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Typology of Bali Madya Residential Buildings and Its Relationship with Green Open Spaces

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ABSTRACT
Open spaces are an important component of Balinese residential environments, where spatial organization is closely related to cultural values and environmental responses. In the Bali Madya spatial pattern, residential buildings are arranged as separate masses connected by open spaces, creating relationships between indoor and outdoor areas. This study aims to identify the typology of open and semi-open spaces in Bali Madya residential buildings and examine their relationship with building configuration and natural ventilation. A qualitative approach was employed using purposive sampling, architectural observation, field documentation, environmental measurements, and literature review. The analysis focused on building mass configuration, orientation, wall openings, open-space characteristics, and relationships with the natah. The findings show that bale daja, bale dangin, bale dauh, and bale delod retain open or semi-open spaces that function as transitional areas, accommodate activities, and facilitate airflow and daylight. Thus, open space is an integral element of Bali Madya architecture.

KEYWORDS
Bali Madya, Traditional Balinese Architecture, Residential Typology, Open Space

Introduction

Global warming and climate change pose real challenges for residential areas, particularly in urban regions experiencing population growth and increasing building density. Dense settlements often face a shortage of open space. Homes in these crowded areas frequently feature paved open spaces that absorb and retain heat. These conditions drive the "urban heat island" phenomenon ultimately affecting the comfort of the living environment. The Meteorology, Climatology, and Geophysics Agency (BMKG) notes that rising urban temperatures in recent decades are linked to city surface characteristics dominated by impermeable materials and a lack of vegetation [1]. Extreme heat is also a growing concern; between December 2024 and February 2025, approximately 48.6 million Indonesians were reportedly exposed to extreme heat [2]. This issue is particularly critical in Bali specifically in Denpasar and surrounding suburban areas

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with dense housing [2]. BMKG observations in March 2026 recorded a maximum temperature of 34.2°C in Denpasar [3]. This situation demonstrates that a home cannot be viewed merely as a shelter; it is also part of a micro-environment directly exposed to heat, airflow, and humidity factors that ultimately impact occupant comfort. Consequently, there is an increasingly urgent need for housing that naturally responds to climatic conditions, particularly through the strategic arrangement of spaces, openings, and open areas within the home.

Traditional Balinese architecture offers an intriguing case study in local knowledge regarding residential design, rather than consisting of a single, enclosed building mass, the home is structured as a residential complex comprising multiple building masses with distinct functions, interconnected by open spaces. Natah at the center of the traditional Balinese compound is defined by the configuration of the surrounding building masses and serves as the focal point for the complex's orientation [4]. Each building within the compound relates to the surrounding open space, creating transitional areas that are either fully open or semi-open. Studies on the sustainability of traditional Balinese spatial layouts indicate that the spacing between buildings creates open areas that allow for openings on multiple sides, thereby facilitating cross-ventilation [5]. This aligns with research by Susanti and Damayanti, which found that the natah configuration in traditional Balinese homes varying thermal responses with specific layouts capable of producing more uniform temperature distribution and airflow [6]. Research by Waisnawa and Padmanaba further demonstrates that the arrangement of building masses and open spaces in homes following the Bali Madya pattern enables natural ventilation and daylighting to reach interior spaces [7]. A study of the Bale Meten Sakutus in Seminyak reveals that the construction methods and gaps inherent in traditional Balinese buildings allow outdoor air to enter and support natural air circulation. Thus, terraces, the natah, and the voids between building masses are not merely residual spaces; rather, they are integral components of a spatial system closely linked to orientation, occupant activities, and the building's response to its environment. Collectively, these studies illustrate that the traditional Balinese residential typology is designed to uphold ecological sustainability [8].

Based on this understanding, it is crucial to examine the typology of traditional Balinese houses in relation to natural ventilation and its impact on the dwelling's thermal conditions. Open spaces within traditional Balinese houses serve as potential entry points and pathways for airflow, while the spacing and orientation of the various structures shape distinct airflow patterns. Research on courtyards in tropical environments indicates that a central open space can optimize natural ventilation, although its effectiveness is heavily influenced by building mass configuration and the placement of openings [9]. In the context of Indonesian housing, studies by Feriadi and Wong demonstrate that occupants of naturally ventilated homes exhibit adaptive responses to heat and tend to desire higher air speeds to achieve thermal comfort [10]. This study aims to investigate the relationship between traditional Balinese house typology and natural ventilation specifically regarding air circulation and velocity, air temperature, indoor thermal conditions, and occupant-perceived comfort. The study seeks to provide a comprehensive understanding of how building mass configuration, orientation relative to open spaces, and the interplay between indoor and outdoor areas in traditional Balinese houses function as passive strategies for creating a comfortable, climate-responsive living environment.

Methods

This study employs a qualitative approach using a correlational method, supported by architectural observation and field documentation. The research aims to identify the relationship between the typology of traditional Balinese houses and natural ventilation conditions. Research subjects were selected purposively, focusing on houses that retain the characteristics of the Bali Madya spatial pattern specifically the building mass configuration, the presence of the natah (central courtyard) and other open spaces, and the interrelationships between open spaces and the various building masses. Selection criteria included the presence of open space as part of the residential configuration, an identifiable building mass arrangement, continued use as a residence, and the occupants' willingness to participate in measurements and interviews.

Data collection involved observation, environmental measurements, documentation, and literature review. Observations were used to gather data on spatial layout, site shape, open spaces, mass configuration, orientation, natah positioning, openings, and the relationship between indoor and outdoor spaces. Rapid measurements were taken at specific points representing indoor spaces, semi-open spaces, the natah, and outdoor areas to visualize the spatial layout (floor plans). Data analysis was conducted in several stages. The first stage involved a typological analysis based on building mass configuration, building presence, orientation, the size and number of openings in the building walls. The second stage is an analysis of the building mass layout to determine the distribution and interconnections of the buildings. Subsequently, a correlation analysis was performed to determine the relationship between house typology characteristics and the presence of open spaces. The study concludes by providing an understanding of the mass configuration and open space characteristics of traditional Balinese houses that have the potential to support natural ventilation and residential thermal comfort.

Result

Table 1. Amount of Buildings and Open Space Walls

No	Buildings	Amount of Buildings	Amount of Walls		
			1	2	3
1.	*Bale Dangin/ Adat*	37	-	37	-
2.	*Bale Daja/* Ruang Tidur	34	20	10	4
3.	*Bale Dauh/ Ruang Tidur*	20	4	8	8
4.	*Bale Delod/ Dapur*	11	5	3	3

Field survey results indicate that all the observed bale dangin structures feature a spacious open area that is an integral part of the building's configuration. This open space arises because the building mass is not fully enclosed by walls; instead, walls are present on only two sides. In some instances, these walls serve as visual screens, shielding activities within the structure from the view of the public road. The remaining two sides-oriented toward the north and west-are left open. Observations also reveal that the positioning of the bale dangin or bale adat does not always adhere to the convention of placing it on the eastern side of the compound, as is commonly understood regarding traditional Balinese spatial layouts. In some residences, the bale dangin is situated in the southern part of the compound, in which case it is referred to as a bale adat. Field data indicates that both the bale dangin and the bale adat serve the same function: hosting traditional or religious ceremonies.

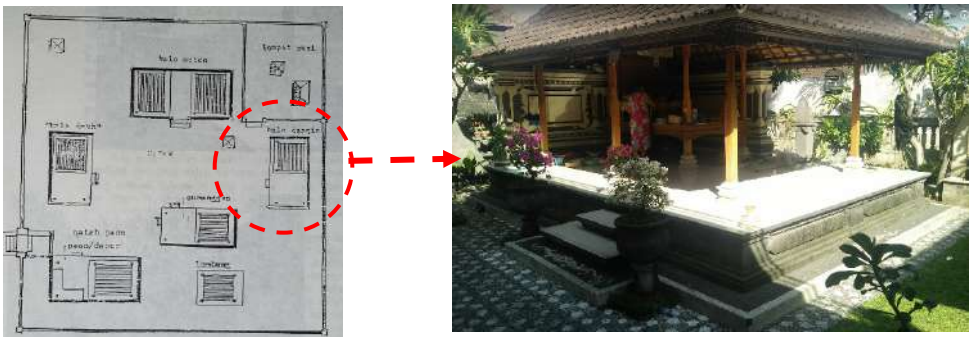


Figure 1. Layout and Typology of Bale Dangin/ Adat

A survey of 37 residential properties revealed that 34 homes still featured a bale daja structure, while three did not. Among the 34 identified bale daja structures, 20 had a wall on one side, 10 had walls on two sides, and four had walls on three sides. In all the observed bale daja structures, the resulting open space served as a transitional area or terrace connecting the interior to the building's exterior environment. Bale daja structures with a single wall tended to retain traditional Balinese architectural character through the use of wooden support posts that functioned as both spatial elements and structural components. In contrast, those with walls on two or three sides featured posts that served primarily as structural columns and boundaries defining the space. Despite their more limited openness, these spaces still functioned as transitional areas-connecting the interior to the exterior or linking one bedroom to another.



Figure 2. Layout and Typology of *Bale Daja/ Tempat Tidur*

Based on a field survey of 37 research subjects, it was found that 20 residential properties still feature a bale dauh structure. The presence of the bale dauh indicates that this structure remains part of the residential spatial configuration, although its form and degree of openness vary significantly. Of the 20 identified bale dauh structures, four have walls on one side, eight have walls on two sides, and the remaining eight have walls on three sides. The sides without walls form an open space that connects directly to the surrounding area. Generally, the open space of the *bale dauh* functions as a veranda, serving as a transitional area between the building's interior and exterior. In terms of shape, the open space of the bale dauh tends to follow a simple geometric configuration, with a square shape being the most common among the research subjects; only a few bale dauh structures feature a rectangular open space.

Based on a field survey of 37 research subjects, it was found that 11 residences still featured a bale delod structure. The presence of the bale delod indicates that it remains an integral part of the building mass configuration in residences adhering to the Bali Madya spatial layout. Among the 11 identified bale delod structures, five featured walls on one side, three had walls on two sides, and the remaining three had walls on three sides. Bale delod structures serving as kitchens tended to utilize their open areas as both a terrace and a dining space, whereas those serving as sleeping quarters generally used the open area solely as a terrace. The open areas of the *bale delod* did not exclusively face the central open space of the compound; some were oriented westward to provide access to the toilet.



Figure 3. Typology of *Bale Delod* and *Bale Dauh*

Discussion

The typology of traditional Balinese buildings cannot be understood solely through their physical form; rather, they must be viewed as part of a system encompassing spatial organization, function, structure, and the Balinese way of life. Gelebet [11] in Traditional Balinese Architecture, explains that traditional Balinese buildings are categorized into hierarchical levels-utama, madya, and nista based on their function and status. Within a residential compound, the architecture does not consist of a single monolithic mass but is instead composed of multiple units serving distinct functions, the bale daja for sleeping, bale dangin for customary and family activities, bale dauh for receiving guests or resting, paon, jineng for storing agricultural produce, sanggah.



Figure 4. Layout and Balinese Madya Traditional Buildings
Source: Gelebet, 1982

These typological variations are further evident in factors such as size, the number of columns, floor plan configuration, the structure of the raised base (bebaturan), and roof shape. Glebet highlights an evolutionary progression in building types, ranging from simple structures like the sakepat to more complex buildings featuring a greater number of columns and verandas (emper). Typology reflects not only differences in form but also the interrelationships between building size, function, construction methods, and the needs of the inhabitants.

This understanding aligns with Dwijendra's perspective, which positions traditional Balinese architecture as an integral part of the community's way of life, characterized by the interconnections between form, function, layout, cultural values, and the environment. The presence of distinct, separate structures creates a unified spatial entity within a single compound. This pattern renders the space between the buildings a crucial element of the overall residential configuration. Typology is defined not only by the characteristics of individual structures but also by the spatial relationships between them [12]. These relationships are governed by the kaja-kelod (mountain-sea) and kangin-kauh (east-west) axes, the functional zoning of spaces, and the presence of a central open area known as the natah. Raharja explains that structures such as the bale daja, bale dangin, bale dauh, paon, and jineng are arranged around this central area, oriented toward the natah. Thus, the typology of Bali Madya traditional architecture exhibits a character that is physically distinct in terms of building masses yet spatially unified, making the relationship between the structures and open space an inseparable part of its architectural identity [13].

There is a strong relationship between the typology of traditional Balinese buildings and open spaces, as the presence of open space is a direct consequence of a building layout that does not consist of a single, unified mass. Natah (central courtyard) serves as a unifying element that connects the bale daja, bale dangin, bale dauh,paon, jineng, and other structures. Waisnawa and Padmanaba found that the detached building layout and the presence of open space in Bali Madya houses facilitate natural ventilation and lighting; their research on residential dwellings indicates that open spaces are linked to thermal conditions and indoor air comfort. Given these factors, the open space within the Bali Madya typology should not be viewed merely as residual space between buildings. Rather, it is a defining element of the typology, as it governs orientation, the relationships between building masses, occupant activities, and the interaction between interior spaces and the surrounding environment [14].

Traditional Balinese architecture is fundamentally characterized by distinct building masses. While each mass differs in shape, size, and function, they collectively form a unified residential environment through the open spaces situated between them. This arrangement is evident in structures designed to face an open courtyard, featuring open frontages created by the use of columns. In other instances, buildings may have walls on some sides while remaining open on the side facing the courtyard. Such configurations demonstrate that the boundary between indoor and outdoor spaces is not always sharply defined. These characteristics align with the Bali Madya architectural style, which employs rectangular or elongated rectangular footprints topped by hip roofs or, in some cases, gable roofs.



Figure 5. Typology of Balinese Madya Traditional Buildings

Based on the floor plan visualizations derived from field observations, the layout of Bali Madya residences reveals a tendency to organize building masses separately, thereby creating open spaces between the structures. The plans show the presence of various building masses-such as the bale daja, bale dangi, bale dauh, paon (kitchen), and other ancillary structures-that are not consolidated into a single building volume. This arrangement demonstrates that the open space is not merely residual land between buildings but serves as a connecting system between the masses and a transitional area for various resident activities. This aligns with research by Waisnawa and Padmanaba, which indicates that the Bali Madya pattern-characterized by separate building arrangements and open spaces-facilitates the entry of natural ventilation and light into the structures [14]. The plans also reveal varying degrees of openness among the buildings; field observations of the bale daja, bale dangin, bale dauh, andbale delod show differences in the number of sides enclosed by walls. These variations can be understood as an

adaptation balancing functional requirements, privacy needs, site conditions, and spatial constraints.

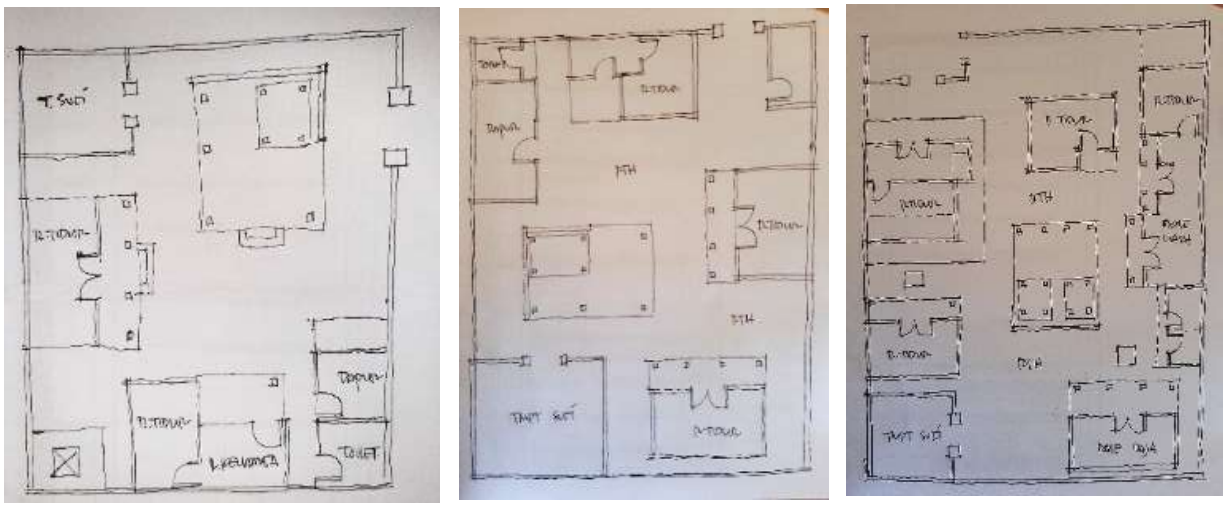


Figure 6. Layout of Balinese Madya Traditional Buildings

A typological analysis reveals that the structure upholds traditional Balinese architectural principles, which favor the use of semi-open spaces as intermediaries between indoor and outdoor areas. Suryantini explains that traditional Balinese dwellings consist of a cluster of pavilions-some open-sided-surrounded by outdoor spaces that can be modified to suit the residents' evolving needs. Regarding spatial orientation, the floor plan configuration demonstrates that building placement cannot be understood solely through geometric cardinal directions; rather, it is governed by cultural orientation systems such as kaja–kelod and kangin–kauh. These concepts underpin the hierarchy of building placement and the spatial relationships within the traditional Balinese home. Changes in the positioning or number of walls in the studied structures do not necessarily signify an abandonment of traditional principles instead, they illustrate the adaptability of the Bali Madya spatial pattern to the requirements of contemporary residential living [15].

Based on natural ventilation analysis, the open space between building masses serves as a zone for receiving and channeling air before it enters through building openings. Research on environmental comfort in traditional Balinese houses indicates that the open-air/courtyard layout, relatively open building structures, non-structural walls, and materials with low heat storage capacity collectively foster a comfortable interior environment within a humid tropical climate. Layout can be interpreted as an integrated system of mass, open space, and openings that work in concert to shape comfort, circulation, and social interaction. This pattern reinforces the view that the typology of traditional Balinese buildings is defined not merely by the form of individual bale structures, but also by the relationships between masses, orientation, openness, and the function of outdoor spaces. Thus, the open space within the subject of study holds a significant position as an architectural element that preserves the character of Bali Madya while simultaneously allowing for adaptation to contemporary residential needs. The analyzed layout is part of the attached research data [16].

Conclusion

The findings demonstrate that open space is an inseparable component of the typology of traditional Balinese residential buildings within the Bali Madya spatial pattern. The observed *bale daja*, *bale dangin*, *bale dauh*, and *bale delod* consistently retain open or semi-open areas, although their forms, number of enclosed sides, orientation, and functions vary according to building use, privacy requirements, site conditions, and contemporary residential needs. The open spaces function primarily as transitional areas connecting indoor and outdoor environments, while also accommodating daily, social, customary, and family activities. The arrangement of separate building masses around the *natah* demonstrates that the spatial identity of Bali Madya is formed not only by individual building forms but also by the relationship between buildings and the open spaces.

The study indicates that the open and semi-open spaces contribute to the environmental performance of the dwelling by providing pathways for natural airflow and daylight into the buildings. The separation of building masses, orientation toward open areas, varying degrees of wall openness, and the presence of the *natah* collectively form a passive environmental system that supports indoor comfort. Therefore, the typology of Bali Madya residences should be understood as an integrated relationship between building mass, open space, orientation, openings, function, and environmental response, rather than as a collection of independent buildings. The adaptability of wall configurations and open-space forms found in the field also indicates that Bali Madya principles can persist while responding to contemporary spatial limitations and residential requirements. Thus, the research confirms that open space is not residual land but a defining architectural element of Bali Madya residential typology, simultaneously maintaining cultural-spatial identity, supporting occupant activities, and contributing to climate-responsive residential environments.

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