiveness of shading and ventilation strategies in two community centers located in tropical urban environments: The Corner House in Manila, Philippines, and The Commons Thonglor in Bangkok, Thailand. Using a mixed approach, the study combines qualitative and quantitative data to assess the impact of shading and ventilation strategies on thermal comfort and visitor satisfaction. The study employs a comparative analysis framework that integrates (1) an inventory of design features, (2) performance evaluations of thermal comfort and airflow, and (3) user feedback surveys to highlight the similarities and differences in (1) design approaches, (2) environmental performance, and (3) user experiences. The findings of this study show that while both community centers incorporate climate-responsive design features through shading and natural ventilation strategies, achieving consistent and effective thermal comfort remains a challenge, indicating a more balanced integration of passive and active design strategies and systems. Overall, the study highlights the practical benefits of adaptive shading and ventilation strategies illustrating how both buildings adequately balance functionality, aesthetics, and sustainability. These findings contribute to the broader discourse on sustainable tropical architecture by identifying best practices for climate-responsive design, focusing on improving thermal comfort in community centers within hot and humid urban contexts.

Keywords: thermal comfort, shading, ventilation, tropical architecture, community center

I. Introduction

The Corner House in Manila, Philippines, and The Commons Thonglor in Bangkok, Thailand, exemplify tropical architecture applied to urban community centers, both designed by the Bangkok-based Department of Architecture design studio. These buildings prioritize climate-responsive design principles to address the

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challenges of intense heat and humidity. As public gathering spaces, The Corner House focuses on blending outdoor dining areas with natural surroundings to align with Filipino dining culture (Tatler Asia, n.d.). Whereas The Commons Thonglor incorporates open-air terraces, courtyards, and shading structures to reflect Thailand's emphasis on communal interaction (ArchDaily, 2016). These buildings demonstrate how tropical architecture can adapt to local cultural and environmental factors while meeting the demands of modern urban living.

Tropical architecture is an approach that adapts built environments to regions with high temperatures, humidity, and rainfall. It employs passive strategies such as shading and ventilation to achieve thermal comfort to minimize energy use. Shading elements reduce solar heat gain, while natural ventilation enhances airflow to cool interiors and create a comfortable environment for users. Thermal comfort is crucial in the design of public spaces in tropical climates where excessive heat and humidity can cause discomfort. Moreover, many public spaces rely on air conditioning, which increases energy consumption and raises sustainability concerns. By integrating these design principles, tropical architecture addresses the dual goals of environmental adaptability and energy efficiency, making it a critical solution in the context of urbanization and climate change.

Manila and Bangkok share similar climate characteristics, but local variations and cultural contexts necessitate distinct architectural responses. The Corner House and The Commons Thonglor serve as community centers in these cities, offering a unique opportunity to examine how tropical design principles are adapted to site-specific conditions. The goal of this study is to evaluate the effectiveness of shading and ventilation strategies in these community centers. It explores how these design strategies contribute to user comfort and satisfaction through comparative analyses of the inventory of the design features, thermal comfort measurements and airflow simulations, along with the user-feedback survey. The comparison of these design features and strategies aims to identify the best practices in tropical architecture that balance the requirements for human comfort and sustainability.

The scope of the study is primarily focused on the alfresco areas of the community centers, constrained by a short data collection period of two months with visits limited to 2 days per center. Due to these constraints, the study had limitations such as presumed material specifications based on visual and tactile observation, a small sample size, reliance on subjective feedback, and challenges in controlling environmental variability. While these constraints and limitations could influence the consistency and broader applicability of the results, the gathered information was sufficient in assessing thermal comfort and effectiveness of climate-responsive design strategies.

Through a structured framework for comparative analysis, the study identifies adaptable design approaches that balance comfort, sustainability, and cultural relevance while strengthening urban resilience to climate extremes. The findings contribute valuable insights into sustainable design in tropical climates, emphasizing shading and ventilation strategies to reduce reliance on air conditioning, enhance energy efficiency, and improve user comfort. These recommendations provide architects and urban planners with a guide for integrating functional efficiency with environmental resilience and adaptability in future urban developments in tropical climates.

II. Literature Review

Effective environmental design is crucial as it directly impacts the well-being of the users, the functionality of the space, and its contribution to sustainable development. By employing passive techniques like natural ventilation, shading, green roofing, and locally sourced materials, these community centers demonstrate sustainability by improving energy efficiency and mitigating the negative effects on the environment.

This review examines shading elements and ventilation systems to enhance thermal comfort and energy efficiency in hot, humid climates, highlighting best practices for reducing solar heat gain and improving indoor air quality through existing research and case studies.

A. Tropical Architecture Principles

Thermal comfort, adapted to the local tropical climate ensures sustainable, efficient spaces through features like sloping roofs, strategic window placement, and natural ventilation (Harisdani & Kartika, 2018; Ghassan et al., 2021). Thermal comfort, adapted to local climates, promotes sustainable, efficient spaces by prioritizing user well-being and reducing dependence on mechanical systems through natural ventilation, shading, and thermal mass (Gadi, 2010).

Natural ventilation plays a key role in tropical architecture, using passive airflow to regulate temperatures and improve air quality, enhancing thermal comfort and energy efficiency in hot, humid climates. Givoni (1998) highlights the importance of site orientation, building form, and opening placement in optimizing ventilation. Relying on wind-driven airflow and the stack effect (Figure 01), its effectiveness can be limited by high humidity, requiring thoughtful design adjustments (Perrau, 2023).

Solar control in tropical architecture improves comfort and energy efficiency by reducing heat gain through overhangs, shading devices, and reflective materials (Givoni, 1998). Techniques like brise-soleil and perforated walls (Figure 02) minimize air conditioning needs by blocking sunlight, managing light, and enabling cross ventilation (Kamal, 2022; Hernan et al., 2012).

Locally sourced, climate-appropriate materials reduce environmental impact, enhance thermal performance, and improve resilience (Shemirani & Niloufar, 2013). It also blurs the boundaries between indoor and outdoor spaces, promoting airflow, daylight, and a connection to nature, which boosts both aesthetic appeal and occupant well-being (Loureiro & Veloso, 2014).

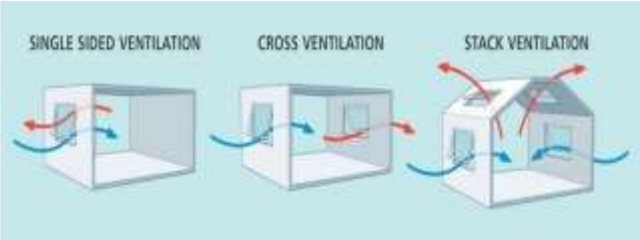

Figure 1. Types of Ventilation
Source: ArchDaily, 2021

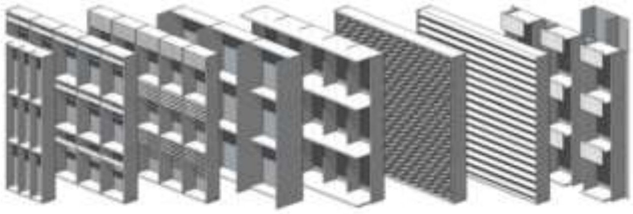

Figure 2. Types of Brise
Source: Rethinking the Future

B. Thermal Comfort

According to Djongyang et al. (2010), thermal comfort is the satisfaction with the thermal environment, which is influenced by elements including clothing, metabolic rate, radiant temperature, air temperature, humidity, and airflow (Figure 03). The two primary models of thermal comfort are the Adaptive Comfort Model, which suggests that people can adjust to a greater range of temperatures in naturally ventilated buildings (Efeoma & Uduku, 2014), and the Predicted Mean Vote (PMV) model, which is based on six factors comprising air temperature, humidity, airflow, radiant temperature, clothing, and metabolic rate (Fanger, 1970). Research shows that effective ventilation can lower operative temperatures by up to 3.9°C in hot climates, reducing discomfort hours significantly (Stasi et al., 2023). Meanwhile, the connection between thermal comfort and environmental psychology explores how people's perceptions of their thermal environment influence their comfort and well-being (Ozbey & Turhan, 2024). This field also examines how thermal comfort impacts behaviors such as social interactions and productivity, leading individuals to adjust their activities or surroundings (Zheng et al., 2022).

Research on thermal comfort in Southeast Asia reveals gaps, including reliance on unsuitable models like Fanger's which is designed for temperate climates (Pau & Peo, 2013), limited field studies despite urbanization and increased air conditioning use (Rodríguez & D'Alessandro, 2019), which the study aims to address.

Figure 3. Environmental and physiological factors affecting thermal comfort
Source: Boonyatikarn, S. & Buranakarn, V., 2006

C. Perceptions of Thermal Comfort in the Philippines

Thermal comfort perceptions vary across climates and are influenced by cultural and individual factors, complicating universal strategies. Andamon (2006) studied thermal comfort in air-conditioned offices in Makati City, Philippines, assessing the applicability of ANSI/ASHRAE Standard 55 in tropical contexts. Surveys of 277 workers showed a preference for cooler indoor temperatures (21.5°C–24.5°C) compared to the mean annual temperature of 26.6°C (PAGASA), differing from global standards of 20°C–26°C. The study highlights the role of cultural and psychological factors in shaping comfort and suggests energy-saving opportunities through localized models and slight temperature adjustments.

Orbon et al. (2019) examine the use and thermal comfort perceptions of outdoor spaces at the University of the Philippines Diliman to guide campus design. Using surveys from 424 students and on-site observations, the study highlights the importance of natural ventilation, shade, seating, and accessibility. Outdoor spaces are valued for social, recreational, and learning activities. The study recommends incorporating shaded, natural elements, ensuring safety, and designing flexible, multifunctional spaces.

D. Perceptions of Thermal Comfort in Thailand

Busch (1991) investigates thermal comfort in Bangkok offices, focusing on differences between air-conditioned (AC) and naturally ventilated (NV) environments. Surveys of over 1,100 office workers and detailed thermal measurements reveal that AC workers prefer temperatures up to 28°C, while those in NV spaces are comfortable with temperatures as high as 31°C. These findings highlight the impact of acclimatization on thermal preferences and emphasize the need for localized thermal comfort standards in tropical climates.

Suwanmanee et al. (2024) examines outdoor thermal comfort for pedestrians on a Thai university campus, identifying a neutral Physiological Equivalent Temperature (PET) of 25.2°C and an acceptable range of 24.6-32.0°C. Cantilever-covered paths with sparse trees offer the best comfort. The study highlights the importance of designing shaded, ventilated walkways to enhance pedestrian comfort and support sustainable campus planning.

Existing published research on thermal comfort focuses mostly on building offices and school campuses. Studies on thermal comfort in offices and school campuses in tropical climates, like those in the Philippines and Thailand, provide valuable insights for community centers due to shared climatic conditions and overlapping design strategies. Features such as shading, natural ventilation, and airflow optimization are universally applicable to enhancing thermal comfort across different building types. While the activities in these spaces differ, the studies highlight common occupant needs for comfort and adaptation to thermal environments, offering a foundation for understanding human perceptions in similar contexts. The lack of specific research on thermal comfort in community centers underscores a gap that the study aims to address, leveraging findings from related settings to inform better design practices.

E. Visitor Comfort and Satisfaction in Community Centers

Visitor comfort and satisfaction in community centers depend on several factors: adequate seating, cleanliness, and recreational facilities (Haq et al., 2023); diverse functions like educational and cultural activities (Lee et al., 2012); aesthetic elements such as lighting and greenery (Waroonkun, 2018); regular facility maintenance (Eliza et al., 2023); integration of local culture (Rebuya & Menez, 2024); and the availability of educational resources (Lee et al., 2012). These factors collectively enhance user experience and community engagement.

In summary, tropical architecture prioritizes passive cooling, sustainable materials, and cultural integration to design energy-efficient and climate-responsive spaces. Passive strategies like ventilation, shading, and local materials reduce reliance on artificial cooling, lowering energy use while improving comfort. Fanger's Predicted Mean Vote (PMV) model, designed for temperate climates, is less effective in Southeast Asia due to its limitations in addressing hot-humid conditions, cultural nuances, and adaptive behaviors. Incorporating local adaptability and context into design is vital for sustainable development, ensuring a balance between social, cultural, and environmental needs in tropical cities.

III. Methodology

A. Research Design

The study used a mixed approach, combining qualitative data with quantitative validation. It assessed shading and ventilation strategies in The Corner House (Manila) and The Commons Thonglor (Bangkok) through (1) design inventories, (2) performance evaluations, and (3) user feedback surveys, focusing on their impact on thermal comfort and user satisfaction in urban tropical architecture.

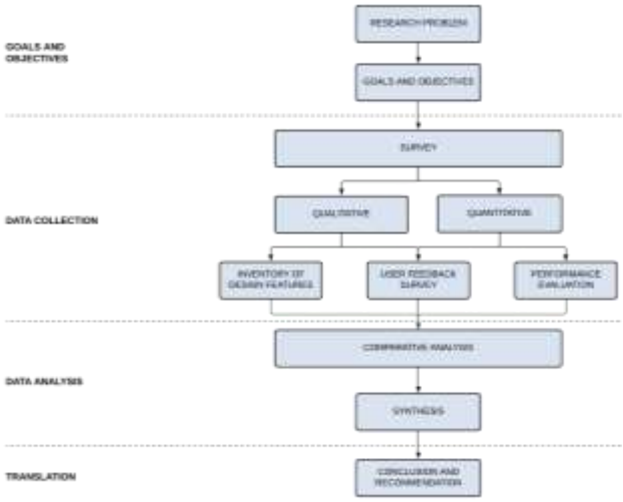

Figure 4. Research design for the case study.

B. Data Collection Methods

The comparative analysis relied on the following three core data components, each analyzed according to specific comparison criteria:

B.1. Design Features Inventory

The inventory compared shading and ventilation strategies at each center, analyzing design types, materials, and their impact on thermal comfort and airflow. It examined shading systems (e.g., louvers, canopies) for solar heat mitigation and ventilation systems (e.g., cross-ventilation, stack ventilation) for airflow efficiency. The findings highlighted how each center addressed tropical climate challenges like solar heat gain and thermal regulation.

B.2. Performance Evaluation

The performance evaluation focused on quantifying the effectiveness of the shading and ventilation strategies through two main components:

- Thermal Comfort: Thermal comfort in two community centers was assessed by measuring air temperature and relative humidity using digital thermometers and hygrometers. Data collection occurred over two days for each site: October 13 and 22, 2024, for The Corner House, and October 24-25, 2024, for The Commons Thonglor. The study supported using digital tools for accurate thermal comfort assessments (Bai et al., 2018). The data was analyzed with Andrew Marsh's Psychrometric Chart and the Givoni Bioclimatic Chart.
- Airflow Simulations: Airflow efficiency evaluation was done through Autodesk Flow Design. These data helped assess how well the designs promoted natural ventilation, allowing for cooling through air movement in space.

Performance metrics from the two community centers were compared to identify design elements that best ensured thermal comfort and airflow while reducing reliance on mechanical systems.

B.3. User Feedback Survey

The user feedback survey gathered visitor insights on comfort and satisfaction with shading and ventilation strategies at each community center. The target number of respondents for each center was 30, with 30 respondents at The Commons Thonglor and 45 respondents at The Corner House. A sample size of 30 respondents is generally considered the minimum for ensuring statistical reliability and identifying key trends, striking a balance between practicality and representativeness (Krejcie & Morgan, 1970). Data for The Commons Thonglor was collected on-site and online on October 25-26, while for The Corner House, on-site data was collected on October 13 and November 18, with online responses from October 14-18 and November 19-21. The survey was designed to procure both quantitative and qualitative data to provide diverse and corroborating feedback.

- Quantitative: Closed-ended questions, with the use of 5-point Likert scale, gathered numeric data on comfort, which was analyzed using descriptive statistics.
- Qualitative: Open-ended questions gathered visitor feedback on discomfort, dissatisfaction, and improvement suggestions, analyzed through thematic analysis to identify patterns and insights on user satisfaction.

Survey responses were cross-referenced with performance data to identify any correlations between subjective user comfort ratings and the objective thermal performance and airflow efficiency.

C. Data Analysis Techniques

The study employed a systematic comparative analysis framework (Figure 05) to evaluate the shading and ventilation strategies of the two community centers. This framework focused on three main components: an inventory of design, performance evaluation, and user feedback. By grouping the data in this manner, the framework facilitated a comprehensive assessment of each center's functional efficiency and visitor experience.

The comparative analysis process unfolded in three key stages:

1. Data Organization: Collected data, including design inventories, performance evaluations, and survey results, were systematically organized for clear interpretation and analysis.
2. Comparative Analysis: Each dataset—design inventory, performance evaluation, and user feedback—was individually analyzed to assess shading and ventilation strategies, highlighting shared and unique deductions relating to thermal comfort, airflow, and user satisfaction.
3. Insights and Implications: The individual analyses were synthesized into a comparative analysis, highlighting each center's strengths, weaknesses, and areas for improvement in ensuring thermal comfort and user satisfaction.

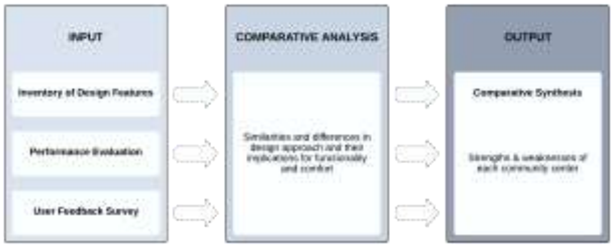

Figure 5. Comparative analysis framework.

IV. Data Results and Analysis

A. Site Inventory

This section provides an analysis of the project location, geographical and climatic context, sun path and windrose diagrams to understand solar exposure and prevailing wind patterns, and an assessment of average temperatures and precipitation levels.

A.1. The Corner House

Figure 6. Aerial view of the location of The Corner House.
Source: Google Earth

The Corner House, a four-storey retail development, sits on a corner lot 26 meters above sea level. It is bordered by C.M. Recto Street to the south, P. Guevarra Street to the west, and low-rise developments with vegetation to the north and east (Figure 06). Its exposed corner location receives direct sunlight all day due to the absence of shade from neighboring structures.

The June solstice, characterized by the longest sun path of the year, offers a stark contrast to the December solstice, which marks the shortest (Figure 07). Evaluating the structure's thermal comfort during the June solstice is crucial, as it provides essential insights into how the building performs under extended periods of sunlight and peak solar intensity, enabling more informed and effective design decisions.

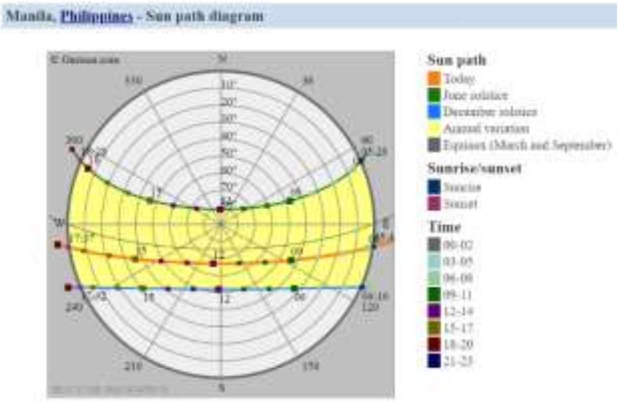

Figure 7. Manila, Philippines Sun Path Diagram.
Source: Gaisma.com

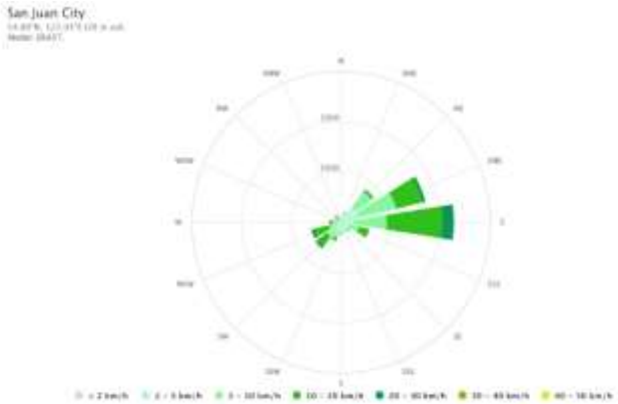

Figure 8. Windrose diagram of San Juan City, Philippines.
Source: Meteoblue.com

The annual wind rose diagram for San Juan City (Figure 08) shows prevailing winds from the east (E) and east-northeast (ENE), with speeds typically ranging from 2–20 km/h. Calm conditions are rare, reflecting consistent airflow influenced by trade winds or the northeast monsoon (Amihan). East-northeast openings in San Juan buildings enhance ventilation; while shading and reinforcements combat heat and typhoon winds.

Figure 09 shows that maximum temperatures of 33°C occur in April and May, while minimum temperatures of 23°C are recorded in January, February, and December. July has the highest precipitation, averaging 420 mm, with the most rainfall days annually.

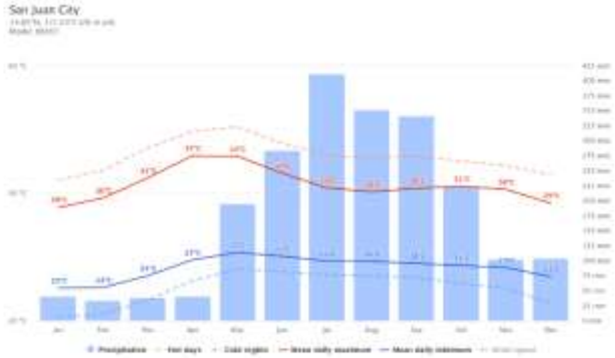

Figure 9. San Juan City, Philippines Average Temperature and Precipitation.
Source: Meteoblue.com

A.2. The Commons Thonglor

Figure 10. Aerial view of the location of The Commons Thonglor.
Source: Google Earth

The Commons Thonglor, a four-storey retail development with a 5,000-square-meter area, is located at 335 Sukhumvit Rd. Soi Thonglor 17, Watthana, Bangkok, Thailand, at 3 meters above sea level. It is bordered by Soi Akkhara Phatsadu to the north and a high-density development to the east, which offers morning shade. To the south is the Villa Market Thonglor, and to the west, a low-rise development (Figure 10).

The annual dominant wind direction of Bangkok varies from the south-south-west to west direction. The SSW direction is the direction with the highest wind speed and gradually decreases toward the west direction (Figure 11).

The annual wind rose diagram for Bangkok as seen in Figure 12 shows dominant winds from the south (S), southwest (SW), and south-southwest (SSW), with speeds mostly between 5–20 km/h. Consistent airflow, typical of monsoonal tropical regions, supports natural ventilation. Aligning openings of Bangkok buildings to the south and southwest improves ventilation, with shading features providing protection from monsoon winds.

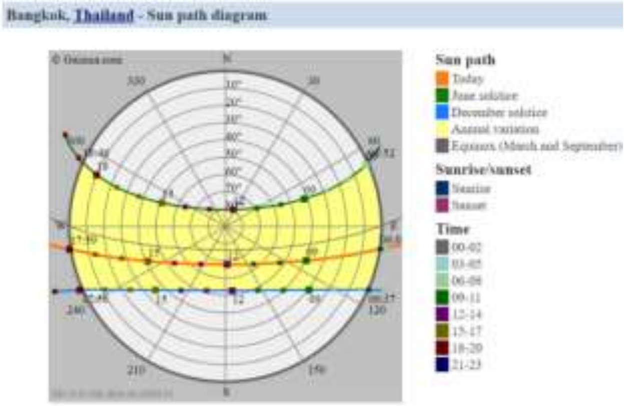

Figure 11. Bangkok, Thailand Sun Path Diagram.

Source: Gaisma.com

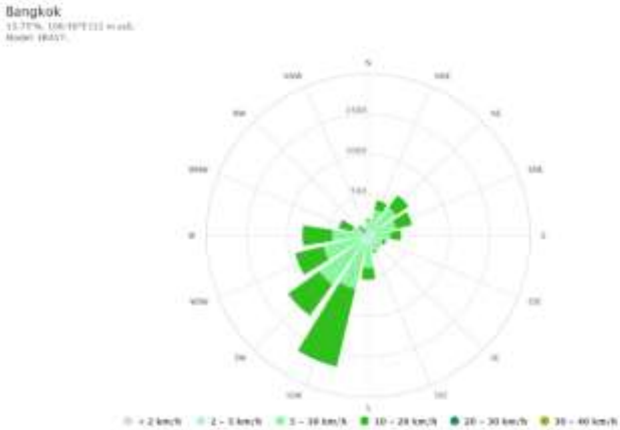

Figure 12. Bangkok, Thailand Windrose Diagram

Source: Meteoblue.com

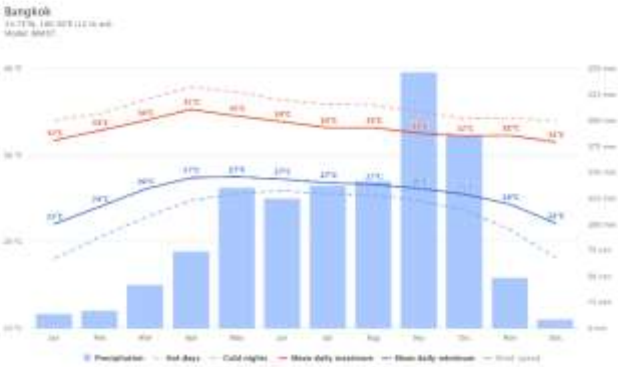

Figure 13. Bangkok, Thailand Average Temperature and Precipitations.

Source: Meteoblue.com

Bangkok experiences a maximum temperature of 35 degrees Celsius during April and May, while the minimum temperature of 22 degrees Celsius is recorded in January and December. The highest precipitation level occurs in September, averaging approximately 240 mm, during which most of the annual rainfall is concentrated (Figure 13).

B. Design Features Inventory

B.1. The Corner House (Manila)

B.1. a. Mass and Orientation of the Building

Designed to maximize natural ventilation, the Corner House capitalizes on the annual dominant wind directions from the east and east-north-east (Figure 14), with a vertical design linking the street level to a four-storey atrium through a cascading crown (Figure 15).

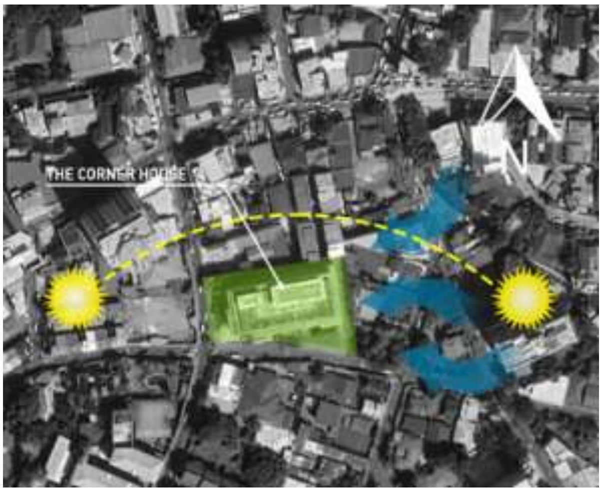

Figure 14. Position and orientation of the building mass.

Source: Google Earth; edited by the Authors

Figure 15. Exterior view of the building.

Source: Authors

B.1.a. Openings and Ventilation

The Corner House features interconnected spaces designed to maximize natural ventilation and daylight. The central atrium is the primary circulation hub, with exposed structural elements and open spaces that allow natural ventilation and light throughout (Figure 16). The Corner

House's spacious corridors serve multiple purposes. They enable natural air circulation and smooth pedestrian flow while flexibly transforming into temporary retail spaces during special events (Figure 17).

Figure 16. Atrium.
Source: Authors

Figure 17. Corridor.
Source: Authors

The building incorporates an open-air dining space with expansive windows that connect to the outdoors (Figure 18). Staircases are for vertical circulation, shading, and cross-ventilation between floors (Figure 19). Ceiling fans are installed throughout the space to supplement natural air movement. Industrial overhead fans are installed in expansive areas with high ceilings (Figure 20), while smaller units are in compact zones (Figure 21).

Figure 18. Open-air dining area.
Source: Authors

Figure 19. Staircase.
Source: Authors

Figure 20. Ceiling fan on atrium.
Source: Authors

Figure 21. Ceiling fan at the open-dining area.
Source: Authors

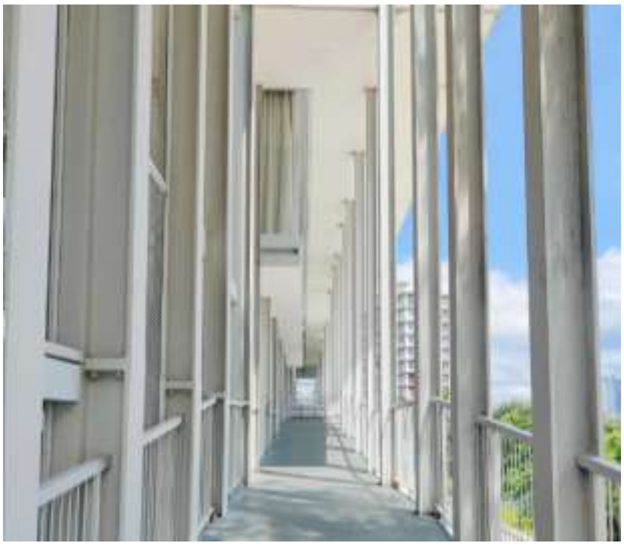

Figure 23. Other view of the outdoor corridor or jogging path.
Source: Authors

B.1.c. Shading

The Corner House integrates layered solar control through diverse shading strategies, including an exterior perimeter corridor that functions as a buffer against direct sunlight. This corridor also serves as a pedestrian and jogging pathway, enhancing circulation while maintaining natural ventilation and views of the cityscape (Figures 22 and 23).

The automated rolling blinds are provided, intelligently deployed when sunlight intensity increases to protect interior spaces (Figure 24). Expanded metal mesh provides a permanent architectural screen that filters harsh sunlight while maintaining views and airflow (Figure 25).

Figure 22. Outdoor corridor or jogging path.
Source: Authors

Figure 24. Automatic roller blinds.
Source: Authors

Figure 25. Expanded metal mesh for shading.
Source: Authors

Synthetic canvas curtains offer a softer aesthetic for areas in the structure requiring additional solar protection while effectively diffusing natural light (Figure 26). Steel horizontal louvers are positioned to block high-angle sun rays (Figure 27).

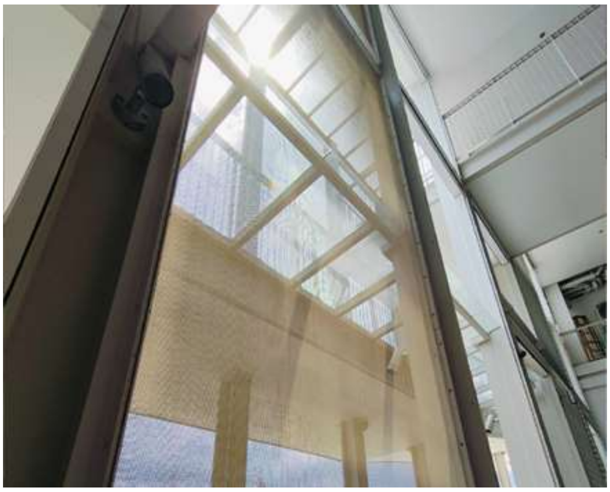

Figure 26. Synthetic canvas blinds.
Source: Authors

Figure 27. Steel horizontal louvers for shading.
Source: Authors

Fritted glass (Figure 28) and curtains (Figure 29) provide occupants with adjustable privacy and light control options on the interior, particularly in air-conditioned zones.

Landscaping is thoughtfully integrated to elevate shading, aesthetics, and environmental comfort. Lush green berms (Figure 30) and mature trees (Figure 31) along the perimeter provide natural shading while softening the building's architectural edges. Interior spaces incorporate vegetation, as illustrated in Figure 32. On the roof deck level, an elevated green berm (Figure 33) serves a dual purpose: it acts as a natural shading element, helping reduce solar heat gain on the building's uppermost surface and adding a visually appealing green feature to the design.

Figure 28. Fritted glass.
Source: Authors

Figure 29. Curtains.
Source: Authors

Figure 30. Landscaping along building perimeter.
Source: Authors

Figure 31. Other landscaping along building perimeter.
Source: Authors

Figure 32. Interior landscaping.
Source: Authors

Figure 33. Roof deck landscaping.
Source: Authors

B.2. The Commons Thonglor (Bangkok)

B.2.a. Mass and Orientation of the Building

The orientation of the Commons Thonglor maximizes natural ventilation and daylight, providing site-specific responses to Bangkok's tropical climate and the annual dominant wind directions, which vary from south-southwest to west (Figure 34). Its mass is characterized by a vertical open-air public space forming the backbone of the building, with large voids on the upper floors connecting to open-air areas that occupy nearly 30% of each floor plate on the third and fourth floors (Figure 35).

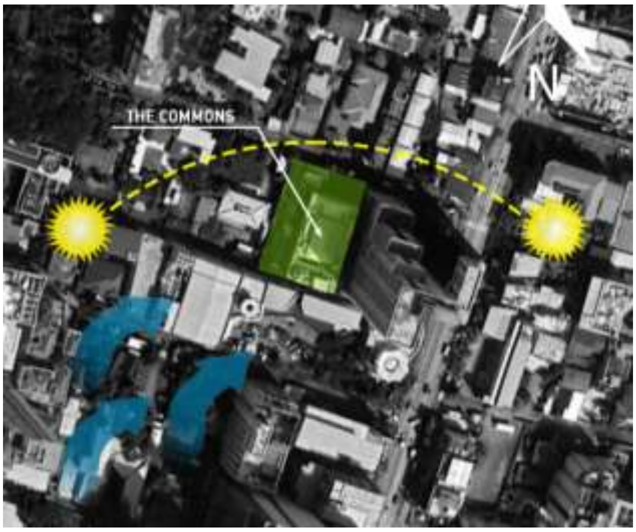

Figure 34. Position and orientation of the building.
Source: Google Earth; edited by the Authors

Figure 35. Exterior view of the building.
Source: Authors

B.2.b. Openings and Ventilation

The section diagram of The Commons Thonglor (Figure 36) illustrates its natural ventilation strategy, utilizing a stepped design for a chimney effect, assisted by roof ventilation to expel hot air. Interconnected spaces, varying floor heights, and vegetation enhance passive cooling, sustainability, and spatial flow.

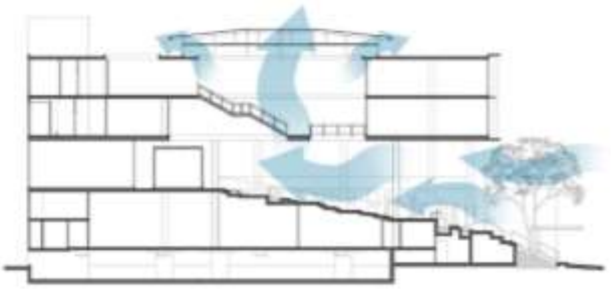

Figure 36. Modified diagram showing the cross-section of the building with light blue arrows illustrating the natural wind flow pattern.
Source: ArchDaily; modified by the Authors

Figure 37. Ground floor open-air space.
Source: Authors

Figure 38. Other view of the ground floor open-air space.
Source: Authors

The Commons Thonglor integrates indoor and outdoor spaces through its multi-level design (Figure 37). The ground floor features an inviting open-air public space with stepped terraces, lighting, and lush greenery (Figure 38).

Figure 39. Voids on the upper floors.
Source: Authors

Figure 40. Other view of the voids on the upper floors.
Source: Authors

The structural voids (Figure 39) provide vertical connections, allowing natural light and air circulation, framed by exposed concrete columns and beams (Figure 40). The fourth floor features semi-covered areas (Figure 41) and open sides for natural breezes (Figure 42).

The Commons Thonglor uses a hybrid ventilation strategy, combining passive and active systems for comfort. Ceiling fans enhance natural breezes in open spaces (Figure 43), while the roof's mechanical ventilation and slatted ceiling improve light penetration and air movement (Figure 44).

Figure 41. Fourth floor open-air public space.
Source: Authors

Figure 42. Other view of the fourth-floor open-air public space.
Source: Authors

Figure 43. Ceiling fan at the open-dining area.
Source: Authors

Figure 44. Mechanical ventilation system at the roof.
Source: Authors

Figure 45. Fourth floor mechanical ventilation system.
Source: Authors

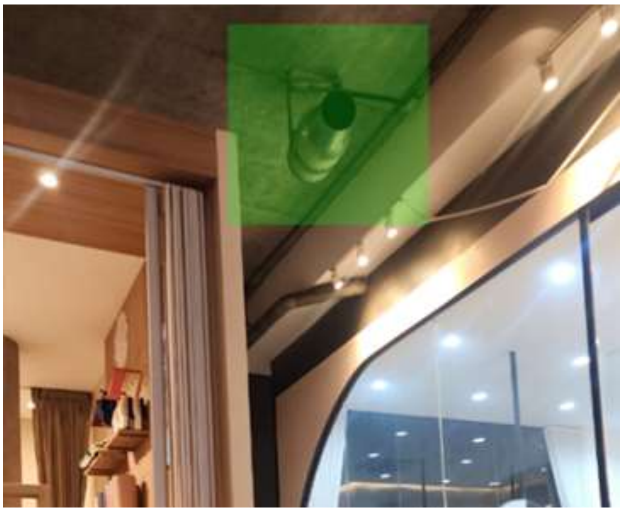

Figure 46. Air flow inducer.
Source: Authors

Ventilation units on the fourth-floor ceiling (Figure 45) and airflow inducers on the second floor (Figure 46) work with ceiling fans, mechanical ventilation, and voids to ensure efficient cooling.

B.2.c. Shading

The Commons Thonglor adopts a sophisticated approach to climate-responsive design through its multi-layered shading system. This design integrates both fixed and adaptable elements (Figure 47). A cross-sectional diagram illustrates the strategic use of horizontal concrete ledges and vertically expanded wire mesh, which block direct sunlight while allowing ample natural light to permeate the space (Figure 48).

Figure 47. Concrete ledge and expanded metal mesh.
Source: Authors

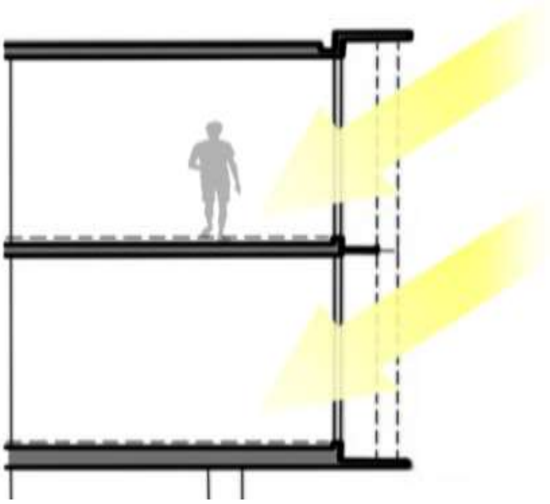

Figure 48. Diagram showing a blow-up cross section of The Commons Thonglor with light yellow arrows illustrating the sunlight direction
Source: ArchDaily; edited by the Authors

The white-painted expanded metal mesh (Figure 49) serves as a permeable screen, softly diffusing sunlight while framing views of the surrounding cityscape (Figure 50). This system is enhanced by retractable fabric shades (Figure 51), which provide users with the flexibility to adjust for additional protection against the sun or rain as needed (Figure 52).

Figure 49. Expanded metal mesh for shading.
Source: Authors

Figure 50. Other view of the expanded metal mesh for shading.
Source: Authors

Figure 51. Pull-down shades.
Source: Authors

Figure 52. Other view of the pull-down shades.
Source: Authors

Lush landscaping along the building's edges (Figure 53) and hanging planters (Figure 54) soften the architectural elements, creating inviting social spaces. The combination of plants, shading devices, and open-air design fosters areas for gathering and dining, offering protection from the elements.

Figure 53. Open-area landscaping.
Source: Authors

Figure 54. Landscaping at fourth floor open area.
Source: Authors

C. Comparative Analysis of Design Features

The Corner House and The Commons Thonglor demonstrate climate-responsive design in tropical urban settings through innovative shading and ventilation strategies. The Commons features a central open-air space with stepped voids covering 30% of upper-level floor plates, creating a chimney effect supported by passive and active systems like ceiling fans and roof-integrated ventilation. In contrast, The Corner House employs a central atrium, open-air corridors, and dining spaces to enhance natural airflow, complemented by varied ceiling fans for thermal comfort. Both buildings integrate staircases that facilitate vertical circulation and cross-ventilation.

For shading, both buildings use multi-layered systems to regulate solar gain, with The Corner House using automated blinds, synthetic canvas curtains, and louvers, for adaptive shading; while The Commons Thonglor has components such as concrete ledges, and retractable shades, giving users more control over sunlight and views. Landscaping, including trees, berms, green walls, and indoor plants, enhances shading and seamlessly connects indoor and outdoor spaces.

D. Evaluation of Building Performance

The psychrometric chart is a key tool for visualizing air thermodynamics and assessing thermal comfort, illustrating the relationship between temperature, humidity, and human comfort. It identifies uncomfortable indoor conditions (Koranteng, 2011) and standardizes the comparison of thermal comfort indices in outdoor settings (Tahbaz, 2011).

The ideal outdoor temperature for thermal comfort in Southeast Asia ranges from 25°C to 30°C (Karyono, 1996), while non-air-conditioned indoor spaces have an ideal temperature of around 30°C (Djamila et al., 2013). Optimal outdoor relative humidity (RH) is generally 75 ± 5% (Slamet & Huynh-Ba, 2010), with indoor RH best maintained between 40% and 60% for comfort and health (Coral, 2022).

D.1. Temperature and Relative Humidity Measurements

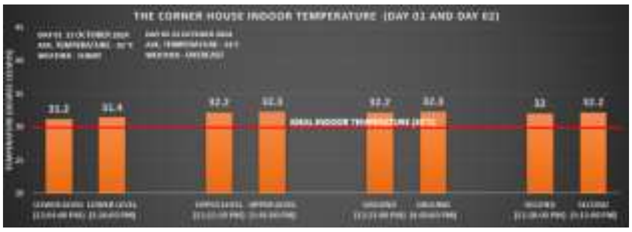

Figure 55. Indoor temperature for Day 01 and 02 of the Corner House.

The indoor temperature analysis of The Corner House (Figure 55) shows consistent exceedance of the ideal temperature on both sunny and overcast days. On Day 1, lower levels rose slightly from 31.2°C at noon to 31.4°C by mid-afternoon, while on Day 2, upper levels reached 32.3°C. Similar trends were observed across all floors.

The outdoor temperature analysis of The Corner House (Figure 56) reveals consistently high temperatures on both sunny and overcast days. On Day 1, temperatures range from 33.7°C at ground level to 40.1°C on the roof deck in the afternoon, while Day 2 shows slightly lower but still elevated readings, with the roof deck peaking at 36.4°C.

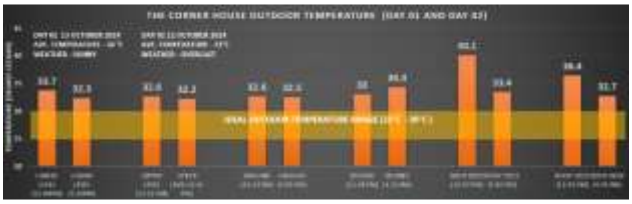

Figure 56. Outdoor temperature for Day 01 and 02 of the Corner House.

The indoor relative humidity (RH) analysis of The Corner House (Figure 57) shows levels frequently exceeding the ideal range. On Day 1, RH is highest on the lower level at 60%, with upper levels closer to acceptable ranges at 55% and 53%. On Day 2, RH increases slightly, with the ground and second floors recording 60% and 63%, indicating a consistent issue with humidity control. Elevated RH levels indicate challenges in maintaining indoor humidity due to poor ventilation and moisture control.

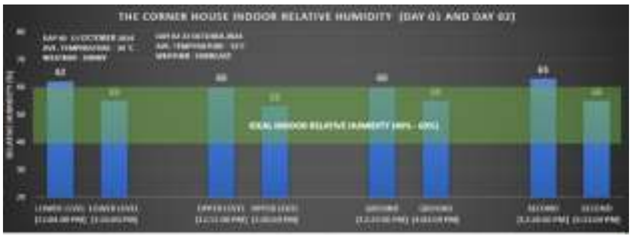

Figure 57. Indoor relative humidity for Day 01 and 02 of the Corner House.

The outdoor relative humidity (RH) analysis of The Corner House (Figure 58) shows most readings are below the ideal range, with slight variations between sunny and overcast days. On Day 1, RH starts higher, with 59% at the lower level and 60% on the ground floor, decreasing to 56% on the roof deck by afternoon. On Day 2, overall RH levels are slightly lower, ranging from 53% on the ground floor to 46% on the upper levels during the hottest period. The decrease in RH in elevated areas, particularly on the roof deck, suggests higher heat exposure and faster moisture evaporation.

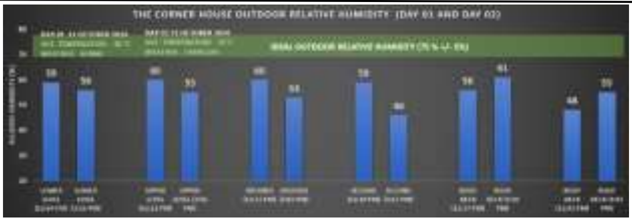

Figure 58. Outdoor relative humidity for Day 01 and 02 of the Corner House.

The indoor temperature analysis of The Commons Thonglor (Figure 59) shows variations across levels, with some exceeding the ideal temperature. On Day 1, the first level remained below the ideal at 28.5°C in the morning but rose to 32°C by mid-afternoon. On Day 2, lower levels began below the ideal but gradually increased, with the fourth level reaching 32.9°C in the late afternoon.

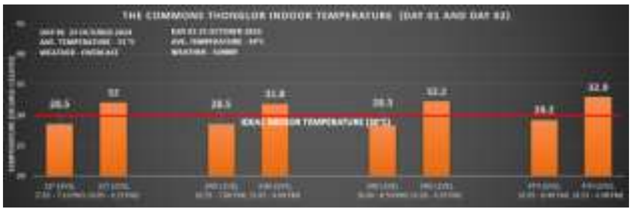

Figure 59. Indoor temperature for Day 01 and 02 of The Commons Thonglor.

Outdoor temperature measurements at The Commons Thonglor (Figure 60) display notable variations across levels and days, with several readings surpassing the ideal temperature range. On Day 1, temperatures on the first level begin at 29.2°C in the morning, remaining below the ideal range, but rise to 32.2°C in the afternoon, exceeding the threshold. On Day 2, outdoor temperatures are consistently higher, with the second and third levels reaching 31.2°C and 32.2°C, while the fourth level records the highest temperature of 32.5°C in the late afternoon.

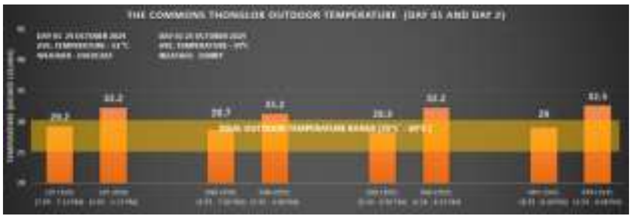

Figure 60. Outdoor temperature for Day 01 and 02 of The Commons Thonglor.

Figure 61 illustrates significant indoor relative humidity (RH) variations across levels at The Commons Thonglor, with many readings exceeding the ideal range. On Day 1, RH peaks at 79% on the first level, while the second level records a lower 51%, highlighting substantial discrepancies. On Day 2, RH remains high at 79% on the first level, 78% on the third level, and 77% on the fourth level, while the second level consistently maintains lower RH values of 51% and 49%, suggesting better moisture control or ventilation in that area. Higher RH levels on upper floors suggest poor humidity control, causing discomfort and condensation.

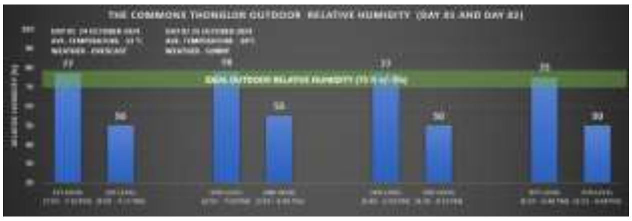

Figure 61. Indoor relative humidity for Day 01 and 02 of The Commons Thonglor.

Figure 62 shows outdoor relative humidity (RH) at The Commons Thonglor varying by floor and weather. On Day 1, RH starts at 77% and drops to 50%. On Day 2, RH peaks at 78%, drops to 55%, and stabilizes around 75-77% on higher levels. These variations highlight the building's ventilation strategies in maintaining RH within the ideal range (75% ± 5%).

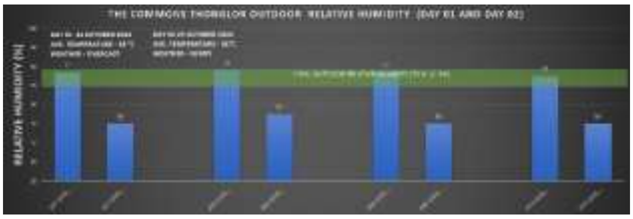

Figure 62. Outdoor relative humidity for Day 01 and 02 of The Commons Thonglor.

D.2. Psychrometric Charts

The psychrometric charts for The Corner House (Figures 63 and 64), show both indoor and outdoor conditions entirely outside the comfort zone, with high temperatures and relative humidity. When passive strategies like natural ventilation and shading fall short, mechanical cooling and dehumidification become necessary for indoor comfort. Outdoor areas can benefit from evaporative cooling, enhanced shading, and microclimate adjustments, such as water features or tree planting, to improve thermal comfort. Energy-efficient HVAC systems reduce energy use and costs over time, while thorough thermal comfort assessments ensure climate control strategies are both sustainable and effective.

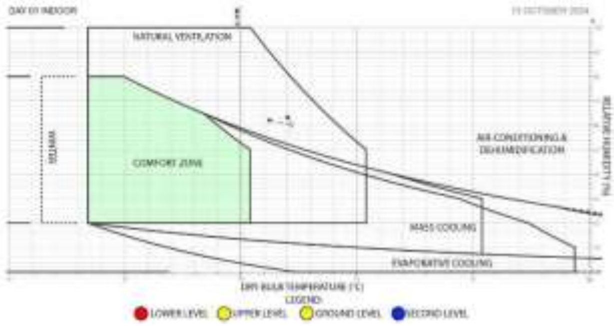

Figure 63. Psychrometric chart of the Corner House (Day 1- Indoor).

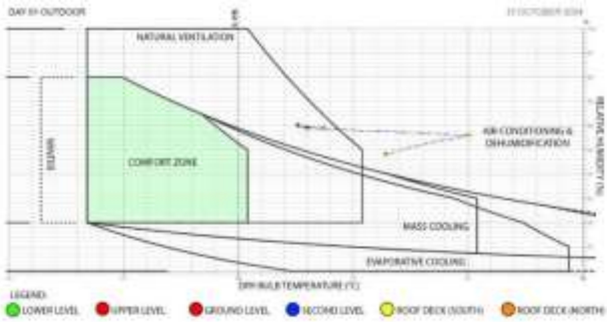

Figure 64. Psychrometric chart of the Corner House (Day 1- Outdoor).

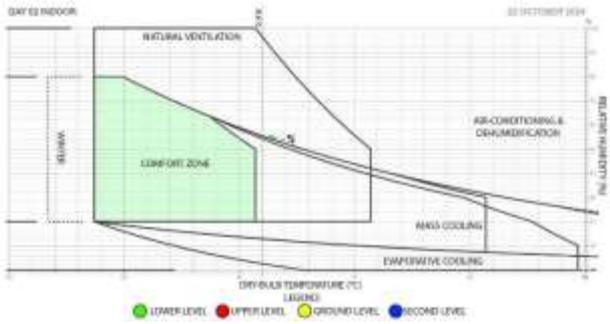

Figure 65. Psychrometric chart of the Corner House (Day 2- Indoor).

Figure 65 indicates temperature and humidity levels across all building levels are slightly outside the comfort zone. While conditions are relatively consistent, with minor variations between levels, temperatures and humidity still exceed thermal comfort thresholds. Figure 66 reveals temperature and humidity levels for all measured areas, including roof decks, are slightly outside the comfort zone. While minor variations exist between levels, the overall conditions remain consistent and still exceed thermal comfort thresholds, indicating elevated heat and humidity across the building's outdoor spaces.

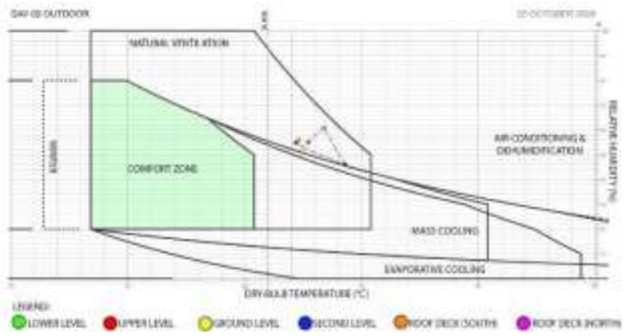

Figure 66. Psychrometric chart of the Corner House (Day 2-Outdoor).

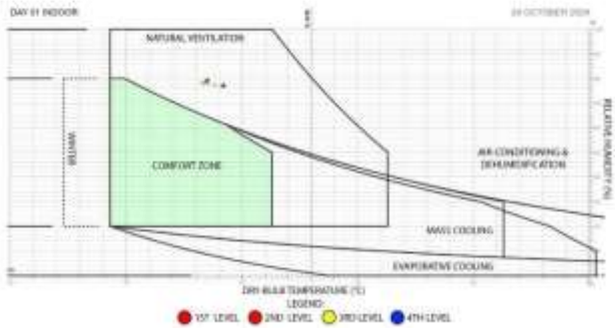

Figure 67. Psychrometric chart of The Commons Thonglor (Day 1-Indoor)

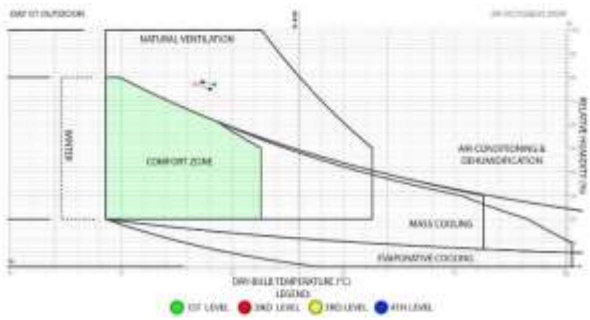

Figure 68. Psychrometric chart of The Commons Thonglor (Day 1-Outdoor).

Indoor and outdoor temperature and humidity levels for all building levels are consistently warm and humid, with measurements slightly outside the comfort zone (Figures 67 and 68). Indoors, minor variations across levels are observed, but overall, the environment exceeds thermal comfort limits. Similarly, outdoor conditions show uniform thermal characteristics, with slight differences between levels. The data highlights the persistent warmth and humidity both inside and outside, presenting consistent thermal challenges across all building levels.

Figure 69 displays temperature and humidity levels across all building levels positioned near the comfort zone, with some data points partially overlapping it. Indoor conditions reflect slight improvements in thermal comfort compared to Day 1, though warmth and humidity remain notable challenges. Similarly, outdoor conditions (Figure 70) also show slight improvement, with levels closer to the comfort zone but still exhibiting consistent warmth and humidity across all measured areas. Minor variations are observed between indoor and outdoor levels, highlighting a generally uniform thermal environment.

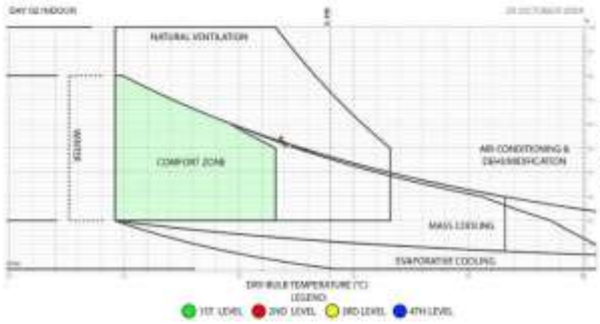

Figure 69. Psychrometric chart of The Commons Thonglor (Day 2-Indoor).

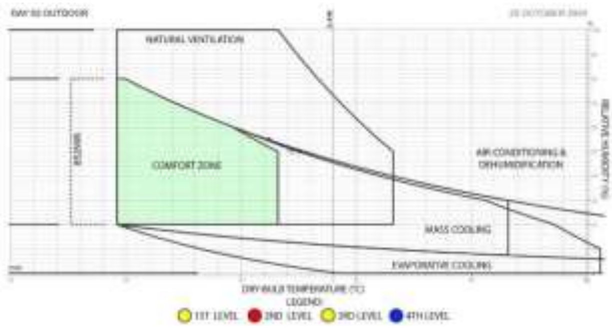

Figure 70. Psychrometric chart of The Commons Thonglor (Day 2-Outdoor).

D.3. Airflow Simulation Data and Analysis

Three-dimensional models analyzed using Autodesk Flow Design reveal similar permeability in both buildings, enhancing indoor thermal comfort through natural airflow. The results align with other findings, confirming data reliability.

D.3.a. The Corner House

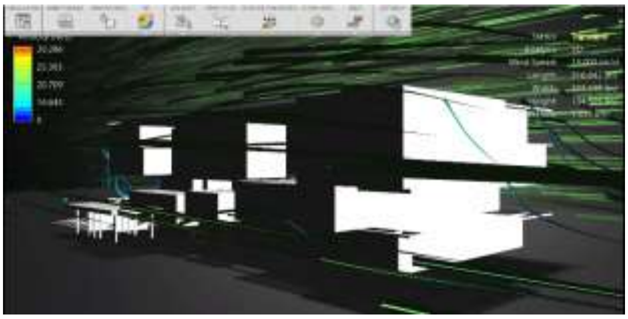

Figure 71. Airflow simulation illustrating the wind from the west direction (dominant wind direction).

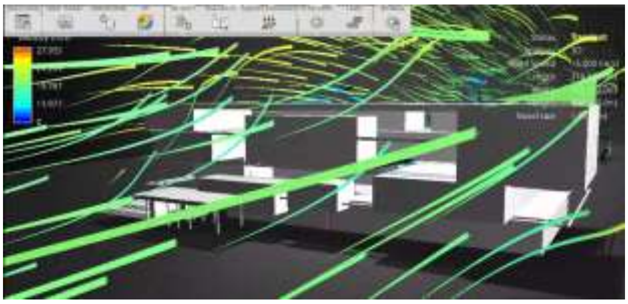

Figure 72. Airflow simulation along CM Recto Street illustrates the wind flow from the south direction.

D.3.b. The Commons Thonglor

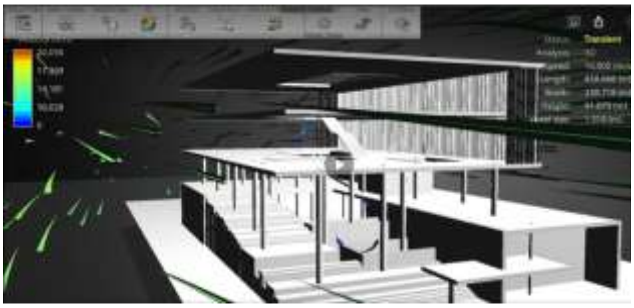

Figure 73. Airflow simulation at the front facade illustrating the wind from the north-west direction (dominant wind direction).

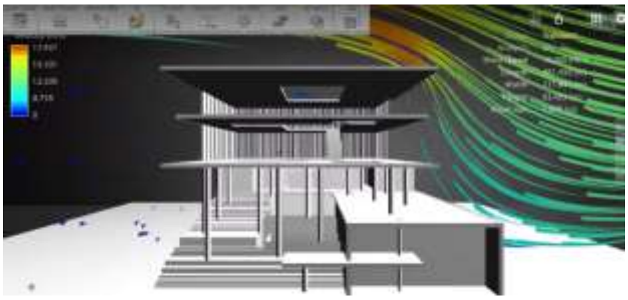

Figure 74. Airflow simulation showing the wind from the west direction.

The Corner House primarily uses cross-ventilation enabled by large fenestration along the sides of the facade, with wind penetration being more effective on the upper floors due to their elevated position. However, the roof deck significantly contributes to heat gain, negatively affecting thermal comfort on the upper levels. Additionally, the lack of sufficient fenestration on the windward facade limits airflow through the structure, reducing ventilation efficiency.

In contrast, The Commons Thonglor employs a combination of cross-ventilation and stack ventilation, supported by its open-air central public space and extensive fenestration along the facades. The upper floors benefit from improved wind penetration, attributed to the chimney effect created by stack ventilation. However, the analysis is limited by the exclusion of assisted mechanical ventilation systems from the simulation, a shortcoming of the software used. This highlights the need for complementary tools or methodologies to achieve a more comprehensive evaluation of airflow and ventilation performance in such structures.

E. User Feedback Survey

This section presents the user feedback survey of The Corner House and Commons Thonglor, starting with the graphs and results, followed by a summary of findings for each community center. The survey collected insights on demographics, visitor activity, building performance and user satisfaction, design and aesthetics of shading elements and ventilation systems, and open-ended feedback.

E.1. Survey Results for The Corner House

E.1.a. Demographics and General Information

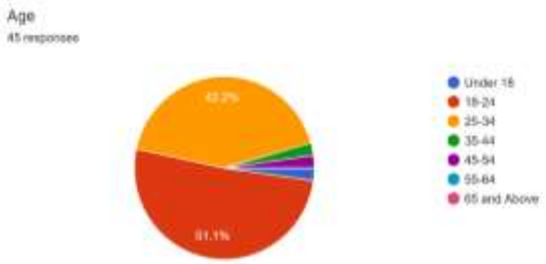

Figure 75. Age bracket of the respondents.

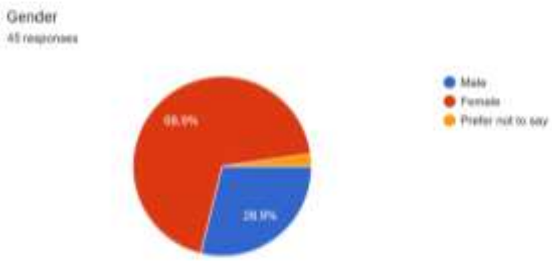

Figure 76. Gender of the respondents.

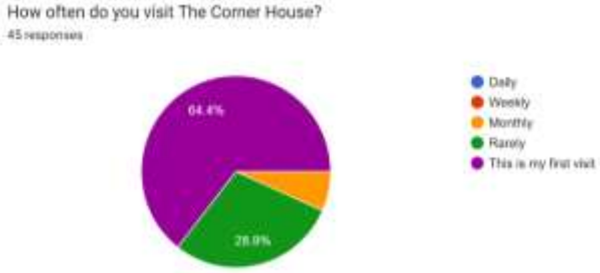

Figure 77. Gender Frequency of visit by the respondents.

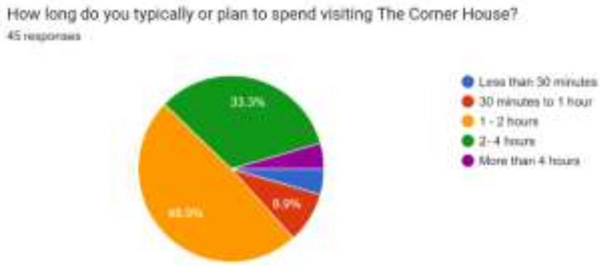

Figure 78. Projected duration of visit by the respondents.

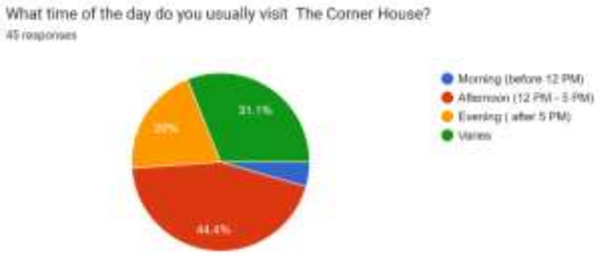

Figure 79. Preferred visiting time of the respondents.

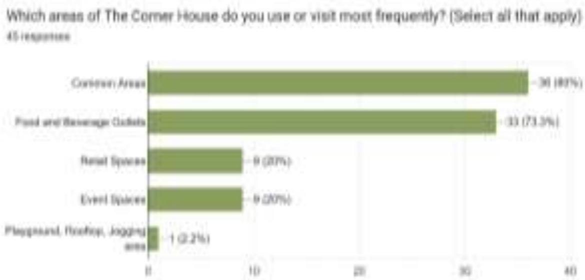

Figure 80. Areas that are frequently visited by the respondents.

E.1.b. Survey on Building Performance and User Satisfaction

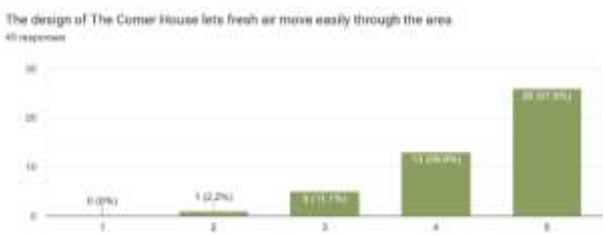

Figure 81. Assessment of fresh air circulation.

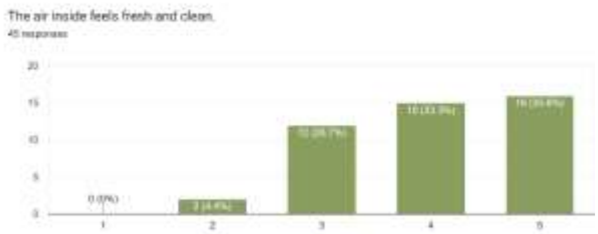

Figure 82. Assessment of freshness and cleanliness of the circulating air.

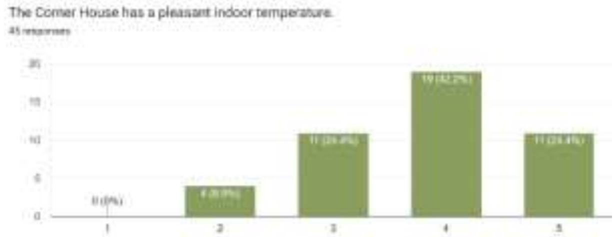

Figure 83. Perception of indoor temperature.

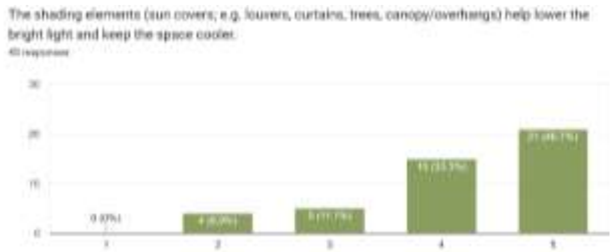

Figure 84. Assessment of the effectiveness of shading elements.

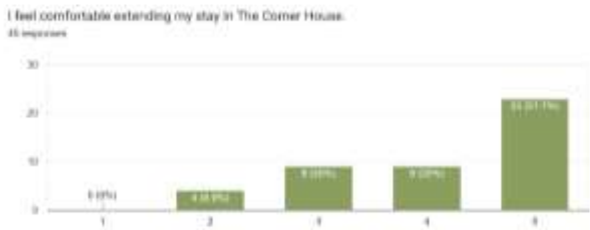

Figure 85. Level of perceived comfort by the respondents.

E.1.c. Survey on Design and Aesthetics of Shading Elements and Ventilation Systems

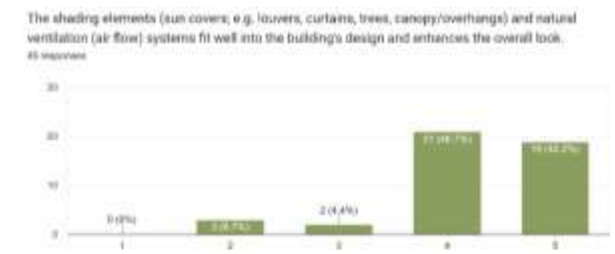

Figure 86. Assessment of the compatibility of shading elements and ventilation systems to the building design.

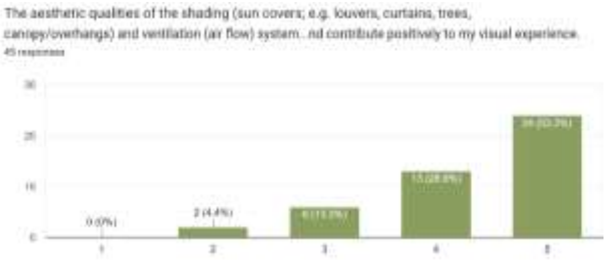

Figure 87. Visual impact of shading and ventilation systems.

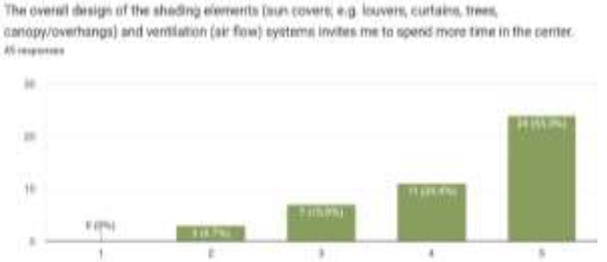

Figure 88. Overall design assessment of shading elements and ventilation systems.

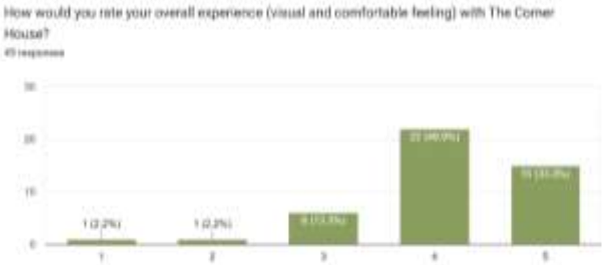

Figure 89. Overall user experience of the respondents.

E.1.d. Open-ended Survey Questions

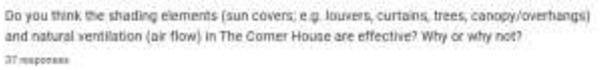
Do you think the shading elements (sun covers; e.g. louvers, curtains, trees, canopy/overhangs) and natural ventilation (air flow) in The Corner House are effective? Why or why not?
37 responses

Figure 90. Open-ended question on the effectiveness of shading elements.

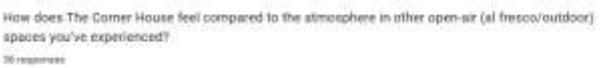
How does The Corner House feel compared to the atmosphere in other open-air (al fresco/outdoor) spaces you've experienced?
36 responses

Figure 91. Open-ended question on visitor perceptions of The Corner House's atmosphere.

E.2. Survey Summary for The Corner House

The Corner House attracts a younger audience, with 93.3% of visitors aged 18–34 and 68.9% being women. Most visitors are first timers (64.4%), likely due to its new status in the area. Most stays range from 1–4 hours, with afternoons to evenings (64.4%) being the most popular time, and visitors primarily favoring common areas (80%) and food and beverage outlets (73.3%), reinforcing its appeal as a new social destination.

The design is praised for promoting natural airflow, with 86.7% of respondents commending the ventilation system for creating a comfortable atmosphere. Shading elements are also valued, with 80% noting their effectiveness in reducing glare and maintaining coolness, and 88.9% highlighting their contribution to both functionality and aesthetics. These features encourage longer stays, with 71.1% of visitors feeling comfortable spending extended periods at the venue.

While the venue generally manages heat effectively, several areas require attention to enhance the visitor experience. Temperature regulation remains inconsistent, with 26.7% rating air quality as average and 8.9% dissatisfied with the temperature. Qualitative feedback reveals the areas for improvement such as ventilation variability, inconsistencies of shading elements and a need for landscaping enhancement as some of the respondents stating "sometimes I feel hot and uncomfortable, but sometimes I feel the cool breeze", "I think the building lacks shading elements, especially for the spaces facing the south and west.", and "The slope garden in front is very nice, but the landscape insides still scatter few and dying, it needs to be more dense, more lush and flowery.". Additionally, some exposed walkways and ramps feel overly warm during peak sun hours, and water runoff during rainfall, combined with a lack of sheltered pathways, affects the space's usability.

The findings suggest that while current design strategies are effective, improving shading coverage and airflow consistency could better address visitor needs. This aligns with Orbon et al. (2019), who emphasized the role of shading and natural elements in enhancing thermal comfort. However, visitor dissatisfaction with temperature may also reflect a preference for cooler conditions, as noted by Andamon (2006) in his study on thermal comfort in the Philippines.

Overall, 82.2% of visitors rate their experience positively, highlighting the comfortable and inviting atmosphere, with a balance of functional design and aesthetic appeal as a key factor in their satisfaction. While most feedback was favorable, addressing areas for improvement such as enhancing shading in key areas, improving landscaping, and ensuring consistent airflow could greatly enhance the overall experience.

E.3. Survey Results for The Commons Thonglor

E.3.a. Demographics and General Information

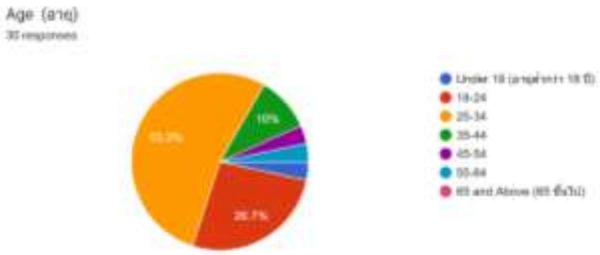

Figure 92. Age bracket of the respondents.

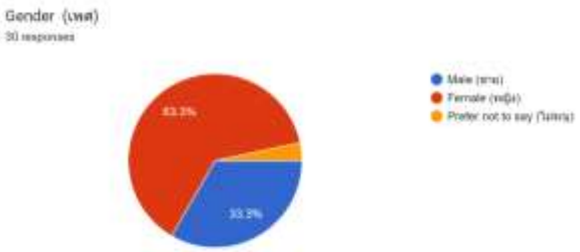

Figure 93. Gender of the respondents.

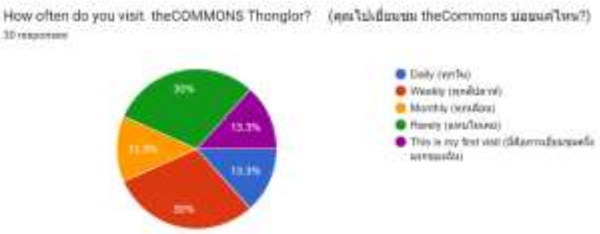

Figure 94. Frequency of visit of the respondents.

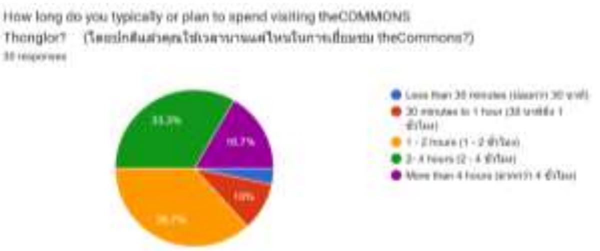

Figure 95. Projected duration of visit by the respondents.

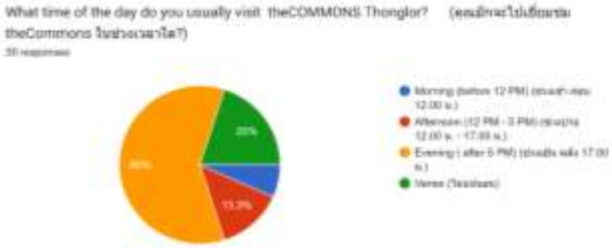

Figure 96. Preferred visiting time of the respondents.

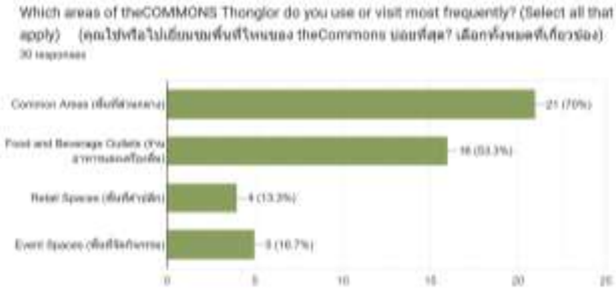

Figure 97. Areas that are frequently visited by the respondents.

E.3.b. Survey on Building Performance and User Satisfaction

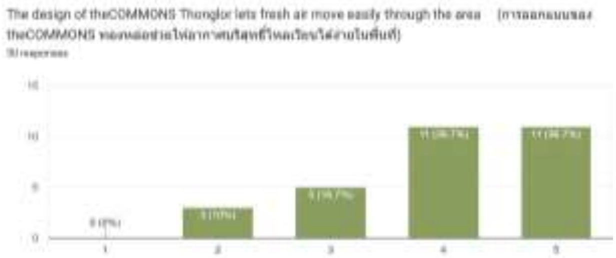

Figure 98. Assessment of fresh air circulation.

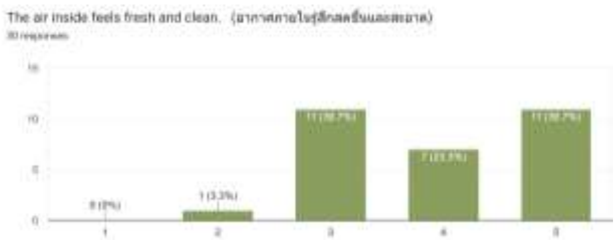

Figure 99. Assessment of freshness and cleanliness of the circulating air.

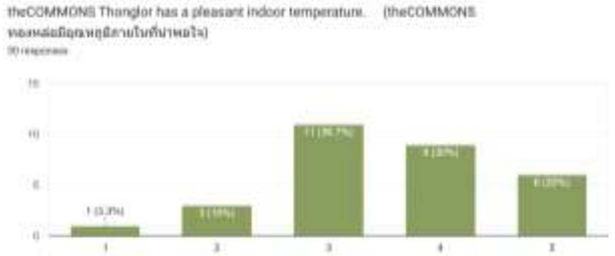

Figure 100. Assessment of indoor temperature.

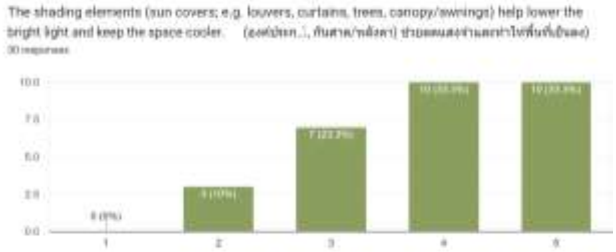

Figure 101. Assessment of effectiveness of shading elements.

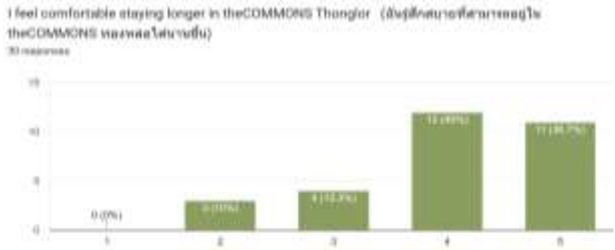

Figure 102. Level of perceived comfort by the respondents.

E.3.c. Survey on Design and Aesthetics of Shading Elements and Ventilation Systems

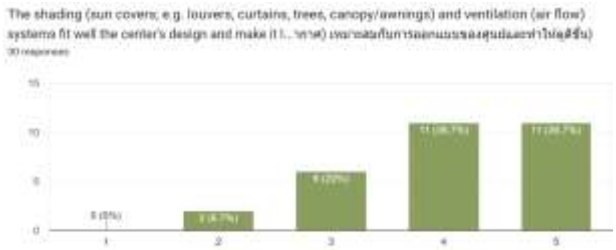

Figure 103. Assessment of the compatibility of shading elements and ventilation systems to the building design.

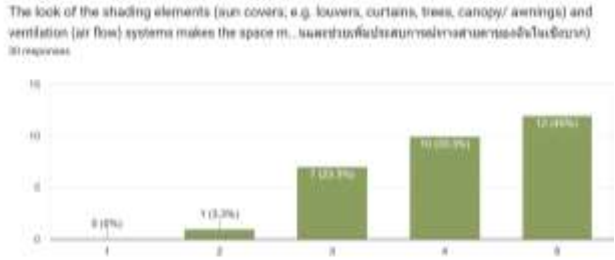

Figure 104. Visual impact of shading and ventilation systems.

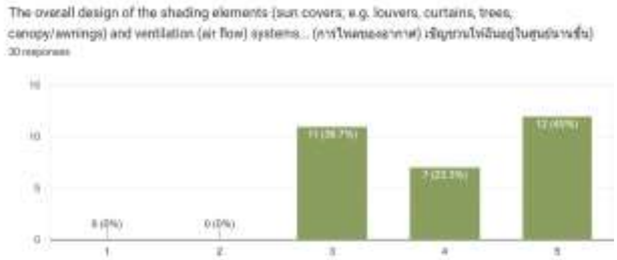

Figure 105. Overall design assessment of shading elements and ventilation systems.

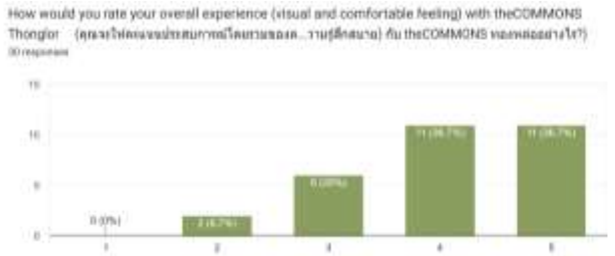

Figure 106. Overall user experience of the respondents.

E.3.d. Open-ended Survey Questions

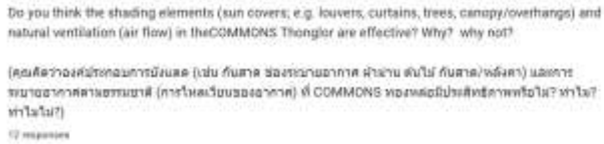

Figure 107. Open-ended question on the effectiveness of shading elements.

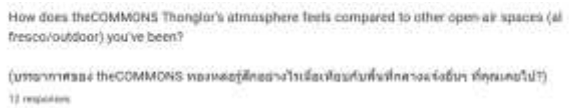

Figure 108. Open-ended question on visitor perceptions of The Commons Thonglor.

E.4. Survey Summary for The Commons Thonglor

The Commons Thonglor appeals to the younger audience, with 53.3% of visitors aged 25-34 and 63.3% being women. Visitor patterns reveal a mix of loyalty and casual attendance, with 30% visiting weekly and 30% occasionally. Most stays range between 1–4 hours, with evenings (60%) as the most popular time, and visitors primarily favoring common areas (70%) and food and beverage outlets (53.3%), solidifying the venue's role as a vibrant social hub.

It is praised for its climate-responsive design, with 73.4% of respondents highlighting the effectiveness of its natural ventilation and 66.6% commending its shading systems for reducing glare and maintaining coolness. However, 36.7% rate air quality and temperature as average, indicating room for improvement in ventilation and thermal comfort solutions. Shading and ventilation systems are recognized for their functional and aesthetic contributions, with 73.4% noting their positive impact and 63.4% acknowledging their role in encouraging extended stays.

Qualitative feedback highlights the venue's integration of comfort and design, with features such as open layouts, double-volume spaces, and central exhaust systems enhancing airflow and creating a relaxing atmosphere. Visitors describe the space as "airy, comfortable, and well-ventilated,". However, feedback also points out areas for improvement, including insufficient shading in certain areas, issues during rainy weather, and inconsistencies in ventilation. Some respondents noted, "when it rains, it's pretty bad" and "the space in the middle is open and it has the gap," indicating that airflow is less effective in more enclosed sections and highlighting the need for better-covered walkways.

The findings indicate that while visitors to The Commons Thonglor value the integration of shading and natural ventilation, inconsistencies in airflow and temperature regulation may impact comfort. This supports Busch's (1991) observations on Thai tolerance for higher temperatures in naturally ventilated spaces and Suwanmanee et al.'s (2024) emphasis on shaded, well-ventilated areas for thermal comfort.

Overall, 73.4% of visitors rate their experience positively, emphasizing the venue's attempt at aligning aesthetics, comfort, and sustainability. While there were areas for improvement for shading and ventilation, it is generally praised with visitors appreciating the balance of natural lighting and airflow that enhances the space's functionality. Addressing these will enhance the overall experience and add to the inviting and airy atmosphere, fostering a sense of relaxation and encouraging longer stays.

E.5. User Survey Analysis

Both The Corner House and The Commons Thonglor demonstrate a strong translation and application of tropical design principles combining shading and ventilation systems to create comfortable and aesthetically appealing spaces. These features not only enhance functionality but also create an inviting atmosphere that encourages medium length stays of 2-4 hours, with visitors favoring the common areas. The balance between practicality and aesthetics is a key strength, fostering positive user experiences and aligning with sustainable design goals.

However, both venues present opportunities for improvement to enhance user satisfaction in aspects such as inconsistent shading coverage and variability in thermal comfort. The visitors noted inadequate weather protection at The Commons Thonglor, indicating the need for retractable coverings or sheltered pathway, while inadequate shading elements at The Corner House in south and west facing spaces, indicating areas where shading effectiveness could be enhanced.

Both venues also receive feedback regarding inconsistent airflow. The visitors noted that in more enclosed spaces at The Commons Thonglor, airflow could feel stagnant despite the open layout encouraging natural airflow, while at The Corner House, there was airflow variability despite being praised for maintaining comfort.

Addressing shading and ventilation inconsistencies is a realistic goal and essential for creating a more uniform and comfortable experience across both venues. Mitigating this imbalance would involve strategic measures, such as adding shading elements (e.g., trees, canopies) and mechanical systems but require careful planning and investment. By adopting a pragmatic approach, these issues can be effectively addressed, enabling both venues to evolve while remaining committed to sustainability and user experience without undermining the architectural vision.

In conclusion, while both The Corner House and The Commons Thonglor excel in creating comfortable, sustainable environments, they may further enhance their designs by addressing shading and ventilation inconsistencies. Addressing these inconsistencies strengthens their reputation as benchmarks for tropical design, enhance visitor satisfaction, and further establish themselves as prime examples of sustainable, user-centered spaces.

E.6. Comparative Synthesis

PARAMETER	THE COMMONS THONGLOR		THE CORNER HOUSE	
	STRENGTHS	WEAKNESSES	STRENGTHS	WEAKNESSES
VENTILATION	- Combines cross and stack ventilation; chimney effect enhances airflow on upper floors. - Ceiling fans and roof-integrated ventilation system assist in cooling.	- Lower levels face limited airflow, requiring additional ventilation solutions. - High humidity levels persist, requiring more effective dehumidification.	- Cross-ventilation; central atrium and open corridors promote airflow. - Ceiling fans strategically placed to induce air flow for effective thermal comfort.	- Limited airflow at lower levels, requiring additional ventilation support. - High humidity levels persist, requiring more effective dehumidification.

SHADING	- Flexible shading (retractable shades, concrete ledges) offers user control. - Green walls and trees provide shade	- Inconsistent shading coverage in some areas - Requires more weather protection and refinement of shading strategies.	- Adaptive shading (automated blinds, louvers) regulates solar gain.	- Insufficient shading coverage in some areas, leading to thermal discomfort. - Landscaping is underutilized in certain areas, which could have improved shading.
VISITOR ENGAGEMENT	- User experience is highly satisfactory, with respondents expressing a willingness to stay longer. - Contributing factors: - open layout with dynamic public spaces - landscaping adds aesthetic value	- Common areas, which are alfresco spaces, are the preferred spaces to go to but struggle with maintaining consistent thermal comfort.	- User experience is highly satisfactory, with respondents expressing a willingness to stay longer. - Contributing factors: - central atrium which maximizes spatial flow and corridors promoting interaction - landscaping enhances the sensory experience.	- Common areas, which are alfresco spaces, are the preferred spaces to go to but struggle with maintaining consistent thermal comfort.

Figure 109. Tabulated Comparative Synthesis.

Both The Corner House and The Commons Thonglor exhibit thoughtful integration of passive design systems, prioritizing ventilation, shading, and user comfort. While both buildings excel in many aspects, targeted improvements are necessary to optimize thermal comfort and space utilization, as enumerated as follows:

The Commons Thonglor stands out with its effective (1) stack ventilation and (2) flexible shading systems, particularly benefiting upper floors, while (3) green walls and trees enhance both aesthetics and thermal comfort. Similarly, The Corner House leverages (1) cross-ventilation to promote airflow and employs (2) adaptive shading systems to regulate solar gain. Both buildings successfully integrate landscaping, contributing to user comfort and design appeal.

However, challenges remain. The Commons Thonglor faces weather-related vulnerabilities such as rain and high humidity in alfresco spaces. The Corner House also struggles with inconsistent shading, leading to occasional discomfort. Both buildings struggle with insufficient airflow at lower levels, indicating the need for air flow inducers, and the issue of managing indoor humidity effectively, indicating a need for better dehumidification systems.

In conclusion, while both buildings demonstrate strengths in passive design and user comfort, addressing ventilation gaps, improving shading coverage, and enhancing humidity control will elevate further their performance, ensuring consistent thermal comfort and fully optimizing their spaces for a greater user experience.

V. Conclusion and Recommendations

A. Summary of key Findings

The Corner House and The Commons Thonglor integrate climate-responsive features like shading elements and natural ventilation, supplemented by mechanical systems, to enhance thermal comfort and user experience. While strategies such as cross and stack ventilation improve airflow, building performance evaluations and user surveys reveal challenges in maintaining consistent thermal comfort. Psychrometric charts show that both buildings occasionally fall outside the thermal comfort zone, with mixed feedback from users highlighting both comfortable conditions and areas needing improvement.

The variation in comfort levels shows the difficulty of achieving thermal comfort in tropical architecture amidst extreme weather conditions, particularly in urban settings. While passive cooling techniques such as shading and natural ventilation are important, they may not always provide sufficient comfort in the hot and humid climate. Therefore, the integration of active systems such as fans or airflow inducers in alfresco areas is essential for a more consistent environment. Furthermore, balancing alfresco spaces with air-conditioned areas is vital, offering natural environments alongside controlled, comfortable spaces when needed, reducing reliance on HVAC systems and cutting energy consumption. A balanced integration of both passive and active strategies, as detailed in the recommendations section, along with the combination of alfresco and air-conditioned areas, optimizes the performance of shading elements and ventilation systems as well as the overall building efficiency while ensuring consistent thermal comfort and reducing energy consumption.

Overall, the study emphasizes the benefits of adaptive shading and ventilation strategies, with both buildings achieving a balance of functionality, aesthetics, and sustainability. Open designs, natural light, and greenery foster a welcoming, community-oriented atmosphere that encourages extended visits and a connection to nature. Addressing thermal comfort challenges would strengthen these community centers as benchmarks for sustainable, user-centered tropical architecture, emphasizing the value of thoughtful, climate-responsive design.

B. Design Enhancement Opportunities

Enhancing the design and operational strategies at The Corner House and The Commons Thonglor presents an opportunity to further optimize thermal comfort and strengthen their roles as benchmarks for tropical, climate-responsive design. The following suggestions aim to build on their strengths and address specific challenges identified in the study:

- Use high thermal resistance materials like reflective coatings and heat-reflective roofing to minimize heat absorption and enhance insulation in exposed areas like roofs and walls.
- Improve airflow by strategically adding ceiling or wall fans, exhaust fans, or ventilation ducts in areas with poor natural ventilation.
- Install adaptive shading solutions, like retractable canopies and automated louvers, in exposed areas, especially south- and west-facing spaces and roof decks, to optimize shading, airflow, and rain protection based on weather conditions.
- Increase denser and more vibrant landscaping such as trees and green walls, to provide natural shading and improve air quality.
- Utilize water-based features, like fountains and mist spraying, to mitigate heat and enhance microclimates.
- Use energy-efficient HVAC systems with smart temperature controls as backup during extreme weather to optimize energy use and minimize reliance on mechanical cooling.
- Indoor improvements focus on dehumidification and ventilation to address high humidity.
- Conduct comprehensive thermal assessments to refine passive and active strategies.

A holistic approach to tropical architecture emphasizes user-centered and site-specific strategies, supported by community involvement. Designing with future occupants in mind ensures that spaces and circulation align with local social interactions and routines, optimizing placement of alfresco areas and design features such as fenestrations and shading elements. Site-specific solutions further account for the unique characteristics of each location, such as microclimates, urban settings, and topography, to create sustainable, culturally relevant spaces. This balance of comfort, efficiency, and local identity ensures tropical designs remain both functional and meaningful to the communities they serve.

C. Recommendation for Further Research

To deepen understanding of thermal comfort and climate-responsive design in tropical architecture, research methods such as field observations, long-term studies, comparative analyses, and energy efficiency benchmarking can be employed.

- Field observations analyze real-time user behavior, examining how occupants interact with spaces, shading, and ventilation systems at The Corner House and The Commons Thonglor. These observations reveal how design features affect comfort and satisfaction in varying weather conditions, helping refine passive cooling strategies.
- Long-term studies evaluate the performance of shading and ventilation systems across seasons, providing insights into sustained comfort and satisfaction.
- Comparative studies evaluate similar structures across tropical locations, highlighting best practices and identifying areas for improvement, with insights applicable on a larger scale.
- Finally, defining energy efficiency benchmarks for commercial spaces in tropical areas would assist designers optimize the balance of passive and active systems. This study would improve sustainability and energy efficiency in future designs.

These methods form a comprehensive framework for advancing climate-responsive design by integrating practical strategies, innovative technologies, and site-specific considerations. Addressing thermal comfort, energy efficiency, and cultural relevance, this approach supports the creation of sustainable, adaptable, and community-centered buildings. It also contributes to the broader discourse on sustainable design, guiding future architectural practices toward resilient and user-focused urban environments.

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