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Author(s)
NGUYEN TRAN Yen Khang / Huynh Van-Khang

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Passive Design principles in the transformation of traditional Cham Muslim villages in Mekong Delta

Khang NGUYEN-TRAN[1][0000-0002-0535-0179] and Van-Khang HUYNH[2][0009-0004-8117-1123]

[1] Shimane University, Matsue City, Japan
[2] HUTECH University, Ho Chi Minh City, Vietnam
khang.ntr@riko.shimane-u.ac.jp

Abstract. The Mekong Delta, famous for its status as a multi-ethnic region featuring many unique historical, cultural, and traditional villages, faces an imminent identity threat due to the ongoing urbanization process. Among them, the focus is on a small ethnic community, the Cham Muslim village, which still maintains many distinctive elements in terms of urban and architecture. In the previous investigations, fieldwork collected nine villages in this community that covered approximately two thousand housing, with attention devoted to the documentation of 151 traditional residences, forming the database for the framework of unique structures that have existed since the 18th century. In this study, the authors aim to clarify the relationship between the traditional spatial configuration and the surrounding environment and illustrate a transformation strategy grounded in passive architecture principles. We obtained results by analyzing village settlement and housing typology and its transformation through the viewpoint of passive design principles that follow the cultural behaviors of Cham Muslim people. The outcomes demonstrate the potential of preserving ethnic architecture while learning insights in adapting to the local climate. Furthermore, the research provides solutions for sustainable communities and contributes to the efforts to preserve ethnic identity for future generations.

Keywords: Passive design, spatial layout, traditional ethnic housing, Mekong Delta, heritage preservation

1 Introduction

Traditional architecture evolved to meet community needs, such as providing shelter, protecting against natural disasters, supporting livelihoods, and preserving cultural and religious values. This evolution involves creation and transformations over periods, resulting in diverse architectural forms. Under the impact of urbanization and increasing climatic threat, research to protect local architectural identities is crucial to sustainable development. This research focuses on an isolated community in the Mekong Delta region of southern Vietnam, a multi-ethnic region with diverse historical and cultural backgrounds cohabiting. However, in the research on ethnic housing, more focus is given to the most accessible communities like the Vietnamese and Chinese or almost disappeared communities like the Khmer. According to Taylor [1], the

study on the Muslim Cham community, with its unique identity regarding religious, political, and economic, still lacks scientific and recorded data concerning spatial organization. In the threat of disappearing, communities like the Muslim Cham urgently need conservation policies and appropriate solutions based on the community's needs and local resources. Besides, as said by Piesik [2], "A sustainable future must fully take into account the entire multifaceted treasury of traditional wisdom", studying the inertia between architectural forms and the local environment in ethnic architecture will provide lessons for human transition to sustainable life cohabited with nature. Based on this literature, the research aims to reveal the transformation of the traditional architecture of Muslim Cham people, contributing to the preservation of urban and architectural forms considered as vernacular heritage. Through fieldwork, the authors surveyed residential buildings in the Cham Muslim community of An Giang province. Firstly, by exploring village settlement and housing typology, the spatial transformations will be illustrated. Secondly, by considering housing environmental techniques, their transformation will be investigated from the viewpoint of passive design principles. Then, the research seeks to summarize these findings into principles serving the conservation and development of the Muslim Cham community. The outcome of this research will establish a foundation for designing sustainable strategies aligned with the ethnic lifestyles in Vietnam and potentially applicable to the communities of Southeast Asian countries and worldwide.

2 Methodology

The challenge of this research is to understand the formation of traditional Cham Muslim villages in the Mekong Delta and further the transformation in urban and architectural forms to understand the passive architectural principles within these transformations. Within the scope of research, several issues are directly related, such as the historical events, the physical characteristics, village size and boundaries between each community, the natural and artificial elements that prevail and define the urban pattern of villages and the original typology of each ethnicity housing. Considering these aspects, the research method consists of:

- Collection of records on historical evolution in the Mekong Delta
- Collection of statistics evolutions regarding population, political, economic, and religious evolutions of Mekong Delta ethnicities through graphical database
- Conduct fieldwork for two years to collect necessary drawings, interviews and observations serving as production of the research database
- Analyze archives of urban planning and mapping from satellite data and verify with the anthropology studies during on-site fieldwork.

The database includes 2028 residential properties consisting of 1974 houses and 151 traditional houses. Regarding the study of traditional house transformation, the data consists of site surveys collecting drawings, site integration and photos of 151 houses and the environmental records regarding the temperature and humidity of a typical traditional house during one week.

3 Results

The Mekong Delta is home to diverse ethnic groups, including the Khmer, Vietnamese, Chinese, and Cham Muslims. Historical movements led to their coexistence, each preserving its unique culture. In the 17th century, Vietnamese settlers spread across the delta, while Chinese communities settled near water for trade. By the mid-18th century, Cham Muslim communities, a minority, were scattered along the Bassac River [3]. Fig.1 shows their concentration in An Giang province. These communities, with nine identified villages, build homes near water networks, maintaining a distinct structural identity. The Cham community is a minority group accounting for 0.1% of the region's population [4]. According to Nakamura's research [5], there are three different religious groups in the Cham community in Vietnam: Cham Balamon, Cham Bani, and Sunni Islam. The Cham Balamon and Cham Bani settled mainly in the south central of Vietnam [6]. Meanwhile, most of the Muslim Cham community resides in Chau Doc town, An Giang province of the Mekong Delta as shown in Fig.2.

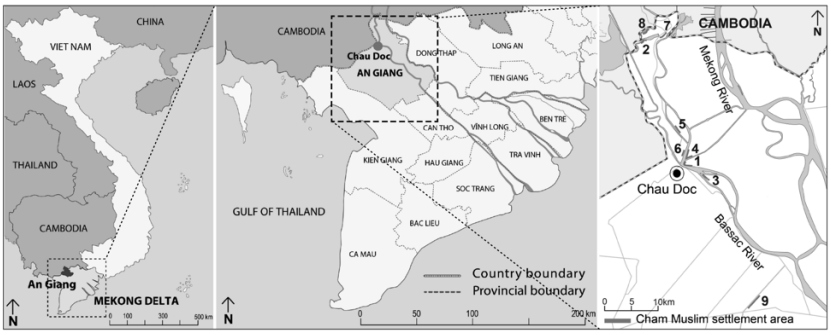

Fig.1. Location of surveyed villages of Cham Muslim in Mekong Delta.

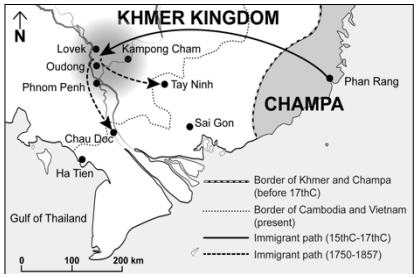

Fig.2. Immigration path of Cham Muslim people from 18th century.

After the Vietnam civil war in 1975, they settled in new economic zones and established villages working in trading, fishing, and handloom weaving. While residing mainly near rivers and canals, the Cham people typically do not open shops where they live like other ethnicities but do business far away from home. Islamic customary law and Vietnamese military policy in the 18th century conditioned the scattered set-

tlement of their villages. The policy “separate to control” defined small clusters integrated with Vietnamese villages to prevent organized protests and protected the borders in An Giang province while strengthening the Vietnamese presence in Eastern Cambodia [1]. From previous fieldwork, the authors collected data from 2028 houses containing 151 traditional houses [7]. The research team conducted field surveys from 2017 to 2019 by mapping documents based on satellite data and information from literature and newspapers, with drawings and measurements on-site. The data are processed for the spatial configuration analysis as of the following:

3.1 Villages settlement

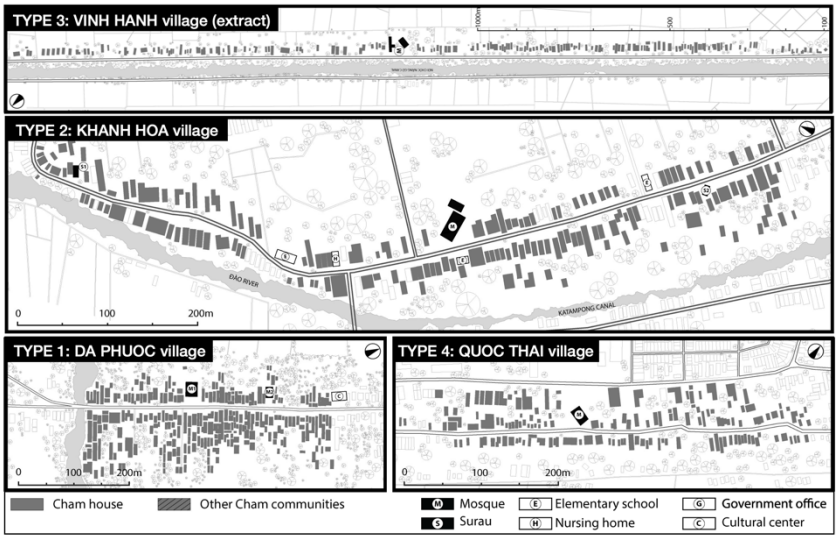

Fig. 3. Example of village settlement of Cham Muslim community.

Nine villages of Cham Muslims are found through surveys. The identical urban settlement is characterized by a linear and symmetrical radiating from the central mosque, their religious landmark. Each mosque features a rectangular floor plan, aligning its East-West axis toward Mecca. Modern village extensions establish new communities, adding to the symmetrical pattern radiating from the mosques, their community gathering place. The villages exhibit a linear configuration parallel to roads and waterways, reflecting the importance of long-distance trading using rivers and canals. Additionally, four types of urban configurations are identified (Fig.3). Type 1 involves strategically placing the mosque inland to minimize the impact of landslides. Type 2, exclusive to villages with only Suraus, features recent constructed, smaller-scale mosques serving as supplementary religious spaces for residences distant from the main mosque. Type 3 is a smaller-scale architectural arrangement commonly seen in villages located near canals and smaller rivers excavated recently. Type 4, found exclusively in recently reconstructed villages or later-established settlement clusters, exhibits distinctive features setting them apart from the other types:

- Type 1 with houses on both sides of the road, the mosque away from the river
- Type 2 with housing on both sides of the road, the mosque by the river
- Type 3 with housing and a mosque on one side of the road and river
- Type 4 with housing and mosque inland, detached from waterways.

3.2 Housing typology

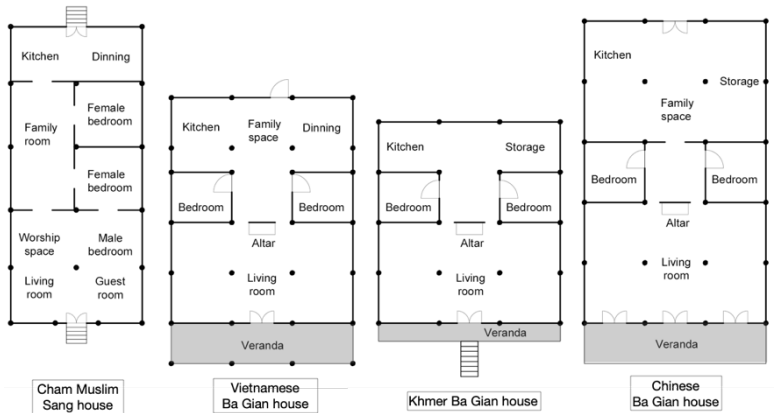

Fig. 4. Main difference between Sang house and Ba Gian house.

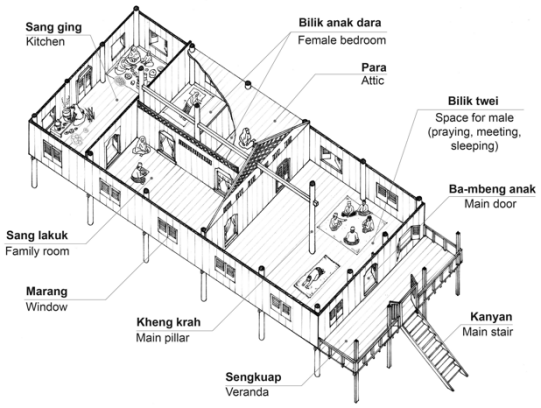

Fig. 5. Spatial division of Sang house.

The Mekong Delta accommodates four ethnic groups with different dwelling typology. While the Vietnamese, Khmer, and Chinese communities live in the Ba Gian style, the Cham Muslims follow the Sang style. These two typologies differ in two aspects. Firstly, it divides space into two compartments along a transversal axis, contrasting with the three compartments of the Ba Gian. Secondly, the original Sang house does not have a front veranda compared to the other one (Fig.4). Raised on high

stilts, around two meters above the ground, the space under the stilts serves various functions. During the dry season, it is a workspace for women working on traditional weaving, while the main activities occur on the elevated floor. During the wet season, it protects the house from flooding. The inhabitants access the upper level by a staircase leading directly to the main entrance. The upper floor contains two main parts: The main front house is a sacred zone for daily worshipping, welcoming guests and sleeping for men and the back of the house, considered a private area, includes bedrooms for women, gathering space and a service area for with kitchen (Fig.5).

4 Discussions

4.1 Transformation of housing typology and villages settlement

In the last 50 years, significant changes in housing among the Cham Muslim community have occurred due to socio-economic transformations [8]. The need for more living space and new houses has been challenged by land management restrictions, leading to a shift from traditional wood to concrete and steel for cost reasons. Changes in family structure, with women working outside, contribute to the demand for increased space, storage, and bathroom facilities. Modern life and increased tourism boost family income, prompting the need for amenities like motorbike parking and entertainment spaces. Government-led urban development in the Mekong Delta has influenced Cham Muslims to adopt architectural elements like verandas to enhance privacy on urban roads. The transformation surveyed in the 151 traditional houses consists of adding rooms or enlarging space compared to the traditional type. While keeping the two spans and initial spatial organization of Sang house, the transformation involves extending the indoor space on a depth axis at the front or back, while keeping the size of the sacred zone like the original model. As seen in Fig.6, there are two transformation methods. The first one extends the back of the house by adding more spans to the wooden structure. The transformation provides more quantities for the female bedrooms and enlarged family gathering spaces, kitchen and dining room depending on the family structure. The second transformation is a buffer space added to the core space. The buffer space can be a front veranda, a back storage, or both. Some variants might have entrances on the left or right, and the staircases are located on the side, which is another buffer space on the side. Also, in the traditional context, toilets and bathrooms were typically located in a separate annex or near the river; however, modern designs incorporate these facilities within the main building. Regarding urban transformation, the linear layout radiating from the mosque does not change over time between housing built before or after 1979 in the villages. Mosques, considering their importance, are always placed far inland, while the additional surau (small mosques) can be located on the riverside to add more focal points for village extensions. Additionally, transformations were observed during the survey concerning the landscape surrounding the housing core due to urbanization progress or environmental threats. As seen in Fig.7, for villages with housing away from the river/canal, the most common is the transformation of spaces under stilts to add storage, annexes,

or secondary living spaces. For villages with housing close to the river/canal, most changes focus on levelling the side facing waterbody for road infrastructure or flood prevention. The space under the stilts is kept for flooding protection, while the housing structure becomes reinforced concrete.

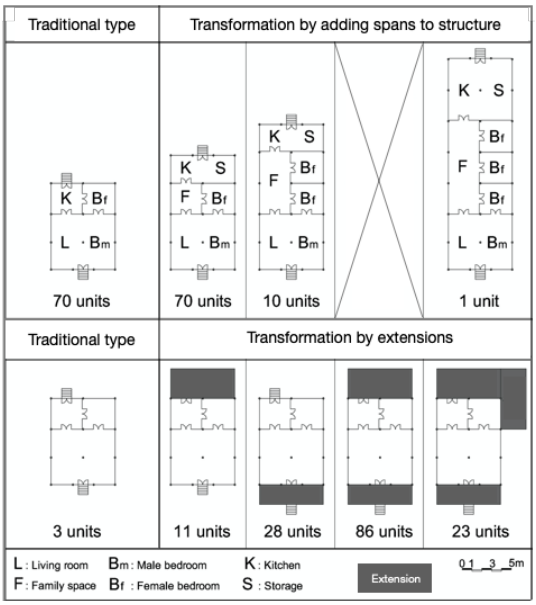

Fig.6. Transformation of housing space.

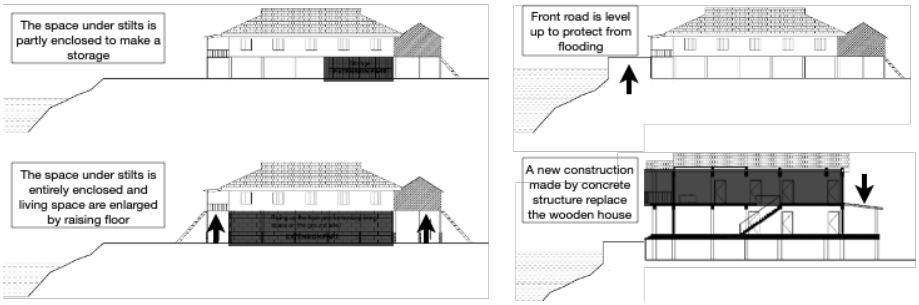

Fig. 7. Transformation of urban settlement.

4.2 Passive Design principles in the transformation of traditional architecture

Passive design in architecture optimizes a building's natural environment for comfortable living, reducing reliance on active systems like heating and cooling to enhance sustainability and minimize environmental impact. In the traditional context, it focuses on using natural resources and features for a pleasant indoor environment [9]. From

the viewpoint of passive design principles for the monsoon climate of the Mekong Delta, the Cham Muslim house has features compatible with the local climate:

- Large eaves protect living space from solar radiation
- Elevated roof system creating stack effect for heat exhaustion
- Porosity including windows, louvres, elevated floor, and gaps between the material of wall and roof allow the indoor space to be ventilated
- Wood and straw as low thermal capacity materials for the house's external envelop
- The surroundings with an abundance of greenery and tree shades enhance the natural wind flow from the river/canal.

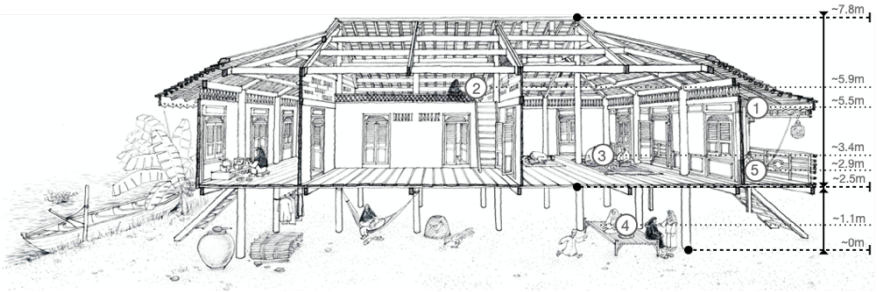

Fig. 8. Measuring temperature and humidity around activities zone.

These traditional features contribute to maintaining acceptable indoor comfort for the inhabitants despite the lack of air conditioning. This idea was supported by research carried out on the vernacular architecture of Vietnam (Nguyen [10]), which is creatively adapted to the local natural environment by various climate-responsive strategies. A transformation by adding more spans and extensions to the housing space will further enhance indoor thermal comfort. Further, the authors conducted an environmental survey in March-April, the transition period between the rainy and dry seasons, to assess the efficiency of the transformation house model (Fig.8). The model maintains the previous structure but adds a veranda. Measurement devices were strategically placed to observe temperature and humidity variations. The devices were placed under the roof (device 1), in the female bedroom (device 2), worship space (device 3), weaving space under the stilt (device 4), and sitting height of the veranda (device 5). The placement rationale involved Devices 1, 3, and 5 near the veranda, the added architectural element during the transformation. The recorded data from these devices offer insights into the thermal and humidity fluctuations induced by the added veranda. In contrast, Devices 2 and 4 recorded data in areas unaffected by the veranda addition, specifically beneath the roof and the stilt structure. The data from these devices serve as benchmarks for comprehending temperature variations in height within the original house structure, ranging from locations exposed to direct solar radiation on the roof to permanently shaded spaces.

In Fig. 9, the recorded temperature and humidity fluctuations over a week depict the overall thermal comfort of a traditional house. Nighttime temperatures remain relatively stable, while daytime variations show up to a five-degree difference between spaces under the roof (device 2) and the weaving area under the stilt (device 4). Spaces near the added veranda exhibit similar daytime temperatures between devices

1 and 2 (under the roof), but device 5 on the veranda's sitting height shows a two-degree decrease compared to under the roof. The worship space (device 3) and weaving space (device 4) maintain a more constant nighttime temperature. In terms of humidity, spaces away from the veranda buffer zone show varying levels between daytime and nighttime, sometimes close to 50%. Spaces near the veranda, particularly the worship area benefit from a humidity range closer to the average throughout the day and night. These findings highlight the effectiveness of the veranda as a thermal buffer zone, enhancing indoor comfort in traditional houses.

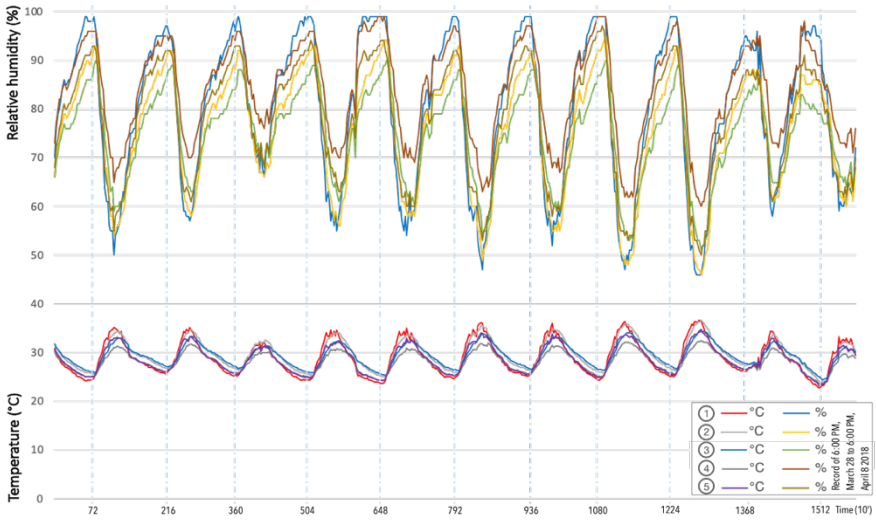

Fig. 9. On site measurement for temperature and humidity.

However, under extreme weather conditions, traditional features might not be sufficient to maintain indoor thermal comfort. As demonstrated by Luu [11], by comparing several traditional houses and modern houses, researchers have pointed out that these features could also be affected by the transformation of the surrounding environment. The recent modifications regarding infrastructure, road levelling for protection against flood or additional housing space for the extended family due to urbanization will impact the cohabitation between traditional housing and the natural environment, such as the reduction of natural wind paths from rivers/canals and increase of sur-rounded surface of high heat capacity material from roads and building envelops. The recent urban transformation that increases housing density and infrastructure reduces green coverage and opens the surface to the rivers/canals might bring a crucial disadvantage to this community.

5 Conclusion

Through a comprehensive analysis, Cham Muslim traditional houses in the Mekong Delta exhibit distinct spatial features and effective adaptations to the prevalent hot and humid tropical climate of Vietnam, especially the Mekong Delta. The presence of

the Cham Muslim community in the region since the 18th century is closely tied to historical and political events, influencing the layout of their villages and housing typology along the riverbanks. Concerning its transformation, traditional Cham Muslim houses adhere to a standardized format that was maintained according to the worship space, with variations based on the extensions to the front or the back of the house. Also, transformations regarding surroundings were added recently due to the pressure of urbanization and environmental threats. From a passive architecture perspective, these houses align well with climate-responsible design. The incorporation of transformation in terms of urban and architecture could be an advantage and disadvantage to the original form of traditional houses. With these features, Cham Muslim houses in the Mekong Delta can be viewed as a potential model for preservation and further design is necessary to protect this vernacular heritage. The principles of spatial distribution and climate adaptation observed in these houses should be considered in the construction of new buildings, not limited to the Cham Muslim community but potentially applied in contemporary designs throughout the Southern region of Vietnam and further Southeast Asian communities around the Mekong Delta to ensure sustainable development while respecting the distinctive characteristics of indigenous architecture in the Mekong Delta.

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Authors' background

Your Name	Title*	Research Field	Personal website
Yen-Khang NGUYEN-TRAN	Assistant Professor	Passive Design, Wind and Light environment, Urban Environment, User behaviour	https://www.researchgate.net/profile/Yen-Khang-Nguyen-Tran
Van-Khang HUYNH	Vice Dean	Passive Design, Wind and Light environment, Ethnography study	https://www.researchgate.net/profile/Van-Khang-Huynh