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## Physical Environment of Stilted Buildings in Rural Area of Southwest China

Hongbo Ma<sup>a</sup>, Zhi Zhuang<sup>a,\*</sup>, Hai Ye<sup>a</sup>, Jun Cheng<sup>a</sup>, Jiao Chen<sup>b</sup>, Bin Qin<sup>b</sup>

<sup>a</sup>Tongji University, 1239 Siping Rd, Shanghai 200082, China

<sup>b</sup>Kaili University, 3 Kaiyuan Rd, Kaili 556011, China

### Abstract

Stilted building is a unique kind of buildings distributed across the southwest mountainous area in China, especially the Miao and Dong dwellings in Qiandongnan area. In this paper, two local traditional stilted houses, old-fashioned and new-fashioned, were selected for case study to investigate indoor environmental quality by field survey. The indoor thermal, luminous and acoustic environment and CO<sub>2</sub> concentrations were tested and evaluated. Results indicated that the electric heating cannot meet the comfort requirements due to the bad thermal performance of the wooden envelope, while heating by the coal stove would cause indoor air pollution. The sound resistance effect of the wooden fabric is so poor that indoor human activities can bring the noise interference to the adjacent room. In addition, the indoor natural lighting illumination was much lower than the standard requirements due to improper interior space layout design, such as few windows with small open area. It is necessary to improve indoor environment for this traditional house for sustainable development. In this study, the indoor environmental conditions in the local traditional houses was objectively evaluated, which helps to guide the residence retrofit and improve indoor environment in the future.

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*Keywords:* Qiandongnan area; Stilted building; Traditional house; Indoor environmental quality

### 1. Introduction

Stilted building is a unique kind of buildings distributed across the southwest mountainous area in China, especially the Miao and Dong dwellings in Qiandongnan area. It maintains both unique architectural image and

\* Corresponding author. Tel.: +086-21-65980778; fax: +086-21-65981002.

E-mail address: [zhuangzhi@tongji.edu.cn](mailto:zhuangzhi@tongji.edu.cn)

profound national culture background despite the long time development and evolution. As a form of traditional architecture through generations, many of its characteristics reflect the harmony with nature, such as combination with landform, economical use of land, adaption to local climate, resource, economic and culture, energy saving, use of local materials and emphasis on ecological environment, etc. However, with the development of economy in China, rural residents' living standards and their requirements for quality and comfort are improving. Recently, many local Miao residents directly change the wooden structure to brick structure at the first floor, or rebuild a simple brick house instead of their old wooden one. This trend will not only destroy the cultural characteristics of traditional local-style dwelling houses, but also cause the indoor environmental problem due to the lack of scientific guidance during the reconstruction. Previous study on traditional Miao dwelling houses in Guizhou area focused mainly on the cultural heritage and ecological environment of architecture [1,2], while objective evaluation on the indoor physical environment of Miao traditional local-style dwelling houses was seldom performed. The existence of these stilted buildings allowed an investigation of indoor environmental quality in the region.

In this study, a field investigation has been carried out in the Kaili area of Guizhou province in January, 2015. Two typical new-fashioned and old-fashioned dwelling houses has been selected to test respectively on the indoor thermal, luminous, acoustic environment and indoor air quality for evaluation of indoor environmental quality of the traditional local-style dwelling houses. Additionally, suggestions according to the existing problems has been given, hoping to guide the new residential construction in the future.

## 2. Objects and Methods

### 2.1. Test objects

The stilted houses are located in Leishan county of Kaili, Guizhou province, southwest of Qiandongnan Miao and Dong Autonomous Prefecture. They are located in the hot-summer and cold-winter climate zone in China. The local annual average temperature is 16.1°C with its highest temperature of 37°C and lowest temperature of minus 4-7°C, and the average annual sunshine hours are 1289h.

This test selected two typical new-fashioned and old-fashioned stilts in the same village, as is shown in Table 1. The old-fashioned house has a history of over 100 years, which is one of the most ancient houses in that village. The new-fashioned house adopts the traditional wooden structure in its most parts while adopts brick structure at the first floor. Besides, the aluminium alloy windows are used in the new-fashioned house.

Table 1. Comparisons of basic conditions between the old-fashioned house and the new-fashioned house

Building type	The old-fashioned house	The new-fashioned house
Building appearance		
Building envelope and functional partition	The old house is divided into two floors: the bottom floor is used for feeding livestock while the upper floor is used for daily function; Wooden wall structure, wooden window frame and single layer glass are used.	The new house is divided into three floors: warehouse is at the bottom, intermediate layer is used for daily function, guest-rooms are at the top floor; The first floor adopts brick structure, the above two floors adopt wooden structure; aluminium alloy window, single layer glass.
Heating methods and energy consumption	The traditional house uses a coal stove for heating; since residents have few things to do for farming in winter, they spend most of their time staying at home, so the coal consumption is much higher than power consumption.	The new house adopts electric heaters for heating in winter, so the power consumption is very high.

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