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Passive Design Strategies for Improving Natural Ventilation in a Tropical Corner House

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Abstract: Natural ventilation is an important passive strategy for improving thermal conditions and reducing dependence on mechanical cooling in tropical houses. Corner houses offer greater ventilation potential due to their multiple exposed façades, although inappropriate spatial and opening configurations may limit airflow. **Objective:** This study develops a corner-house design model to improve natural ventilation based on the environmental evaluation of an existing residential building. **Methodology:** A descriptive qualitative and quantitative approach was applied to a type 27/60 corner house in Forest Hill Housing. Literature and SNI standards were reviewed, while air temperature, relative humidity, and air velocity were measured using a hygro-thermometer and an anemometer. The results were evaluated to identify ventilation problems and formulate design solutions. **Findings:** Most indoor spaces recorded air velocities of only 0–0.1 m/s, while the carport and terrace reached 1.5 and 1.4 m/s at midday. Indoor temperatures reached 30.6°C in the drying area and 30.5°C in the dining room, indicating that available outdoor airflow was not effectively distributed indoors. The proposed redesign therefore integrates additional openings, cross and stack ventilation, operable skylights, an innercourt, increased ceiling height, spatial reconfiguration, and solar shading. **Implications:** The proposed strategies provide practical design considerations for improving natural ventilation in tropical corner houses and potentially reducing reliance on mechanical cooling. **Originality:** This study translates field-measured environmental deficiencies into an integrated passive redesign that combines multiple exposed façades, horizontal and vertical airflow strategies, spatial reconfiguration, and solar control.

Keywords: Corner house; Natural ventilation; Cross ventilation; Stack ventilation; Passive design

INTRODUCTION

Natural ventilation is an important passive design strategy for maintaining indoor thermal comfort while reducing dependence on mechanical air-conditioning systems and the associated consumption of electrical energy. This issue is particularly important in hot-humid tropical regions such as Indonesia, where relatively high air temperature and humidity can create prolonged periods of thermal discomfort inside residential buildings. Naturally ventilated houses remain highly relevant in Indonesia, and improving their passive thermal performance is therefore necessary to reduce overheating and excessive dependence on active cooling systems (Iqbal et al., 2023). Studies in other tropical regions have similarly shown that occupants of naturally ventilated residential buildings are frequently exposed to relatively high indoor temperatures and rely on air movement and behavioral adaptation to achieve acceptable thermal conditions (Taing et al., 2023; Yadeta et al., 2022). The ability of a residential building to provide adequate natural ventilation is strongly influenced by building orientation, façade exposure, size and position of openings, internal spatial configuration, solar radiation, and surrounding environmental conditions. Corner houses have particular potential because their location generally provides two or more exposed façades that can accommodate openings from different directions. Compared with intermediate houses that are constrained by adjacent buildings, corner houses therefore provide a greater opportunity to capture prevailing winds, promote cross ventilation, and improve indoor air movement. Nevertheless, this geometrical advantage does not automatically result in comfortable indoor conditions when openings, solar protection, and airflow paths are inadequately designed.

Previous research related to natural ventilation can be classified into three major categories. The first category concerns openings, airflow configuration, and thermal comfort. Andriawan observed that residential thermal conditions were affected by the microclimate and the ability of air to move between interconnected spaces (Andriawan, 2021). Salsabila found that rooms without appropriately positioned opposing openings experienced inadequate cross ventilation (Salsabila et al., 2021), while Fitrawansyah demonstrated that the dimensions and positions of openings in traditional Mandar houses contributed to the effectiveness of natural airflow (Fitrawansyah et al., 2021). Vidiyanti also emphasized the need for sufficient openings to increase indoor air velocity (Vidiyanti et al., 2018), whereas Rachmalia examined the influence of openings on natural ventilation and daylighting (Rachmalia et al., 2023). More recently, Chen experimentally demonstrated that different door and window opening configurations significantly affect residential thermal environments and thermal comfort under natural ventilation (Chen et al., 2024). Research on naturally ventilated tropical residences has also shown that increased indoor air movement is an important adaptive mechanism for maintaining acceptable thermal conditions (Taing et al., 2023; Yadeta et al., 2022). These findings collectively demonstrate that ventilation performance is strongly dependent on the relationship between opening configuration, airflow paths, and the thermal characteristics of occupied spaces.

The second category concerns building-envelope design, solar control, and passive cooling strategies, while the third concerns integrated natural-ventilation systems and spatial interventions. Lestari and Pasaribu reported that limited openings and inappropriate material selection could contribute to high indoor humidity (Lestari & Pasaribu, 2022), whereas Pratiwi investigated the effects of natural ventilation and daylighting on thermal comfort and occupant productivity (Pratiwi et al., 2023). Sabtalistia highlighted the environmental role of an innercourt (Sabtalistia, 2024), while Idris examined architectural responses associated with natural environmental performance (Idris et al., 2024). At the building-envelope scale, Lapisa demonstrated that wall characteristics, roof configuration, orientation, albedo, ventilation, and other envelope parameters can be optimized to improve thermal comfort in Indonesian tropical residential buildings (Lapisa et al., 2022). Iqbal further showed that modifications to ventilation openings and insulation can improve the performance of naturally ventilated houses in tropical regions (Iqbal et al., 2023). Regarding integrated ventilation systems, Tan showed that the location and velocity of inlet and outlet airflow influence indoor conditions (Tan et al., 2023), while Heidari demonstrated through numerical analysis that integrated natural ventilation and passive cooling systems can improve residential thermal comfort and reduce energy requirements (Heidari et al., 2024). Despite these extensive studies, most previous research has focused on existing building evaluation, individual ventilation elements, conventional housing types, or isolated passive strategies. Research remains limited on how measured environmental deficiencies in an existing corner house can be translated into an integrated architectural redesign that simultaneously utilizes multiple exposed façades, cross ventilation, stack ventilation, solar shading, increased ceiling height, innercourt configuration, and envelope modification. This constitutes the main research gap addressed in the present study.

Therefore, this study aims to develop a passive design model for a corner house capable of improving its natural-ventilation potential based on the measured environmental performance of an existing residential building. A type 27/60 corner house located in Forest Hill Housing is used as the case study, and its existing environmental conditions are evaluated through measurements of indoor air temperature, relative humidity, and air velocity. The measurement results are used to identify rooms with insufficient airflow and elevated thermal conditions and subsequently provide the basis for architectural redesign. The proposed interventions include distributing openings across three exposed sides of the building, establishing continuous cross-ventilation pathways, introducing vertical airflow through operable skylights and stack ventilation, increasing ceiling height, reorganizing internal spaces, providing an innercourt, and reducing afternoon solar heat gain through shading and façade treatment. This study argues that the ventilation potential of a corner house can be better utilized when its multiple exposed façades are integrated systematically with complementary passive-cooling strategies rather than treated merely as additional external walls. Cross ventilation is expected to increase horizontal air movement between openings, while high-level openings and skylights can facilitate vertical airflow through buoyancy-driven ventilation. Solar shading and envelope modifications are expected to reduce direct heat gain and support more favorable indoor thermal conditions. However, because the proposed redesign has not yet been subjected to post-construction measurement or computational airflow validation, these interventions are presented as an evidence-informed architectural design proposition derived from field measurements, previous research, and established passive-design principles rather than as experimentally verified improvements in building performance.

RESEARCH METHOD

The unit of analysis in this study was a type 27/60 corner house located in Forest Hill Housing. The house is oriented toward the southwest and occupies a corner (hook) position, providing relatively large open spaces along its side and rear boundaries. The southwest orientation exposes the house to afternoon solar radiation; therefore, the occupants planted pucuk merah trees and other vegetation around the terrace to reduce heat exposure during the daytime and afternoon. The rear side of the existing house has an operable window, whereas the side wall has no window openings. The house was selected as the case study to investigate the potential of a corner residential configuration for optimizing natural ventilation. The existing house is also planned to be developed into a two-story residence, with an additional bedroom, bathroom, and roof garden on the upper floor.

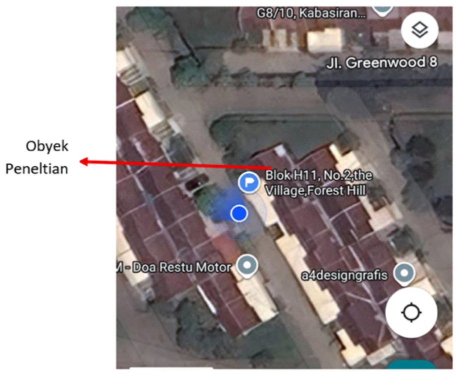

Figure 1. Location of the Research Object

Figure 2. Existing Condition of the Research Object

Figure 3. Side and Rear Views of the Research Object

A descriptive qualitative and quantitative approach was employed in this study. The qualitative descriptive approach was used to examine theoretical concepts and previous studies related to natural ventilation and to review the Indonesian National Standard (SNI) used as a reference for evaluating ventilation conditions. The quantitative approach was applied through direct environmental measurements of the case-study house. The combination of these approaches was used because the study required both measurable information concerning the existing environmental conditions and theoretical considerations for identifying the causes of ventilation problems and formulating appropriate architectural solutions. The solutions derived from these two approaches subsequently provided the basis for developing the design concept of the proposed two-story corner house.

The study used information obtained from both theoretical references and direct observations of the case-study house. The theoretical information consisted of previous studies related to natural ventilation and the relevant SNI standard. Field information included the physical characteristics of the house, its southwest orientation, existing openings, side and rear open spaces, vegetation around the building, and the environmental conditions of the spaces being observed. Environmental data consisted of three measured variables: air temperature, relative humidity, and air velocity. These variables were selected to describe the existing natural-ventilation conditions and to provide measurable information for evaluating the performance of the case-study house.

Environmental measurements were conducted on Saturday, 15 March 2025, during three periods representing morning, midday, and afternoon conditions: 09:00–09:15, 12:00–12:15, and 15:00–15:15. Air temperature and relative humidity were measured using a hygro-thermometer, while air velocity was measured using an anemometer. During the measurements, the doors, windows, and curtains were maintained in an open condition. The weather was clear during the morning and midday measurements and cloudy during the afternoon measurement. Measurements were conducted at nine locations consisting of the carport, terrace, living room, front bedroom, rear bedroom, bathroom, kitchen, dining room, and drying area. The complete measurement results for air temperature (°C), air velocity (m/s), and relative humidity (%) are presented in Table 1.

Table 1. Measurement Results of Air Temperature, Air Velocity, and Relative Humidity on March 15, 2025

Space	**09:00–09:15 Clear Sky**			**12:00–12:15 Clear Sky**			**15:00–15:15 Cloudy Sky**		
	Temp. (°C)	**Air Velocity (m/s)**	**RH (%)**	**Temp. (°C)**	**Air Velocity (m/s)**	**RH (%)**	**Temp. (°C)**	**Air Velocity (m/s)**	**RH (%)**
Carport	28.5	0.5	80.7	29.4	1.5	74.6	29.9	0.5	74.2
Terrace	28.1	0.5	80.7	29.3	1.4	75.7	29.9	0.3	74.5
Living Room	28.5	0.0	79.9	29.5	0.0	74.9	30.1	0.0	75.9
Front Bedroom	28.4	0.0	79.2	29.5	0.0	74.9	30.1	0.0	75.8
Rear Bedroom	28.4	0.0	81.2	29.5	0.0	76.2	30.1	0.0	76.1
Bathroom/WC	28.6	0.0	80.4	29.6	0.0	76.3	30.1	0.0	76.6
Kitchen	28.7	0.0	79.2	29.7	0.1	75.1	30.2	0.1	75.4
Dining Room	29.0	0.0	78.8	30.0	0.1	73.9	30.5	0.1	76.1
Drying Area	29.1	0.0	81.9	30.1	0.0	76.3	30.6	0.0	74.5

The analysis was conducted by tabulating the measured air temperature, relative humidity, and air velocity for each observation location and measurement period. The measurement results were subsequently compared with the relevant SNI criteria to evaluate the existing natural-ventilation conditions. When environmental conditions that did not meet the reference criteria were identified, the possible causes were examined based on the physical and spatial characteristics of the existing house. The identified problems were then linked to findings from the literature review to determine appropriate architectural responses. These solutions were subsequently used as the basis for developing the design concept of a two-story corner house intended to optimize natural ventilation. The overall research process, from literature review and field measurement to evaluation and formulation of the proposed design, is summarized in Figure 4.

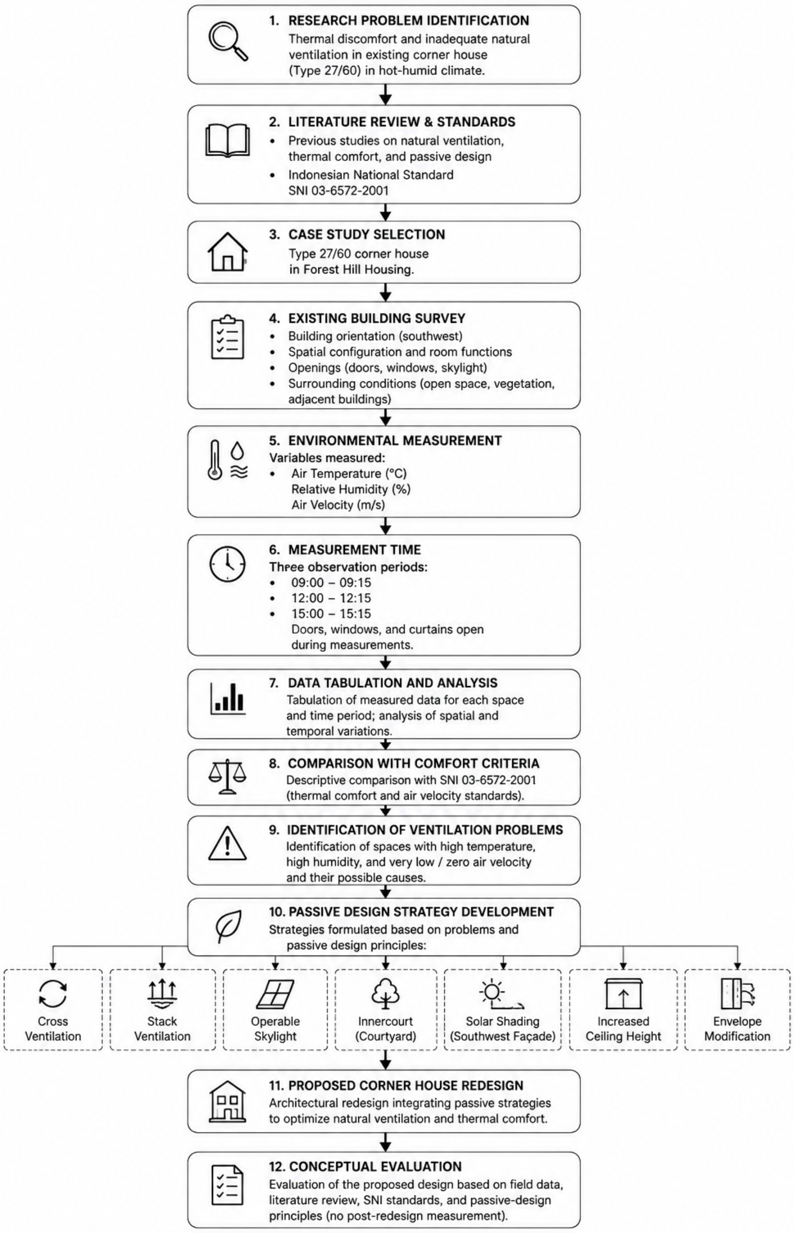

Figure 1. Research Methodology Flowchart

RESULT

The existing house consists of two bedrooms and one bathroom, with the bathroom positioned in the middle of the building between the living area and the kitchen (Figure 5). This spatial arrangement creates several limitations. The bathroom interrupts the visual connection between the front and rear parts of the house and makes the central area appear more confined. In addition, its position restricts the penetration of natural light from the rear openings toward the central part of the house. These conditions indicate that the existing internal spatial configuration does not fully utilize the potential of the corner site, particularly the availability of open spaces along the side and rear boundaries. The field measurements presented in Table 1 further support this condition. Indoor spaces generally recorded air temperatures between 28.4°C and 30.6°C, while most rooms recorded air velocities of 0–0.1 m/s. In contrast, the carport and terrace recorded considerably higher air velocities, reaching 1.5 m/s and 1.4 m/s, respectively, at midday. These differences indicate that outdoor airflow is available around the house but is not effectively distributed into the interior spaces.

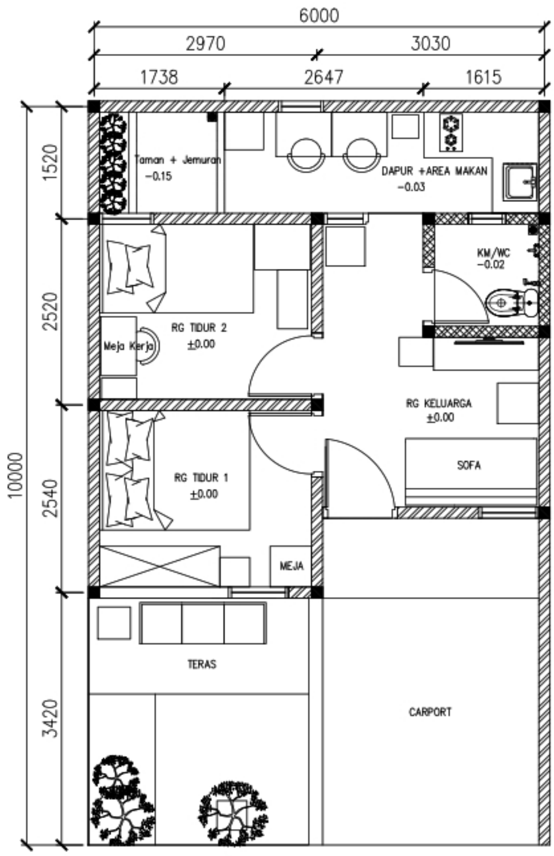

Figure 5. Existing Floor Plan (Scale to Fit)

Source: Field Survey, July 2025

The proposed design reorganizes the spatial configuration while maintaining two bedrooms and adding one bathroom on the upper floor (Figure 6). The bathroom on the ground floor, which was previously located adjacent to the living room, is relocated toward the rear of the building. This intervention allows the living room, dining room, and kitchen to form a more continuous open-plan space without major internal partitions. The relocation is intended not only to create a more spacious interior but also to provide a clearer airflow path between the front, side, and rear openings. The ground-floor bedroom is enlarged and provided with openings facing both the front and side of the building. Two windows are directed toward the adjacent green open area, while another opening provides a connection toward the terrace. The arrangement allows the bedroom to take advantage of the corner-site condition by receiving air and daylight from more than one façade. A new wall is also introduced along the right side of the ground floor so that the proposed structural foundation and tie beam do not depend on the existing shared wall with the neighboring house.

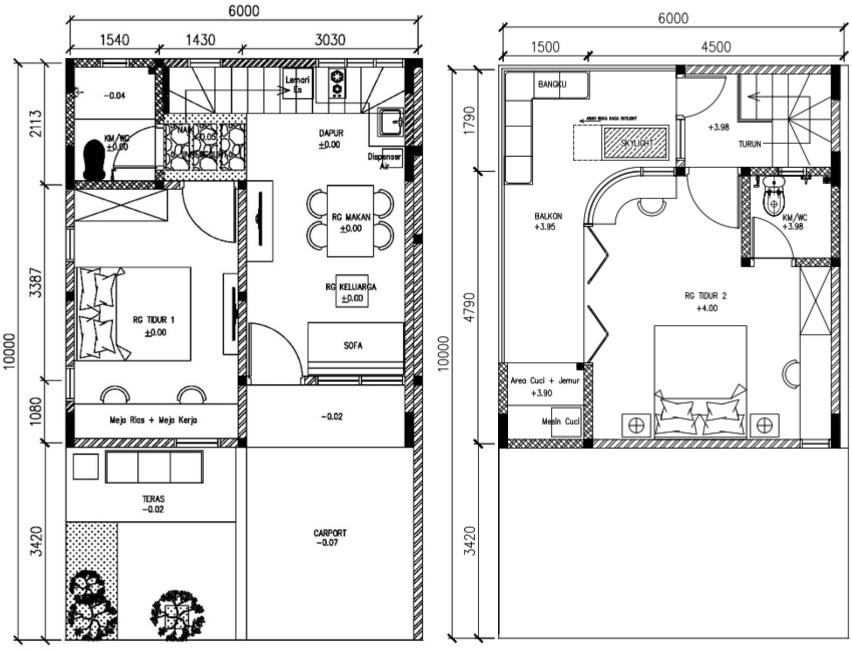

Figure 6. Proposed Ground- and Upper-Floor Plans (Scale to Fit)

Source: Authors' Design, August 2025

The southwest orientation of the building creates a particular challenge because the front façade receives relatively intense afternoon solar exposure. The proposed design responds to this condition by retaining the existing extended u-PVC roof above the ground-floor carport, which provides shading to the lower façade during the afternoon (Figure 7). On the upper floor, the bedroom wall facing southwest is designed with additional thickness and an exposed-brick finish. The opening on this façade is kept relatively limited to reduce direct solar exposure while still maintaining an outward view from the upper-floor bedroom. The proposed façade therefore attempts to balance the need for daylight and visual connection with the need to reduce excessive afternoon heat gain. The building is bordered by a green open area on the left side and a neighboring house on the right side. A light-gray wall finish is proposed because it remains relatively bright and reflective while producing less glare than a completely white surface. A textured *kamprot* finish is applied to the light-gray exterior wall.

Figure 7. Perspective View of the Proposed House Design

Source: Authors' Design, August 2025

A major characteristic of the proposed design is the addition of multiple openings along the side, rear, and upper parts of the building (Figure 8). These openings are intended to increase opportunities for both daylight penetration and natural airflow. On the upper floor, curved walls and windows are introduced to maximize the view toward the surrounding open area. The roof is designed with a sloping configuration to facilitate rainwater drainage and increase the volume beneath the roof structure. Concrete roof tiles are proposed as the roof covering, while a concrete edge element functions as a rainwater gutter. Skylights are incorporated above the staircase, innercourt, and drying area. The staircase skylight includes a small opening to allow air exchange, while the skylight above the innercourt is designed to be operable so that outside air can enter or indoor air can escape vertically. In contrast, the skylight above the drying area is enclosed to prevent rainwater from reaching the drying space, while one side of the area remains open to provide natural ventilation.

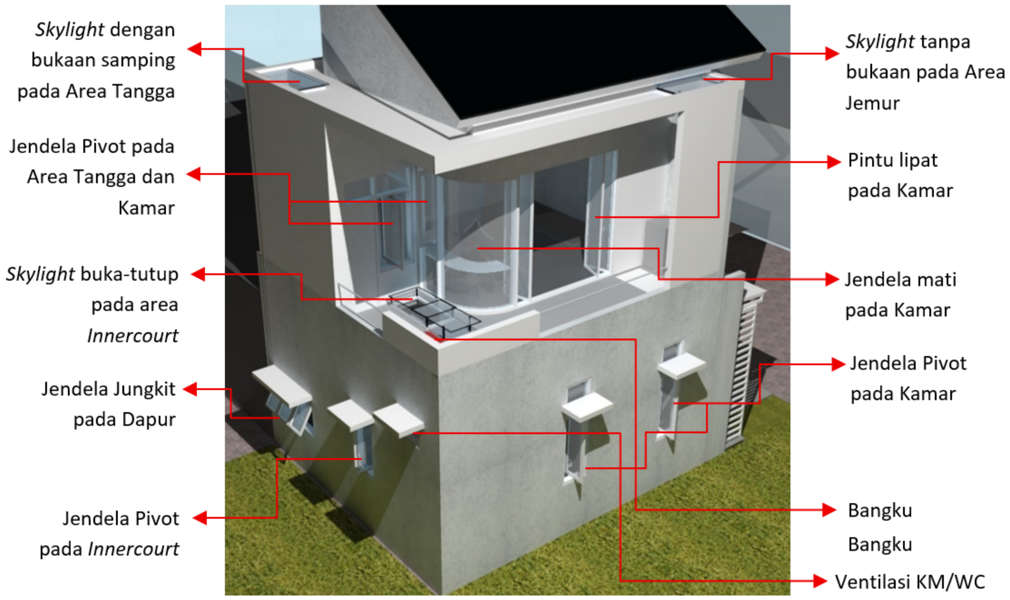

Figure 8. Openings on the Side, Upper, and Rear Parts of the Proposed House

Source: Authors' Design, August 2025

The arrangement of openings is designed to facilitate cross ventilation throughout the ground and upper floors. The kitchen and innercourt are provided with windows facing the green open area at the rear and side of the building (Figure 9). The availability of open land adjacent to these windows provides an opportunity for outdoor air to enter from the rear and move toward the front of the house. Air entering through the rear and side openings can pass through the kitchen, dining area, and living room before leaving through doors and windows at the front. The ground-floor bedroom also contains openings on more than one side, allowing air to potentially move across the room rather than enter and leave through the same façade. This spatial configuration directly addresses the existing condition shown in Table 1, where the living room, front bedroom, rear bedroom, and bathroom recorded no measurable air movement during all three observation periods. The proposed opening arrangement therefore constitutes an architectural response to the absence of airflow observed in the existing interior.

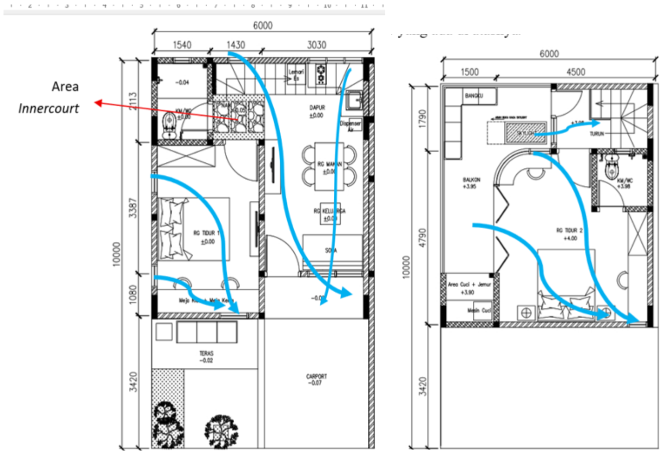

Figure 9. Cross-Ventilation Strategy on the Ground and Upper Floors

Source: Authors' Design, August 2025

Vertical airflow is additionally encouraged through the application of stack ventilation. An operable skylight is positioned above the staircase, with the kitchen located below this vertical circulation area (Figure 10). This configuration provides a potential vertical pathway through which warm indoor air may rise toward the upper opening, while outside air can also enter through the higher-level opening depending on prevailing pressure conditions. A similar principle is applied to the innercourt, where an operable skylight connects the lower interior space with the exterior environment above. The combination of lower-level side openings and higher-level roof openings is intended to complement horizontal cross ventilation by providing an additional vertical airflow path. In the context of the existing measurements, this strategy is particularly relevant because several internal spaces recorded air velocities of 0 m/s throughout the observation period. However, because the proposed design has not yet been subjected to post-construction measurements or airflow simulation, the improvement in air velocity should be interpreted as an expected design outcome rather than a quantitatively verified performance result.

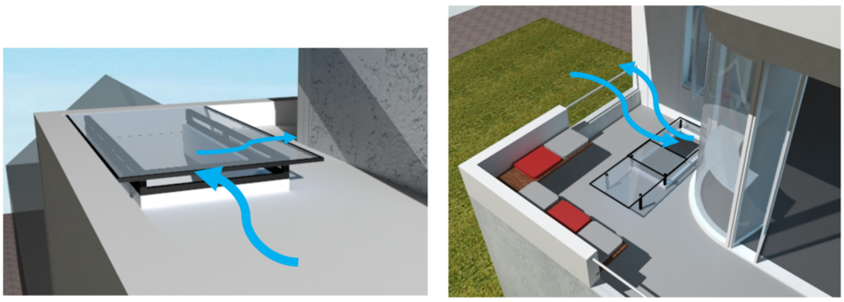

Figure 10. Stack-Ventilation Strategy in the Proposed House

Source: Authors' Design, August 2025

The proposed redesign also modifies the vertical dimensions and building-envelope configuration. The existing floor-to-ceiling height of 2.93 m is increased to 3.50 m on the ground floor and 3.25 m on the upper floor (Figure 11). Increasing the ceiling height provides a larger indoor air volume and creates additional vertical space for warm air accumulation above the occupied zone. This strategy is combined with the use of red-brick walls, roof materials, façade shading, and the cross- and stack-ventilation systems described previously. The design therefore addresses the existing thermal problem through several complementary architectural interventions rather than relying on a single strategy. Based on the field measurements, indoor temperatures increased progressively from morning to afternoon, with the highest value of 30.6°C recorded in the drying area and 30.5°C in the dining room during the afternoon period. At the same time, most indoor spaces experienced little or no measurable air movement. Consequently, the proposed design prioritizes both reduction of solar exposure and the creation of additional horizontal and vertical airflow paths. The overall design outcome demonstrates how the specific characteristics of a corner site—particularly the availability of multiple exposed façades—can be incorporated into a residential redesign intended to improve the potential for natural ventilation.

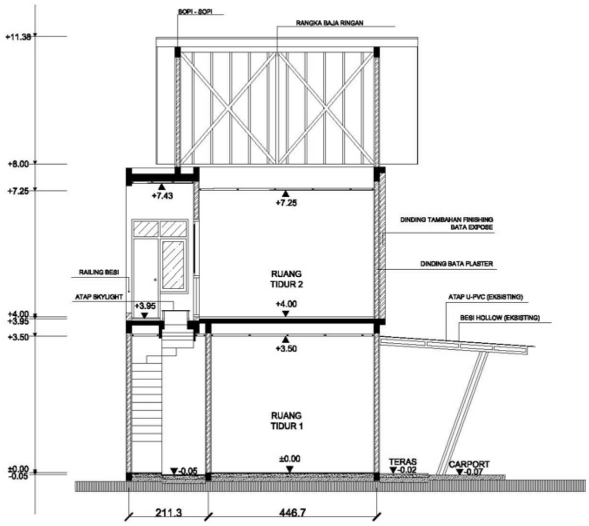

Figure 11. Section Y–Y of the Proposed House (Scale to Fit)

Source: Authors' Design, August 2025

DISCUSSION

The findings indicate that the main limitation of the existing house is not the absence of outdoor airflow, but the inability of the internal configuration and façade openings to distribute that airflow effectively into occupied spaces. This interpretation is supported by the measurement results, where the carport and terrace recorded air velocities of up to 1.5 m/s and 1.4 m/s at midday, respectively, while most indoor spaces recorded only 0–0.1 m/s. At the same time, indoor air temperatures ranged from approximately 28.4°C to 30.6°C, indicating that the interior spaces experienced relatively high thermal conditions with very limited air movement. The contrast between outdoor and indoor air velocities suggests that the existing corner position already provides access to external airflow, but this potential is not sufficiently utilized because of the limited number and arrangement of openings. This finding is consistent with previous studies showing that the effectiveness of natural ventilation depends strongly on the position, size, and relationship between openings rather than merely on the presence of openings themselves (Chen et al., 2024; Fitrawansyah et al., 2021; Salsabila et al., 2021).

The proposed spatial reconfiguration is therefore intended to improve the continuity of airflow paths within the house. Relocating the bathroom from the central part of the building to the rear creates a more open relationship among the living room, dining room, and kitchen. From a ventilation perspective, the removal of a major internal obstruction can provide a clearer path for air entering from the side and rear openings to move toward the front of the building. The provision of windows on more than one façade, particularly in the bedroom and communal spaces, also increases the possibility of cross ventilation. This approach supports findings from previous studies that opposing or differently oriented openings can improve air exchange and indoor airflow distribution (Andriawan, 2021; Rachmalia et al., 2023; Vidiyanti et al., 2018). The particular advantage of a corner house is therefore not only its additional exterior wall area, but also the possibility of connecting multiple façades through an integrated internal airflow pathway.

The introduction of an innercourt, operable skylights, and high-level openings expands the ventilation strategy beyond horizontal cross ventilation. These elements are intended to provide vertical airflow pathways that support stack ventilation. Warm air naturally tends to rise, and an upper opening may provide an exit path while lower-level openings allow replacement air to enter. In the proposed design, the staircase and innercourt function as vertical transition zones connecting lower occupied spaces with roof-level openings. This strategy is particularly relevant because several interior rooms in the existing house recorded zero air velocity during all measurement periods. The integration of horizontal and vertical ventilation pathways is therefore expected to provide a more comprehensive passive response than the use of façade openings alone. Previous research has similarly emphasized that integrated natural-ventilation strategies can improve indoor environmental performance when airflow paths are planned as part of the overall spatial and architectural configuration (Heidari et al., 2024; Tan et al., 2023).

Solar exposure is another important factor influencing the thermal condition of the case-study house. The southwest orientation exposes the front façade to afternoon solar radiation, while the measurements show that indoor air temperatures generally increased from morning to afternoon. The proposed use of extended shading, limited glazing on the southwest-facing upper wall, additional wall thickness, and a light-colored exterior finish is therefore intended to reduce the amount of heat absorbed by the building envelope. The design also retains vegetation in the outdoor area as part of the environmental response. These interventions correspond with previous studies demonstrating that building-envelope configuration, shading, orientation, roof characteristics, and surface properties affect thermal conditions in tropical residential buildings (Iqbal et al., 2023; Lapisa et al., 2022; Lestari & Pasaribu, 2022). The findings of the present study therefore reinforce the argument that natural ventilation should not be considered independently from solar-control strategies because air movement alone may not provide sufficient thermal relief when the building envelope is exposed to substantial heat gain.

Increasing the floor-to-ceiling height from 2.93 m in the existing house to 3.50 m on the ground floor and 3.25 m on the upper floor also represents an important spatial modification. A higher ceiling increases the internal air volume and provides greater vertical separation between the occupied zone and the upper part of the room where warmer air may accumulate. When combined with operable high-level openings, this increased vertical dimension may also support buoyancy-driven air movement. However, ceiling height should not be interpreted as an independent guarantee of lower indoor temperature. Its effectiveness depends on the interaction between air exchange, envelope heat gain, opening configuration, and external climatic conditions. For this reason, the proposed design combines increased ceiling height with cross ventilation, stack ventilation, shading, and façade modifications rather than relying on a single intervention.

The main contribution of this study lies in translating measured environmental deficiencies into an integrated architectural redesign specifically for a corner residential building. Previous studies have frequently examined natural ventilation through individual factors such as openings, materials, building envelopes, or indoor airflow conditions. In contrast, the present study uses the additional exposed sides of a corner house as the starting point for coordinating several passive strategies within a single design proposal. The design incorporates side and rear openings, open-plan spatial organization, an innercourt, operable skylights, cross ventilation, stack ventilation, shading, increased ceiling height, and envelope treatment. This integrated approach highlights the potential of corner houses to use their greater façade exposure as an environmental design advantage rather than merely as an additional building frontage.

Nevertheless, the results should be interpreted within the limitations of the study. Environmental measurements were conducted on one day and at three observation periods, and the proposed redesign has not yet been evaluated through post-construction measurement, computational fluid dynamics simulation, or other quantitative performance verification. Consequently, the study demonstrates the architectural potential of the proposed strategies but does not yet provide direct evidence of the magnitude of temperature reduction or air-velocity improvement that would occur after implementation. Future research should therefore evaluate the proposed design under different weather conditions and seasons and, where possible, employ numerical airflow simulation or post-occupancy measurement to quantify the effectiveness of the proposed cross-ventilation and stack-ventilation strategies.

CONCLUSION

This study shows that the main problem of the existing corner house is the limited distribution of natural airflow into the interior spaces despite the availability of outdoor airflow around the building. Field measurements indicated that most indoor spaces recorded very low air velocities of 0–0.1 m/s, while the carport and terrace reached 1.5 m/s and 1.4 m/s at midday. Indoor air temperatures also increased from morning to afternoon, reaching approximately 30.6°C in the drying area and 30.5°C in the dining room. These findings indicate that the existing configuration of openings and internal partitions does not optimally utilize the environmental potential of the corner site. Based on these conditions, the proposed redesign integrates additional side and rear openings, cross ventilation, stack ventilation, operable skylights, an innercourt, increased ceiling height, façade shading, and spatial reconfiguration to create more continuous horizontal and vertical airflow paths.

The scientific contribution of this study lies in demonstrating how measured environmental deficiencies in an existing corner house can be translated into an integrated passive architectural design strategy. Rather than evaluating natural ventilation through a single design element, the study combines site position, multiple exposed façades, internal spatial organization, opening configuration, solar control, and vertical airflow into one coordinated design approach. The findings emphasize that the environmental advantage of a corner house is not merely the availability of additional exterior walls, but the opportunity to use those façades systematically to improve the potential for natural ventilation and reduce dependence on mechanical cooling. This approach provides a practical design framework that can be considered in the development or renovation of similar corner residential buildings in tropical environments.

This study is limited by the environmental measurements being conducted on only one day and during three observation periods. In addition, the proposed redesign has not yet been validated through post-construction measurements, computational fluid dynamics simulation, or other quantitative performance evaluations. Therefore, the study cannot yet quantify the actual reduction in indoor air temperature or the increase in air velocity resulting from the proposed interventions. Future studies should conduct measurements over longer periods and under different weather conditions and should evaluate the proposed design through numerical airflow simulation or post-occupancy monitoring. Such validation would provide stronger evidence regarding the effectiveness of the integrated cross-ventilation, stack-ventilation, shading, and spatial-design strategies proposed in this study.

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