INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN APPLIED SCIENCE (IJRIAS)
ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

Habitability in Urban Density: Microclimate and Comfort in Mohammadpur's Multistoried Apartments, Dhaka, Bangladesh

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DOI: https://doi.org/10.51584/IJRIAS.2025.100800095

Received: 10 August 2025; Accepted: 16 August 2025; Published: 18 September 2025

ABSTRACT

Dhaka's rapid vertical growth has changed residential life, often sacrificing thermal comfort and environmental quality. This study compares multistoried apartments in Mohammadpur's planned, spacious Japan Garden City with those in the denser, organically evolved Shekhertek neighborhood. It examines how building height, orientation, and open spaces affect indoor microclimates and resident well-being. Four units at different floor levels and directions were monitored using on-site temperature, humidity, and daylight measurements, along with resident surveys. The findings show that apartments surrounded by ample open spaces enjoy better airflow, moderated humidity, increased daylight, and less reliance on cooling systems. These conditions are reflected in the residents' comfort assessments. In contrast, units in crowded areas face higher heat buildup, moisture issues, and increased energy costs, resulting in significant discomfort. These results highlight that open spaces serve as essential microclimatic regulators, affecting health, satisfaction, and energy efficiency in Dhaka's growing residential spaces.

Keywords: Vertical growth, Microclimate, Multistoried apartments, Comfort Assessment, Residential space.

Living in Density: Thermal Comfort and Resident Experience in Multistoried Apartments of Mohammadpur, Dhaka, Bangladesh

Over the past three decades, Dhaka's urban landscape has changed drastically. Low-rise homes have been replaced by groups of tall apartment buildings. This shift has altered not just the city's skyline but also the local climate and daily life. In Mohammadpur, a quickly growing residential area, these changes are especially noticeable. Once filled with low-rise homes and large open spaces, many places now have high-rise apartments crammed together with little room to breathe. These conditions highlight the pressing need to explore how living in tall buildings affects residents' comfort and well-being.

In tropical megacities, indoor thermal comfort emerges from the complex interplay of temperature, humidity, air movement, and solar radiation, mediated by cultural practices and behavioral adaptations (Koenigsberger, Ingersoll, Mayhew, & Szokolay, 1975; Fergus Nicol, 2012). Dense urban expansion, little green space, and inadequate cross-ventilation in Dhaka are straining this equilibrium more and more, causing the urban heat island effect to worsen and interior temperatures to rise (Tariq & Poerschke; Khatun, Khatun, & Hossen, 2020; Rahman & Islam, 2024; Tabassum, Park, Seo, Han, & Baik, 2024). Beyond physical parameters, thermal comfort encompasses psychological and social dimensions (Altman, 1975), where access to daylight, visual openness, and natural ventilation contribute significantly to residents' perceived quality of life (Woo, et al., 2021). Recent studies also highlight that in hot-humid Asian contexts, such as Bangladesh and Japan, residents adapt their behaviors—through clothing adjustments, shading, and ventilation control—to maintain comfort despite high humidity, though these strategies are often constrained in high-density apartments (Rijal, Humphreys, & Nicol, 2015)

Building morphology, orientation, and the availability of open voids between structures directly influence airflow, daylight penetration, and heat dissipation (Oke, 1988; Emmanuel, 2005; Ng, 2009). In Mohammadpur, these factors vary considerably even between buildings located within the same neighborhood, affected by differences in site planning, construction era, and developer priorities. Research on tropical urban heat mitigation emphasizes the crucial role of ventilation corridors in dense cities. These features, often comprising green spaces, water bodies, and open thoroughfares, actively reduce surface temperatures by facilitating airflow that carries heat away from built concentrations (Eldesoky, Colaninno, & Morello, 2020)

Comparative analysis in urban studies is meaningfully based on the divergent methods to urban development and plot layouts in Dhaka's planned and spontaneously growing neighborhoods. (Ahmed, Hasan, & Maniruzzaman, 2014; Islam, 2019). This research employs a comparative lens to examine two distinct multistoried apartment settings within the Mohammadpur zone. The first, in Japan Garden City, is a gated complex planned with open spaces and wider setbacks, while the second, in Shekhertek, occupies a denser, organically developed neighborhood with minimal breathing space. Through on-site thermal monitoring and resident interviews, the study explores how spatial form, openness, and design influence thermal comfort and quality of life in Dhaka's vertical housing.

LITERATURE REVIEW

Thermal Comfort in Tropical Urban Housing

Thermal comfort in tropical housing is influenced by a dynamic interplay between climatic factors and residents' adaptive behaviors. The adaptive comfort model (de Dear & Brager, 1998) emphasizes how occupants adjust their clothing, modify their behaviors, and utilize environmental controls to maintain comfort. Yet, in densely populated tropical cities, such adaptive strategies often face significant challenges due to limited opportunities for cross-ventilation and the tendency of urban environments to retain heat (Frontczak & Wargocki, 2011). In Dhaka, the urban heat island effect is now well-documented and adds further strain by increasing cooling demands, intensifying discomfort for residents (Rabbani, Rahman, & Islam, 2011)

Indoor Microclimate and Building Morphology

The shape and arrangement of urban buildings profoundly affect the indoor microclimate experienced by occupants. Research across major Asian megacities underscores how factors such as building height ratios, plot setbacks, and orientation play vital roles in determining heat gain, airflow patterns, and daylight penetration (Oke, 1988; Prianto & Depecker, 2003; Emmanuel & Steemers, 2018). In the context of Dhaka, the prevalent compact and densely packed residential layouts characterized by limited open and breathable spaces tend to restrict natural ventilation and amplify indoor heat accumulation, thereby undermining thermal comfort for inhabitants (Sinthia, 2024).

User Perception and Social Dimensions of Comfort

Perceptions of comfort are shaped not only by measurable environmental parameters but also by psychological and social factors. Elements such as visual access to outdoor spaces, the sense of privacy, and connections to open communal areas significantly contribute to residents' overall well-being (Altman, 1975). In tropical climates, this subjective dimension is especially important, as residents' adaptive behaviors like enhancing airflow through window openings or using fans reflect how comfort is negotiated through both the physical environment and lived experience (Gou, Gamage, Lau, & Lau, 2018).

Dhaka's Vertical Housing Context

While the Bangladesh National Building Code (BNBC, 2020) provides clear structural and safety standards for high-rise residential buildings, enforcement of these regulations often varies across different parts of the city. Typical well-structured layouts with wider streets and defined building setbacks are meant to be available in Dhaka's planned and designed neighborhoods, which improve airflow and outdoor comfort. On the other hand, narrow, irregular streets often result in crowded living conditions with poor ventilation in naturally developed areas. This distinction shows how much urban management and design affect the quality of life for residents.

METHODOLOGY

A comparative case study design with a mixed-methods approach was employed to explore differences in thermal comfort and resident experience in the Mohammadpur zone. Two multistory residential buildings were

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

selected for investigation. One is in a gated community with planned open spaces, and the other is in a more naturally developed neighborhood with denser building arrangements. Building heights, orientations, and spacing patterns were typically found in the area and highlighted differences. Four apartment units on different floors: low, mid, and top, as well as various cardinal directions surveyed within these buildings. A wide range of environmental conditions was captured, and valuable feedback was obtained from residents. This research included samples who had lived in their apartments for at least one year but not more than five years. Enough experience with seasonal changes throughout the year by the respondents without undergoing long-term adjustments that could diminish their awareness of ongoing thermal discomfort ensured through these requirements.

This study focused on the variety of Dhaka's residential environments, concentrating only on fully residential multistoried apartment buildings for consistency in housing type. To understand the complexity of the city's microclimate, we carefully considered factors such as construction period, building materials, presence of greenery, availability of open spaces, and surrounding urban activity.

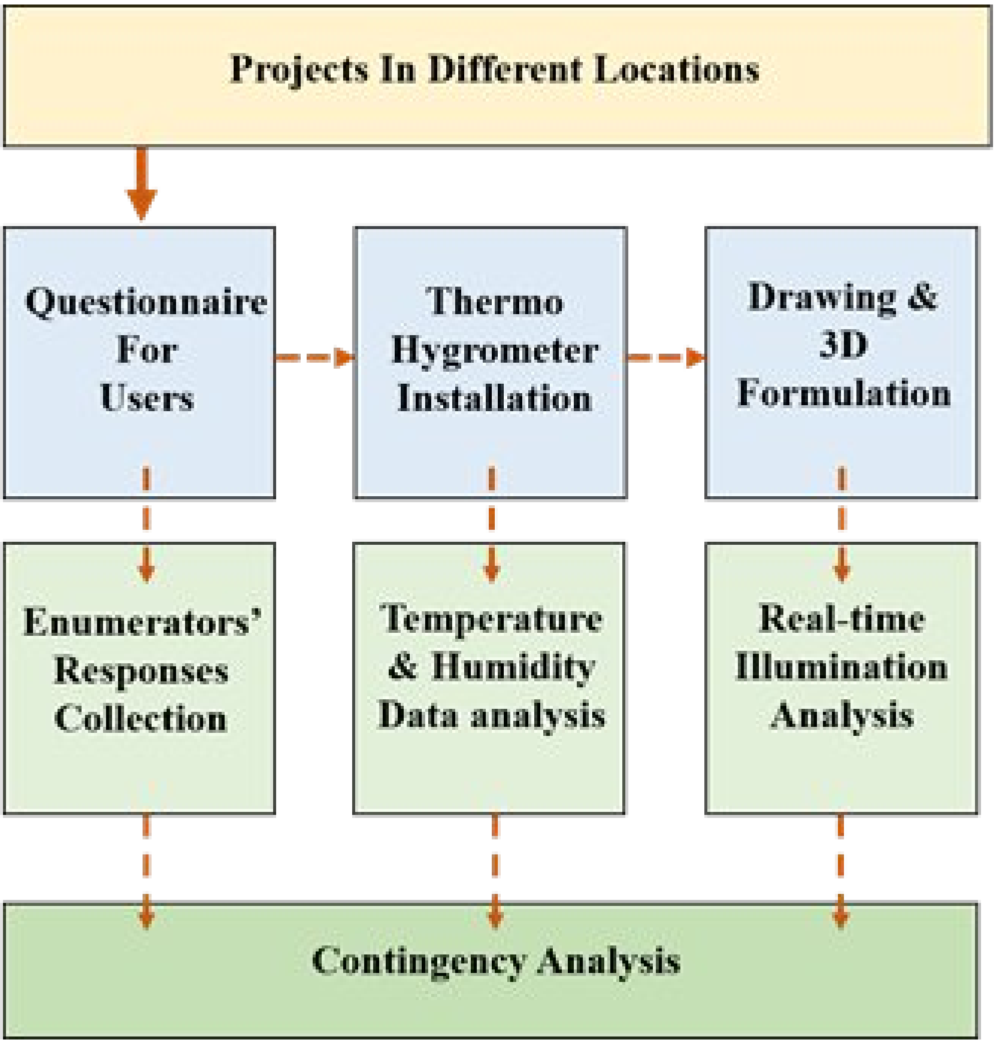

Figure 1: Analysis Methodology Diagram

This integrated approach provided a comprehensive view by triangulating quantitative environmental data, computationally modeled daylight performance, and the lived experiences of occupants. A key methodological novelty lies in this triangulation, particularly the integration of validated 3D daylight simulations with resident perception data. This allowed for a nuanced analysis of "contingency perception," revealing how actual occupant experiences of light and thermal conditions might align with or diverge from sensor readings and simulation predictions, potentially mediated by contextual factors, interior design choices, or individual behaviors. This combination of sensor data, simulation, and surveys offers a robust framework for validating environmental models against human experience and uncovering adaptive tolerances not detectable by instruments alone. (Figure 1).

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Data Processing and Analytical Framework

Building Inspection Process

For this comparative study, two multistoried residential buildings; one building is located in Shekhertek, an organically developed neighborhood where open spaces are virtually nonexistent except for roads to the north and east, while the other is situated in Japan Garden City, a large-scale gated complex featuring thoughtfully planned open spaces and wider setbacks were carefully selected to represent contrasting urban conditions within Mohammadpur.

Within each building, four apartment units were purposefully chosen to cover a range of vertical positions (low, mid, and top floors) and varied cardinal orientations such as South, North, South-West, and North-East. This selection was designed to capture the full spectrum of environmental factors affecting indoor conditions, including variations in sun exposure, airflow, and surrounding spatial context. By analyzing units across these diverse settings, the study seeks to provide a nuanced understanding of how an apartment's position within a building and the broader neighborhood morphology influence residents' thermal comfort and overall perception of their living environment (Table 1).

Table 1:Selected Buildings and Unit Details

SI.No.	Project	Address	Location	Height (Floor Numbers)	Total Units	Surveyed Units	Build Year
01	Akasaka- D	H-22,Japan Garden City, Mohammadpur	Mohammadpur-Shekhertek	16	60	02	2006
02	Ameena Villa	H-30,R-04, Shekhertek		07	12	02	1990
Total number of surveyed buildings			**2**				
Total number of surveyed units			**4**				

To streamline the identification of buildings and their respective living units, a coding system was adopted.

Buildings: For ease of reference throughout the study, each of the selected buildings was assigned a unique alphabetical identifier, with the two case study buildings labeled as D and E. This coding system helped streamline data management and ensured clear communication of results.

Living Units: Similarly, individual apartment units within these buildings were coded based on a combination of their vertical position (such as low, middle, or top floors) and their cardinal orientation (e.g., North, South-East). This systematic approach allowed for a detailed analysis of how location within the building influences environmental conditions and resident experience.

Table 2:Vertical Location of The Units Coding & Unit Cardinal Location (CL) Coding

Unit Vertical Location	Category	Legend	Unit Cardinal Location (CL)	Legend
Top	Below Roof	Top	East	E
Middle	Below Top to Upper second floor	Mid	South	S
Lower	Up to the second floor	Low	West	W
			North	N
	Unit Vertical Location	**Numbering**		
	Ground	GF	South-East	SE
	First	1	South-West	SW
	Second	2	North-West	NW
	Eighteenth	18	North-East	NE

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Vertical location was noted in two ways: by exact floor number (e.g., 1, 2, 3, with the ground floor marked as GF) and by a broader category of “Top,” “Mid,” or “Low”. Cardinal orientation was indicated using the first letter of each direction, such as E for East or N for North, following the same format for other positions (Table 2). This system ensured a clear and consistent reference for all surveyed projects and units.

Following this coding process, a unit was named “D4NE,” which represents the unit from building “D” on the 4th floor in the “North-East” Cardinal direction (Appendix 1)

Environmental Data Collection & User Experience Surveys

Temperature, humidity, and illumination levels were measured in primary living spaces using calibrated 1104 hermos-hygrometers [HTC-2 (AD-01)] and lux meters. Digital 3D daylight simulations, though.“Shadedat (Beta)”, a plugin of “Sketchup” 3d modeling software, validated annual natural light distribution patterns (Figure 2). Data collection spanned different times of day to capture diurnal variations.

Segments	Room Cardinal Location	Legend	Remarks
01	East	E	Most of the openings of the room in the East part of the unit
02	South	S	Most of the openings of the room in the South part of the unit
03	West	W	Most of the openings of the room in the West part of the unit
04	North	N	Most of the openings of the room in the North part of the unit
05	Central	Central	No openings are there. Mostly placed almost at the central position of the unit
06	South-East	SE	Most of the openings of the room in the South-East part of the unit
07	South-West	SW	Most of the openings of the room in the South-West part of the unit
08	North-West	NW	Most of the openings of the room in the North-West part of the unit
09	North-East	NE	Most of the openings of the room in the North-East part of the unit

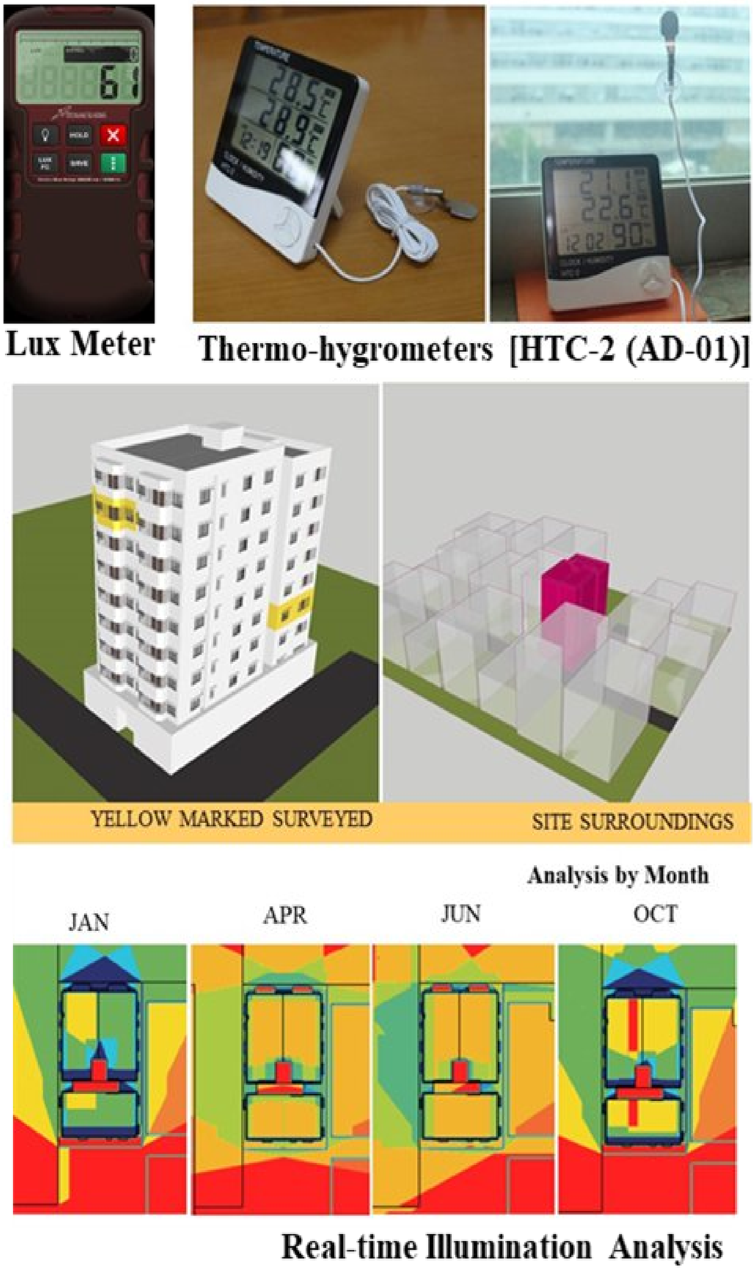

Figure 2: Cardinal Location of Spaces and Lux meters, Thermo-hygrometer, Real-time Illumination Analysis

Four residential units, each representing different vertical levels and orientations within the buildings, were examined. The specific location of each unit within the building influenced its exposure to environmental factors.

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For each unit, temperature and humidity were measured to capture both the indoor living conditions and the influence of outdoor climate.

Outdoor data: Readings at different heights and orientations helped assess how sunlight, wind, and surrounding structures influenced external conditions.

Indoor data: Key spaces such as bedrooms, family living areas, and dining rooms were monitored, with their orientations noted to understand how placement within the building impacted thermal comfort.

By linking outdoor environmental variations with indoor conditions, this method offered a thorough understanding of the thermal behavior of the units and their responsiveness to orientation and spatial configuration (Table 3).

Table 3: Sample Environmental Condition Data Collecting & User's Living Condition Statement Format

Building Details (Name_ Location_ Number of Floors)									
Space Detail				Environmental Data					
				External			Internal		
Unit Type	Date	Time	Space	Temperature (°C)	Humidity (%)	Light (lux)	Temperature (°C)	Humidity (%)	Light (lux)
A3W	dd/mm/yy	10:00am - 12:00pm	Living	0	0	0	0	0	0
			Dining				0	0	0
			Bed 01				0	0	0
			Bed 02				0	0	0
Max							0	0	0
Min							0	0	0
Average							0.0	0	0

Environmental Living Condition													Physical			
SN	Unit	Vertical Location	Coolest Room		Warmest Room		Coolest month	Warmest month	Summer Experience	Winter Experience	Air Flow	Living State	Open Space	Dampness	Strain on wall	Utility Cost (Electricity,
			Function	C.L	Function	C.L										
01	A3W	Mid	Living	S	Bed Room	S										
02	A2E	Low	Living	S	Bed Room	E										

Structured questionnaires captured residents' views on thermal comfort, airflow, and seasonal changes, along with how these factors affected their daily life and overall well-being (Table 3). Comparing responses from the two residential zones revealed clear spatial and climatic contrasts, showing how differences in building design and environmental context shaped residents' comfort levels and psychological experiences.

Statistics Analysis

Inter-Space Temperature Variation (ISTV) and Inter-Space Humidity Variation (ISHV) were calculated for each unit. Comparative analysis correlated these with building spacing, orientation, and user feedback to highlight zone-specific patterns. For authenticity and accuracy, firstly, the indoor-outdoor temperature and humidity of the individual projects are identified using the thermo-hygrometer, which is verified in two simple ways:

One-hour focused Investigation: To assess its effectiveness, a monitoring device was placed on the fourth level of a sixteen-story building in Japan Garden City, Dhaka. Over an hour, temperature and humidity were recorded at brief, regular intervals to assess the instrument's accuracy in responding to abrupt changes in the environment. (Figure 3).

Ten- and Fourteen-hour Investigation: To capture daily climatic fluctuations under typical Bangladeshi conditions, temperature and humidity were monitored over longer and shorter daylight periods, with readings taken every thirty minutes to track gradual changes (Figure 3).

All measurements were taken in an enclosed setting. The device was moved between points, and readings were recorded after brief stabilization to ensure accuracy.

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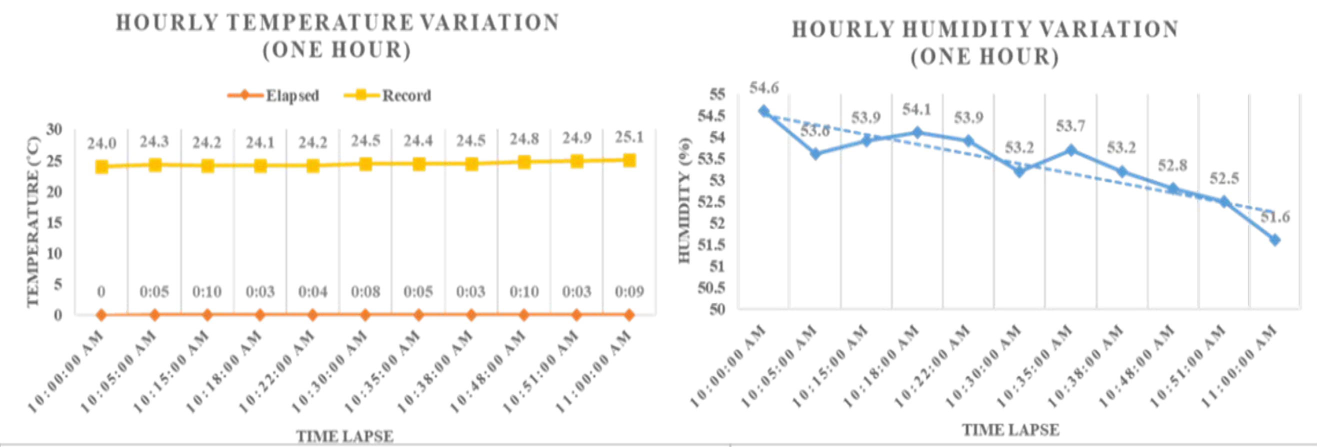
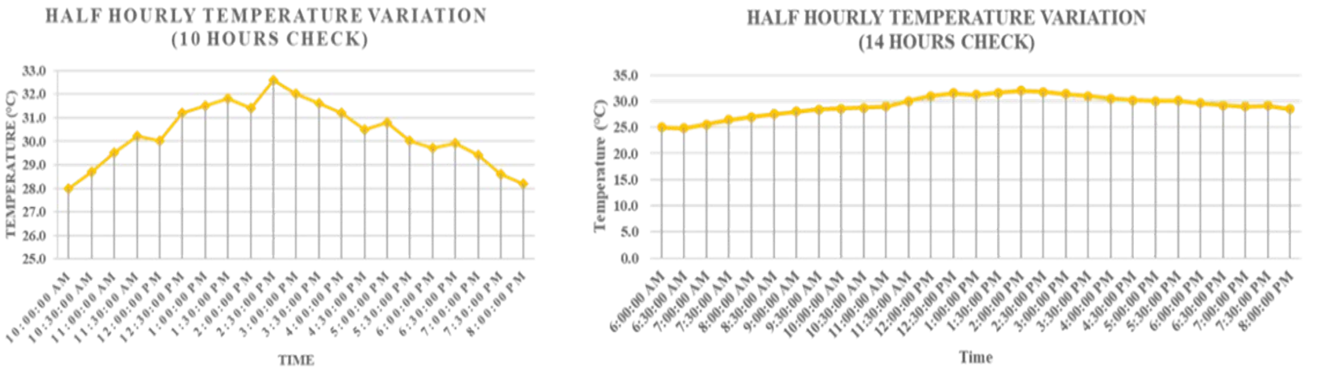
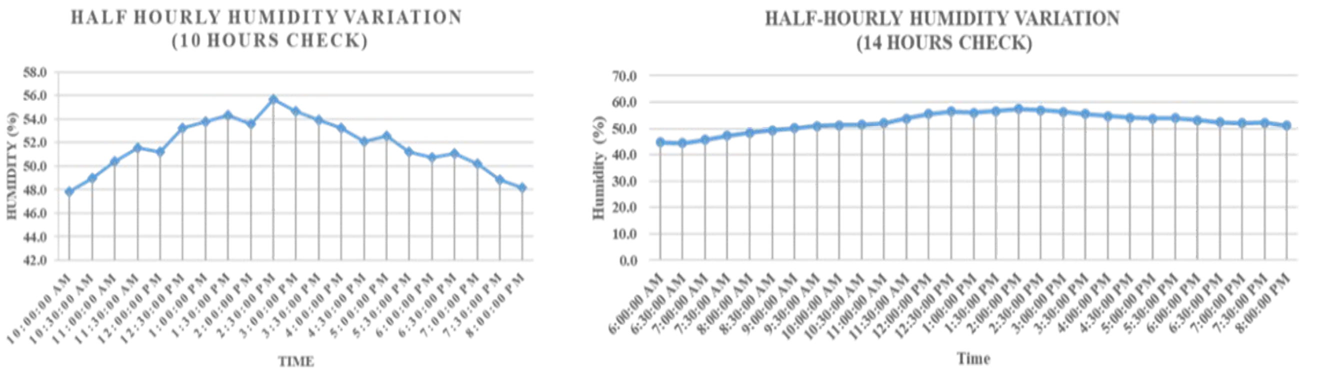
One-Hour Temperature & Humidity Variation & Inspection Summary



Outdoor Temperature	28˚C (± 2˚C)
Outdoor Humidity	48% (± 2%)
Longest duration in same temperature	0:10 minutes [24.3˚C & 24.8˚C]
Shortest duration in same temperature	0:03 minutes [24.1˚C,24.5˚C & 24.8˚C]
Longest duration in same Humidity	53.90%
Quickest variation of humidity	±0:03 minutes [± 0.2 %]

Humidity and Temperature & Inspection Summary (10 hours-14 hours)





Outdoor Temperature (All Day)	28˚-34˚C	
Outdoor Humidity	60% (± 2%)	
Maximum Indoor Temperature (within 30 minutes)	32.6	°C
Minimum Indoor Temperature (within 30 minutes)	28.0	°C
Maximum Humidity (within 30 minutes)	55.65	%
Minimum humidity (within 30 minutes)	48.14	%

Outdoor Temperature (All Day)	27˚-33˚C	
Outdoor Humidity	56% (± 2%)	
Maximum Indoor Temperature (within 30 minutes)	32.0	˚C
Minimum Indoor Temperature (within 30 minutes)	24.8	˚C
Maximum Humidity (within 30 minutes)	57.34	%
Minimum humidity (within 30 minutes)	44.44	%

Figure 3: Hourly Humidity and Temperature & Inspection Summary

Individual Project Details

Two residential projects in different locations within Mohammadpur were examined, documenting each building's architectural features, spatial orientation, and surrounding environment. Factors such as adjacent

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structures, road access, openness, and greenery were recorded to assess their impact on indoor environmental quality. Specific units in each building were studied in detail to compare how site-specific conditions influenced living comfort.

Building D (Akasaka- D)

A sixteen-story residential building within Japan Garden City, a large gated housing complex in Mohammadpur, Dhaka, comprising multiple high-rise apartments within a secured boundary. The ground level of the complex accommodates public access areas, community spaces, and parking facilities. The selected building, positioned on the eastern side of the site just behind the Tokyo Square shopping complex, contains four units per floor. For this study, two units, "D12SW" and "D4NE" were investigated in detail. (Figure 4).

Building E (Ameena Villa)

A seven-story residential building located at the intersection of a 7.5m wide road in Shekhertek, Mohammadpur, Dhaka. The building's main entrance faces north, with residential units beginning at the ground floor due to the absence of parking facilities. Each floor contains two units, oriented toward the north and south. The west side of the property is bordered by another 7.5m wide road, while the south and east sides are obstructed by adjacent six-story buildings, limiting natural openness. No green space is provided at the ground level. For this research, two units "E6S" and "E4N" were examined in detail(Figure 4).

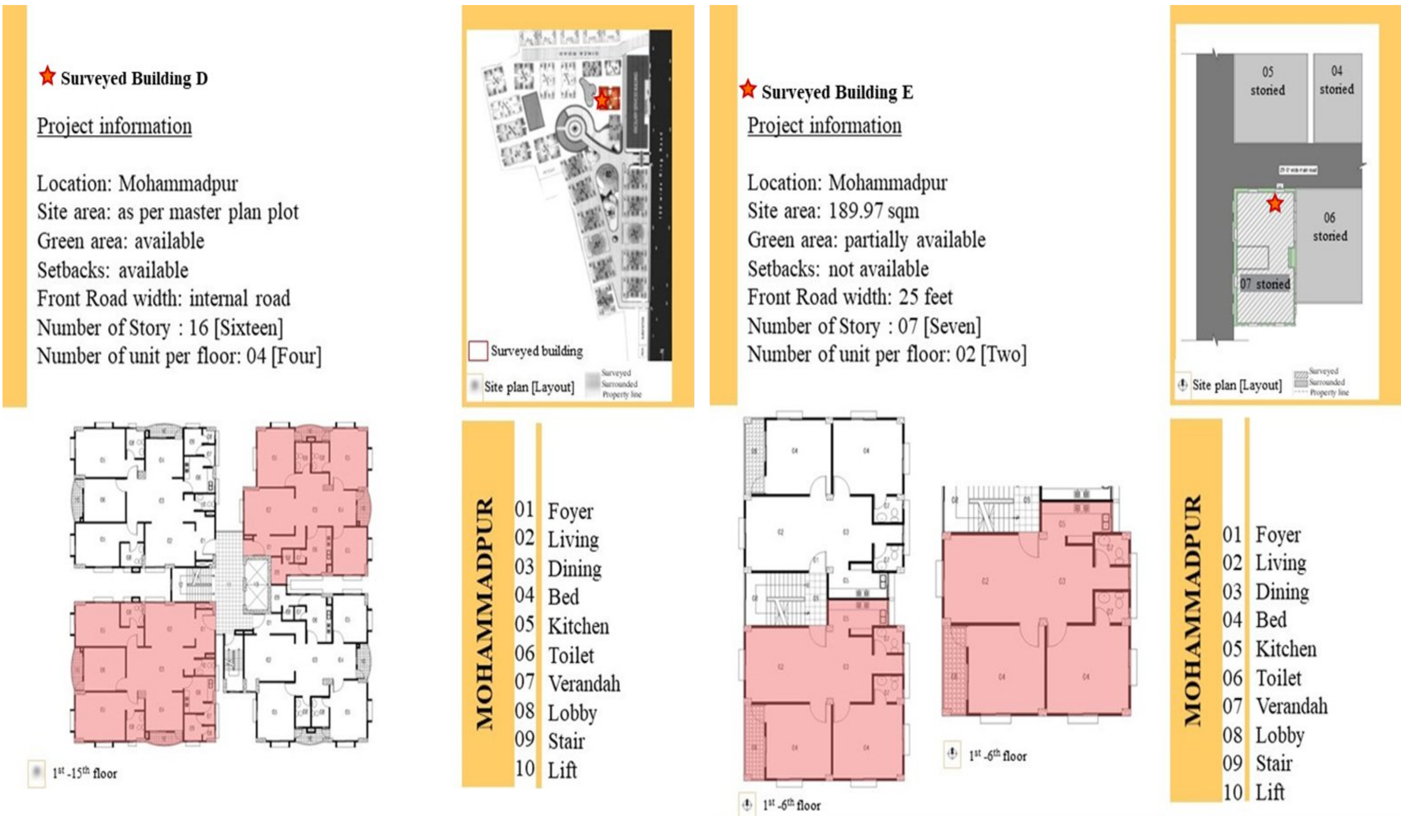

Figure 4: Building A & B with Surveyed Units

DISCUSSION AND VERDICTS

Across the two residential projects, four distinct units were investigated, with attention given to both their vertical placement within the buildings and their cardinal orientations. Most of the units (three out of four) were positioned in the "Mid" level floors, offering a balance between ground-level influences and rooftop exposure, while the remaining unit was located at the "Top" floor, more directly affected by external climatic conditions. The units also represented four different cardinal directions: South-West (SW), North-East (NE), South (S), and North (N), allowing the study to capture a broader range of environmental variations influenced by orientation and exposure (Figure 5).

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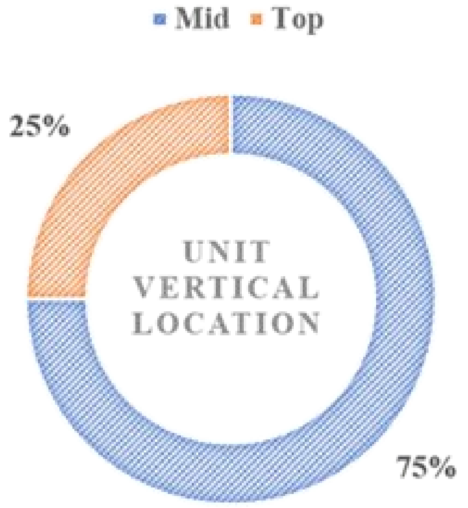
Unit Vertical Location	Category	Legend
Top	Below Roof	Top
Middle	Below Top to Upper second floor	Mid
Lower	Up to second floor	Low

Unit Vertical Location	Number	Total Survey Utits
Mid	3	4
Low	0	
Top	1	

Cardinal Location	Legend	Number of Units
South	S	1
North	N	1
South-West	SW	1
Noth-East	NE	1



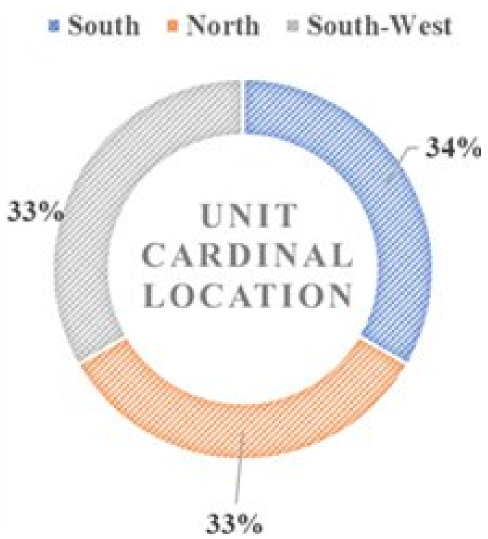


Figure 5: Unit Locations (Vertical and Cardinal)

Climatic Data Comparison

Each apartment's living areas were carefully inspected in order to determine the humidity and temperature in each room. The inquiry was conducted in two stages. To find the hottest and coolest areas, the initial phase involved gathering and recording data from every room. This was followed by determining the highest and lowest temperatures inside each unit. This method, known as Inter-Space Temperature Variation (ISTV), classified temperature variations as "Average" for values in the range between 0.1 and 0.2°C, "Considerable" (0.5 to 0.8°C), and "Negligible" (Figure 6). In the second step, the vertical and cardinal locations of these warmest and coolest rooms were mapped to gain a better understanding of how spatial orientation affects interior warmth. Following this system among four (04) units, one (01) unit was found as "Considerable", which was located in the "South" in cardinal direction and at "Top" in the vertical direction. From the other units, three (03) were in the "Mid", in which two (02) were under "Average", and the rest one (01) was under "Negligible" (Figure 6).

Similarly, humidity data were analyzed through a process termed Inter-Space Humidity Variation (ISHV). Variations between rooms were classified as "High" for differences of 3% or more, "Low" for differences of 1%, and "Mid" for values in between. This helped identify how humidity levels shifted across different spaces within each unit (Figure 6). Following this system among four (04) units, two (02) units were found with "Moderate" humidity spaces, which were located in the middle parts of the buildings, where cardinal location does not matter, but the vertical location impacts. Others located vertically, both in "Top" & "Middle", were in "Low" condition.

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Temperature Variation	Category	Legend
0.5-0.8	Considerable	Con
0.3-0.4	Average	Ave
0.1-0.2	Negligable	Neg

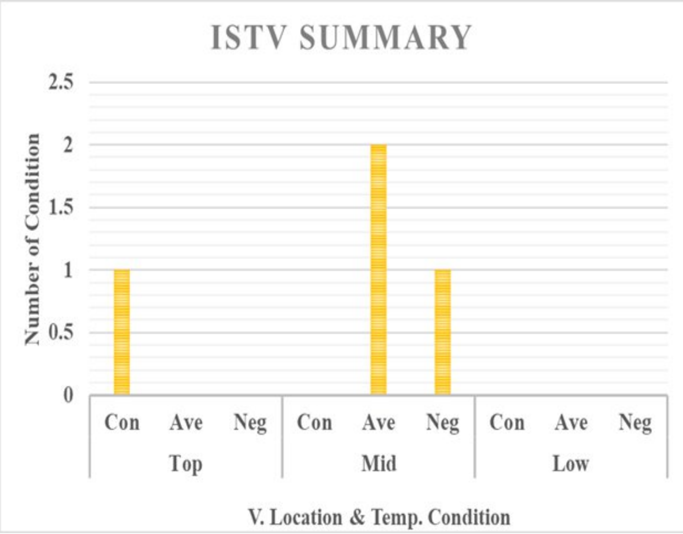
Category	Number	Total Survey Utits
Con	1	4
Ave	2	
Neg	1	

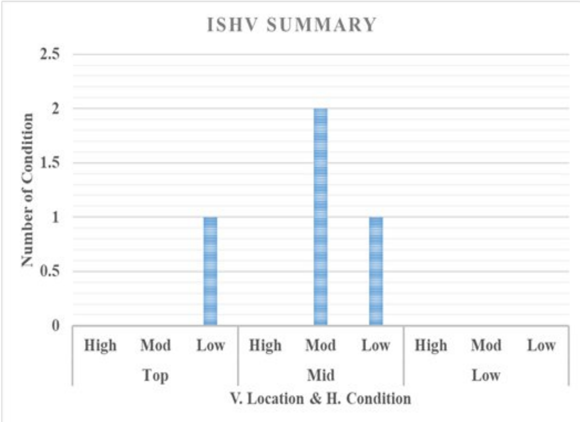
Vertical Location	Temperature Variation Condition	Number
Top	Con	1
	Ave	0
	Neg	0
Mid	Con	0
	Ave	2
	Neg	1
Low	Con	0
	Ave	0
	Neg	0

Humidity Variation	Category	Legend
3%	High Variation	High
2%	Mid Variation	Mod
1%	Low Variation	Low

Category	Number	Total Survey Utits
High	0	4
Mod	2	
Low	2	

Vertical Location	Humidity Variation Condition	Number
Top	High	0
	Mod	0
	Low	1
Mid	High	0
	Mod	2
	Low	1
Low	High	0
	Mod	0
	Low	0





Cardinal Temperature Condition Map			
Cardinal Location	Temparature Condition		
SW			
NE			
S			
N			

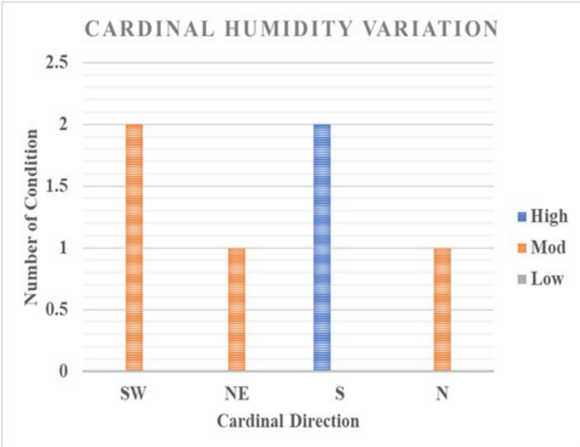


Figure 6: Temperature & Humidity Variation Data

User and Enumerators' Data Collaboration

Drawing on feedback from residents of the four investigated units, an annual experience chart was prepared to reflect perceptions of their indoor climatic conditions. The majority of respondents, three (03) out of four (04), reported receiving average airflow year-round, which they associated with a slightly higher degree of comfort compared to others in the study. Seasonal patterns were also evident: most residents described a noticeable increase in warmth during "May", marking it as one of the warmer periods of the year. However, "Summer" as a whole was generally perceived as comfortable, suggesting that factors such as building orientation, openness, and ventilation opportunities may have contributed to moderating indoor conditions despite the city's warm climate (Figure 7).

Most users who reported a comfortable living situation resided in units with satisfactory open spaces around the building, which enhanced proper ventilation and contributed to better indoor comfort. In some cases, partial open spaces or strategically positioned urban windows also created a comfortable situation for lower-level units by facilitating airflow. Based on both user feedback and enumerator-collected data, it was further observed that the "Coolest Room" in most cases was located in the "North-East" or "Central" cardinal positions of the units, while the "Warmest Room" was typically found in the "South-West" or "North-West" positions. These findings closely aligned with residents' perceptions.

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Additionally, among the four (04) units studied, users of two (02) units described their living environment as healthy, and these units were characterized by open spaces surrounding them. The unit with partially open surroundings experienced a compromised living situation, while the remaining unit, with no surrounding open space, was perceived as unhealthy (Figure 7).

Coolest Room	
Category	Number
Living	2
Dining	2

Coolest Room	
Cardinal Location	Number
Central	3
NE	1

Warmest Room	
Category	Number
Bed Room	3
Living	1

Warmest Room	
Cardinal Location	Number
SW	1
NW	2

Coolest Month	
Name	Number
December	2
January	2

Summer Experience	
Category	Number
Comfortable	2
Moderate	0
Discomfortable	2

Warmest Month	
Name	Number
May	3
June	1

Winter Experience	
Category	Number
Comfortable	0
Moderate	3
Discomfortable	1

Living State	
Category	Number
Healthy	2
Compromised	1
Unhealthy	1

Air Flow Experience	
Category	Number
Satisfactory	0
Average	3
Dissatisfactory	1

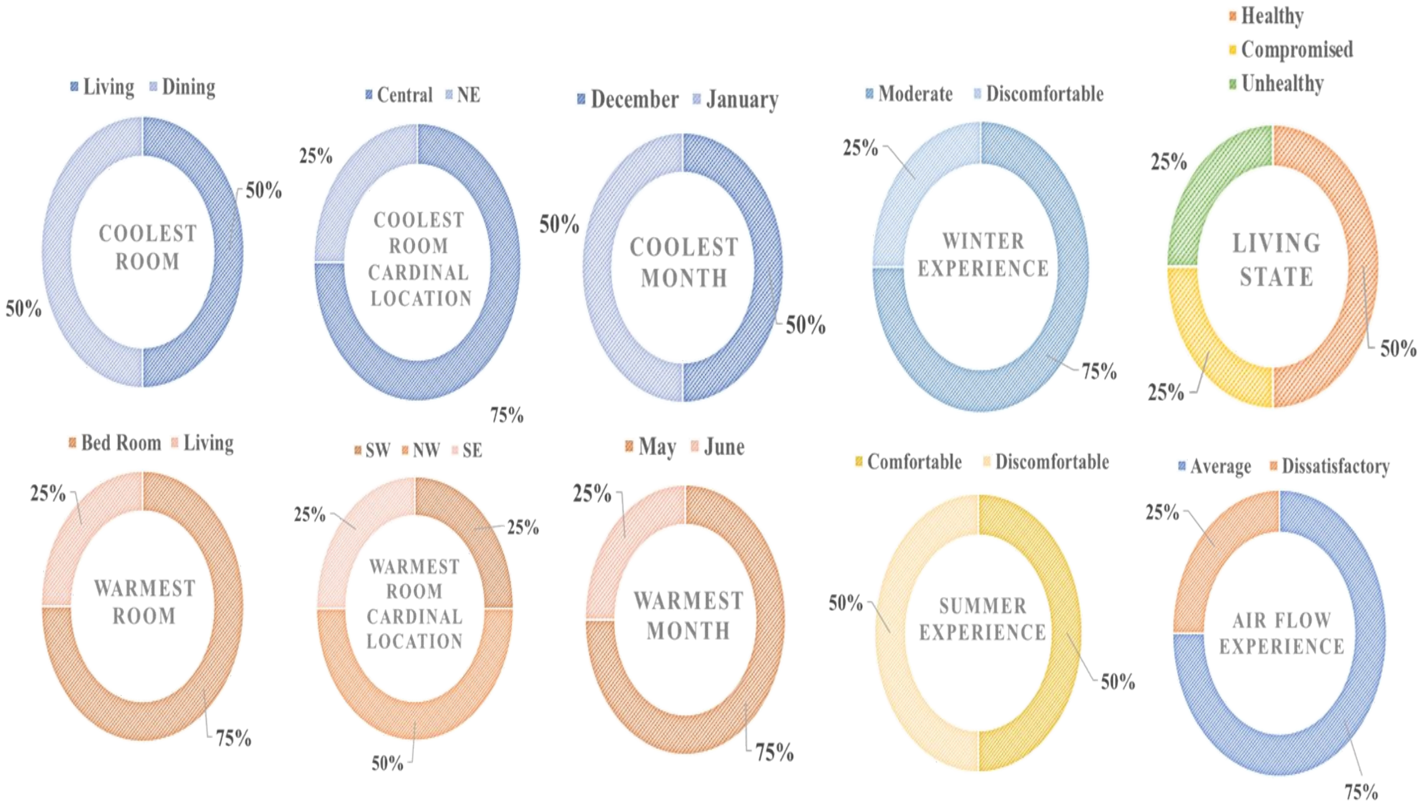

Figure 7: Unit Internal Living Experiences and Annual Climate Experience

Real-Time Illumination Analysis

Following the assessment of residents' perceptions, annual natural light distribution patterns were simulated using Shadedat (Beta), a plugin integrated with SketchUp 3D modeling software. The simulation, conducted at three-month intervals, illustrated how sunlight interacted with different spaces and surfaces within each unit over the year. A distinct gradient from red to blue was used to represent thermal variations, red indicating the warmest areas with the highest sunlight exposure, and blue marking the coolest areas with minimal exposure. The analysis showed that the warmest zones, often reported by residents as less comfortable, were consistently located where direct sunlight penetration was greatest, particularly in certain cardinal orientations. Conversely, cooler areas are aligned with spaces receiving limited daylight. This close correlation between the simulated patterns and user-reported experiences highlights the role of sunlight distribution in shaping thermal comfort within high-density residential environments (Figure 8).

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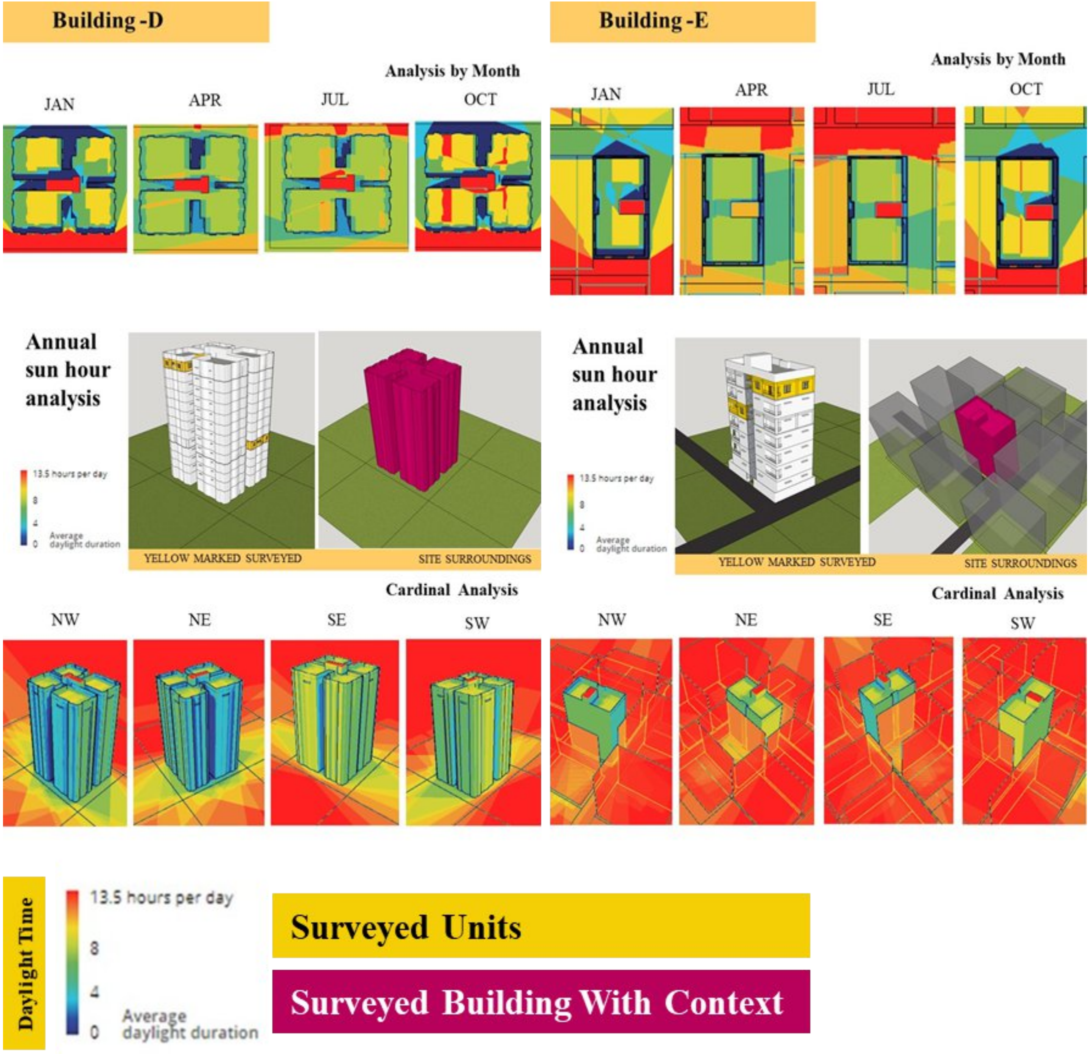

Figure 8: Real-Time Illumination Analysis

Supportive Physical State

In the final stage of analysis, a comparative assessment was carried out to examine the relationship between the availability of open space surrounding the surveyed units and their physical conditions, with particular attention to dampness, wall stains, and utility costs. The results indicated a clear pattern: units with sufficient surrounding open space consistently incurred lower utility expenses, including electricity and water consumption. This outcome reflects the benefits of enhanced natural ventilation and daylight penetration, which reduce reliance on artificial cooling, lighting, and mechanical ventilation. Such units not only offered a healthier indoor environment but also promoted a more comfortable and cost-efficient living experience for residents.

Three of the surveyed units had low or moderate utility costs. Two of these units had a lot of open space around them, while the third had only some. This shows that even a little exposure to open areas can improve energy efficiency. In contrast, the unit with no open space had the highest utility costs. This is likely because it lacked natural ventilation and daylight. Along with rising costs, heavy reliance on mechanical systems for lighting and cooling also lowered environmental quality and overall comfort.

In addition, physical deterioration in the form of wall stains and dampness was observed in the units with either partial or no surrounding openness. Conversely, two units surrounded by ample open space showed no signs of dampness or wall stains. This highlights the vital role that spatial openness plays not only in enhancing thermal and visual comfort but also in promoting healthier, more durable indoor environments. Collectively, these findings emphasize the importance of building orientation, adequate spacing, and environmental context in influencing both residents' lived experiences and the long-term physical performance of residential buildings (Figure 9).

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

Open Space	
Category	Number
Available	2
Partial	1
Not Avilable	1

Utility Cost (Electricity, Water)	
Category	Number
Economic	1
Moderate	2
High	1

Utility Cost (Electricity, Water)	
Category	Perimeter (tk)
High	>4000/-
Moderate	2500-4000/-
Economic	<2500/-

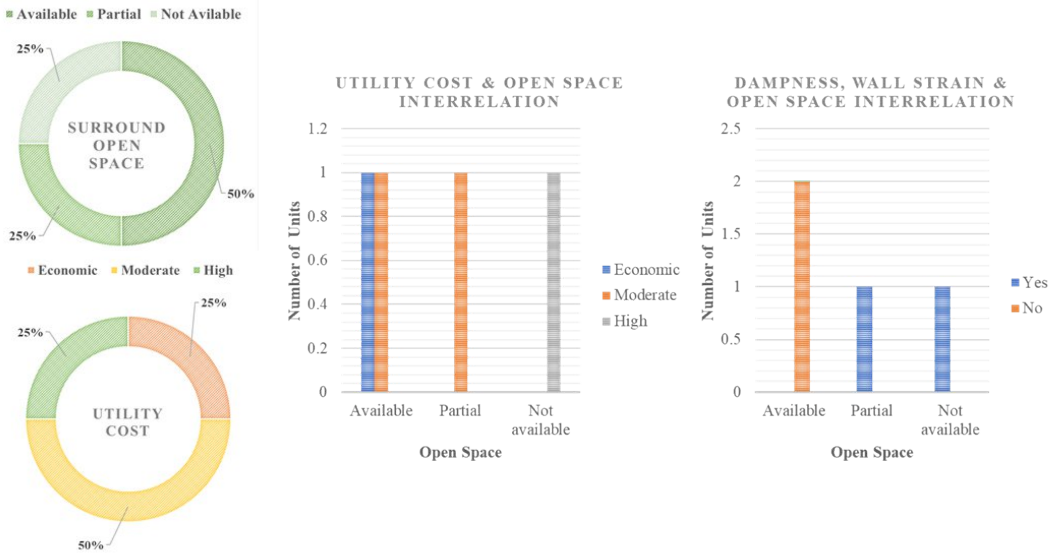

Figure 9: Sample's Physical State Analysis

Comparative Findings in the Environment

The environmental assessment of two individual residential apartment projects in Mohammadpur highlighted clear differences in indoor comfort based on the buildings' orientation and the amount of open space. Units with ample open space enjoyed better natural ventilation and more daylight, which resulted in lower utility bills and fewer problems like dampness and wall stains. On the other hand, higher energy use, physical wear, and often unhealthy living conditions were experienced by the units with limited openings. Thermal comfort varied by cardinal direction. For example, warmer areas were mainly in the southwest and northwest, while cooler spots were found in the northeast and central regions. Residents' comfort and their overall quality of life are impacted by these factors.

Patterns of Comparative User Perception

Through the observation of the survey findings, the residents in Mohammadpur who lived in units with plenty of open spaces were found to be generally more satisfied with their indoor environments. They often linked their satisfaction to better ventilation and natural light. In contrast, those in units with limited or partial openings commonly reported issues such as moisture, wall stains, and poor airflow. These problems decreased their comfort and raised utility costs. Their personal experiences matched the objective assessments. This highlights how building design and nearby open spaces greatly impact the overall quality of life.

CONCLUSION

The findings from this comparative study suggest that environmental quality and user satisfaction within multistoried residential buildings of Dhaka are strongly influenced by site-specific factors like the availability of open space, orientation of buildings, and, very importantly, the maintenance of adequate setbacks between buildings. Building units that are surrounded by sufficient amounts of open space tended to consistently show lower utility costs, improved natural ventilation, and fewer building-related issues such as dampness and wall stains; meanwhile buildings lacking open space or setbacks, were generally found to experience higher levels of environmental stress and maintenance issues that compromised living conditions or led to an unhealthy living.

This short but operative comparative analysis on Dhaka's vertical developments reveals how inadequate building setbacks and limited open space intensify urban heat, humidity retention, and energy demands challenges mirrored in Jakarta, Manila, and other tropical megacities. The findings demonstrate that climate-responsive design strategies, including optimized building orientation and ventilation-enhancing features, significantly improve thermal comfort. These insights suggest urban policy should prioritize enforceable open-space ratios and microclimate-sensitive regulations. The study's integrated methodology, combining environmental monitoring with occupant feedback, offers a transferable framework for addressing thermal inequities in rapidly growing cities across the Global South, promoting healthier high-density urban development without compromising livability.

The results of this study provide important evidence affirming the need to enforce building codes and urban regulations, specifically those pertaining to building setbacks and open space requirements, to promote better, healthier, and more sustainable residential environments. More than just achieving density, future housing development in Dhaka, Bangladesh, needs to uphold building regulations and to considerately apply design strategies like orientation to the sun, and open spacing between building structures. These actions are vital to positively influencing microclimatic conditions, conditions that affect the environment and building performance that can ultimately also improve the comfort of residents, while also contributing to resilient urban growth in the vertical growth city of Dhaka.

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APPENDICES

Appendix 1: Project Unit Coding System