

# Passive Cooling Effects of Traditional Vernacular Houses in the Sub-tropical Region of Nepal

Hom Bahadur Rijal<sup>1</sup>, Harunori Yoshida<sup>1</sup> and Noriko Umemiya<sup>2</sup>

<sup>1</sup> Department of Urban and Environmental Engineering, Kyoto University, Japan

<sup>2</sup> Department of Urban Engineering, Osaka City University, Japan

**ABSTRACT:** For the purpose of evaluating passive cooling effects in summer, a thermal investigation and a thermal comfort survey of traditional houses and their residents were conducted in the sub-tropical region of Nepal. The results were as follows: 1) Daytime indoor air temperature is 4.6 K less than outdoor air temperature. Passive cooling effects are found in houses with earthen floors, mud and brick walls, and mud vessels. 2) Residents' lifestyles support passive cooling by residing not only indoors but also in semi-open spaces and outdoors. 3) The residents are satisfied with the thermal conditions of their houses and the neutral temperatures were high both in the indoor and the semi-open spaces. The results indicate that traditional houses and traditional lifestyles are effective in producing thermal comfort for residents.

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## 1. INTRODUCTION

Although Nepal is a small country, the climate varies from sub-tropical to arctic due to the broad range in altitude (60 m to 8,848 m, Fig. 1). The different and sometimes extreme climate conditions necessitate specially adapted types of housing, which incorporate a variety of passive cooling methods designed to keep indoor environmental conditions thermally comfortable. In the sub-tropical region, traditional houses are designed to exploit building elements such as earthen floors, eaves, huge mud vessels and brick walls to produce effective ventilation, semi-open spaces, and thermal mass. However, in these same structures defects can be found. Large gaps in doors and between the top of walls and the roof severely detract from the overall cooling effect, instead creating excessive heat and increased air humidity. Firewood combustion in kitchens also contributes to high indoor air temperatures. In addition, the gradual increase in the use of cement roofs further intensified indoor heat.

There is no known, substantial research on thermal mitigation in traditional Nepalese houses. However, such research is imperative if this low-energy consumption lifestyle is to continue. By introducing new techniques into existing houses in sub-tropical Nepal, it would be possible not only to support a comfortable thermal environment, but also to build a sustainable society based on energy conservation. The main aim of the present research is to determine the passive cooling techniques now in use in traditional houses in Nepal, and to suggest improvements.

In the present research, a thermal environment survey and a thermal comfort survey of traditional houses and their residents were conducted in the sub-tropical region of Nepal for the following purposes [1]:

- 1) To evaluate passive cooling methods through the use of semi-open spaces, earthen floors, mud and brick walls, mud vessels, and grass roofs.
- 2) To analyze the lifestyles of residents who employ passive cooling techniques such as use of semi-open spaces and other methods of thermal mitigation.
- 3) To determine what constitutes thermal satisfaction and a neutral temperature for residents in indoor and semi-open spaces.

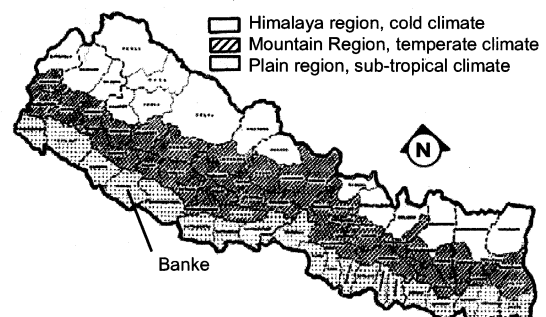


Figure 1: Location of the survey area