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An investigation on climate responsive design strategies of vernacular housing in Vietnam

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ABSTRACT

Energy conservation issues and environmental problems in recent years have increased interest in traditional architecture which is well known for its energy saving designs. This paper thoroughly investigates vernacular housing designs and evaluates on the aspect of building physics. A new research methodology which is adapted to the natural and social context of Vietnam was proposed and applied. The process was carried out step by step, including: climate zoning, systematic analysis, in-situ survey and building simulations. The results of this study indicate that vernacular housing in Vietnam is creatively adapted to the local natural conditions and uses various climate responsive strategies. Through this study, the most frequently used strategies and their effectiveness were derived. The authors also found that under extreme weather conditions, traditional designs might not be sufficient to maintain indoor thermal comfort.

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1. Introduction

In recent years, facing the risk of global warming and of the depletion of fossil fuels, reduction in energy consumption along with sustainable development is a priority for many countries, including Vietnam. Today, we generally acknowledge that the building sector consumes about one-third of the total energy consumption worldwide and this figure may vary according to building type and location. In 2010, the building sector in Vietnam occupied between 20% and 24% of the total national energy consumption and this portion is expected to increase significantly [1]. Reducing energy use, especially energy used by occupants of buildings, is an important issue in Vietnam as the country is constantly in the state of energy crisis. Research to reduce energy consumption in the building sector through climate responsive strategies without compromising human comfort is essential. Vernacular architecture is widely recognised as a practical, effective and popular solution.

Vernacular architecture is a term used to categorise methods of construction which use locally available resources to address the local needs [2]. Vernacular architecture results from long-term growth and is part of traditional popular culture; therefore vernacular architecture is considered well adapted to the natural and social conditions of a specific location in which it exists.

In Vietnam, many detailed studies have shown that Vietnamese vernacular architecture is multiform and valuable. Unfortunately, due to many fierce wars, the impact of state policies (for example the land reform from 1953 to 1956) and natural disasters, much vernacular architecture in Vietnam has been destroyed or has disappeared altogether. Today, those remaining are very modest in scale and form, but the architectural and environmental lessons that they provide are still considerable.

The principal purposes of this study were to: (1) search and discover the underlying climate responsive strategies conceived in vernacular architecture; (2) transform and recommend appropriate solutions for current design and construction, aiming towards sustainable development and (3) assess the importance of preserving the vernacular housing remaining in Vietnam.

Six old houses in rural and urban areas spread over the 3 regions of Vietnam, representing vernacular architecture, traditional architecture and old architecture, were thoroughly investigated to understand the climatic design strategies employed and their effectiveness in maintaining human comfort and health.

2. Materials and methods

To comprehensively and systematically review architectural strategies in Vietnam, both scientific methods and respect for the

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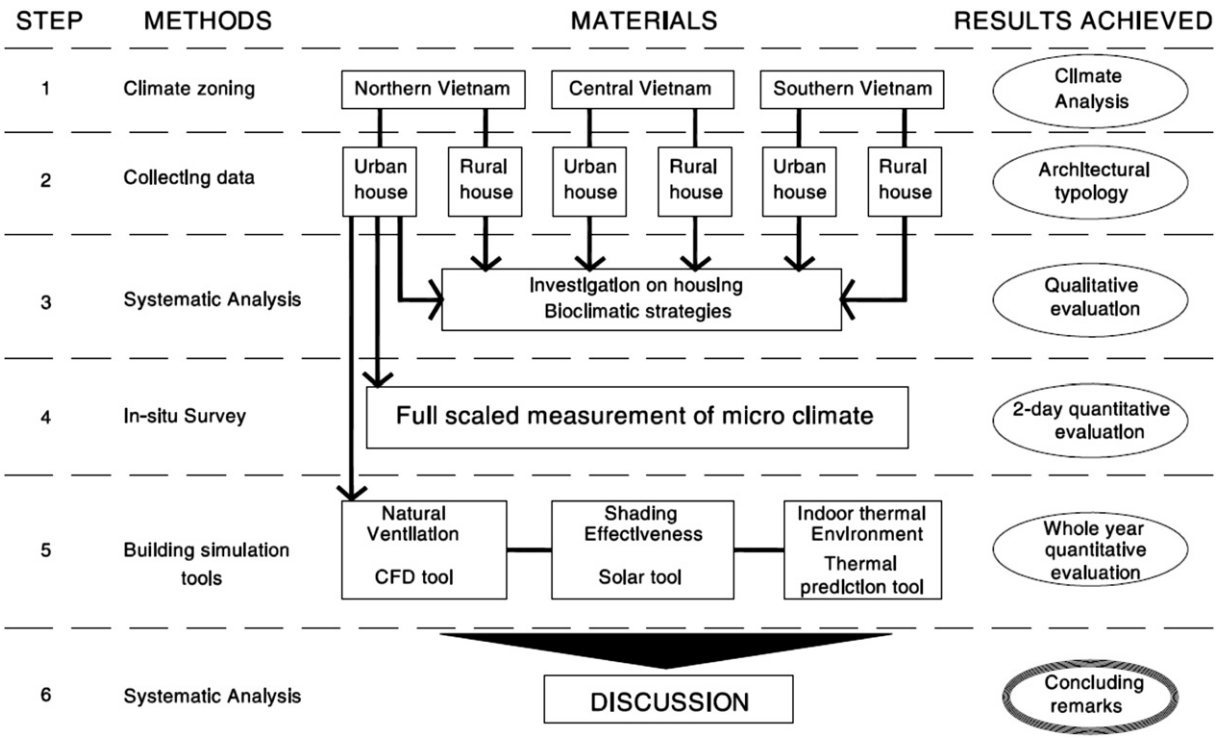

Fig. 1. New approaches and steps proposed and applied in this research.

natural and social context was essential. Various approaches were employed in the literature. Dili et al. [3] used *long-term in-situ measurement method* to evaluate the thermal environment in a traditional building in Kerala, India. Cañas and Martín [4] employed *statistical method* to gather data about vernacular Spanish buildings and categorised them into different bioclimatic strategies based on their locations. By doing so, they found the most frequently used strategies which correspondenced to the building locations and local climate. Vissilia [5] conducted a study to evaluate a sustainable Greek vernacular settlement by using *subsequent analysis*, based on two major steps: (1) a study concerning the evolution of the built environment (typological analysis, site planning, construction materials and techniques), and (2) an evaluation of specific vernacular dwelling types and their response to climate, based on passive design principles. She has made it clear that the vernacular settlement demonstrates an economical use of local building resources, adapting to climatic conditions without using much energy and providing human comfort.

Manioğlu and Yılmaz [6] studied energy saving design strategies employed in ancient housing in Mardin, Turkey. They made a simplified thermal evaluation and *comparison of a traditional house with a contemporary house* by using *in-situ measurement method and questionnaires* which were carried out for 100 buildings. They found traditional houses performed better than their counterparts in providing human comfort and energy saving.

In an intensive study in Japan, Hiroshi et al. [7] researched four traditional farmhouses using both *in-situ measurement and computer simulation* on a model house. Their findings revealed that cooling technologies of traditional buildings, such as solar shading by thatched roof, earthen floor and natural ventilation et cetera are effective for interior cooling.

The territory of Vietnam stretches from the North to the South and along the country the complex social background differs. Based on these geographical and social characteristics and referring to all the above-mentioned methods (in-situ measurement, statistical method, comparative study and computer simulation), this study proposes a new approach for analysing and evaluating vernacular dwellings in Vietnam in terms of building physics. This approach includes six subsequent steps as clearly described in Fig. 1. It is expected that both qualitative and quantitative analysis included in this method will reinforce the findings from this study.

Fig. 2. The map of Vietnam which shows the selected sites of the present study.

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