Climate Responsive Building Design in the Kathmandu Valley

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Abstract

Traditional architecture in the Kathmandu Valley is the outcome of centuries of optimization of material use, construction techniques and climate consideration. However, contemporary buildings are being built with little consideration of the climate. This study aims to explore strategies for energy efficiency and climate consciousness in modern buildings in the Kathmandu Valley. The Bioclimatic chart, Building Bioclimatic chart and Mahoney tables are used to analyse climatic parameters, and design recommendations are given based on the results of the analysis. An overview of vernacular architecture helps to understand the climatic or technological limitations of the past in order to formulate design guidelines. These guidelines provide recommendations on the orientation and layout of buildings, the size and position of openings, and the characteristics of walls and roofs.

Keywords: climate; comfort; vernacular architecture; energy efficiency; design guidelines

1. Introduction

Climate and environmental conditions are highly important parameters in a building design. Buildings are designed to achieve or to create a suitable atmosphere for human comfort. Comfort may be defined as the sensation of complete physical and mental well-being of a person within a built environment (Givoni, 1976).

Traditional builders used limited resources to achieve maximum comfort and climate was the major determinant in the traditional building techniques. With the advancement in building technologies, heating and cooling in buildings have become easy and for modern buildings, there is less concern with climate and environment in maintaining comfortable indoor conditions. Modern buildings in the Kathmandu Valley, Nepal, also follow the standardized international style of building with very little response to the local climate.

Building construction methods have changed greatly in the last two or three decades, and modern designers often choose to ignore fundamental aspects such as climate. The climate of the Kathmandu Valley is generally cool and solar energy can be used to heat buildings, but contemporary Nepalese designers rarely address this concept. The incorporation of solar energy in building design is one of the most important criteria for energy-efficient building design in a climate like that of the Kathmandu Valley.

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2. Climate

The Kathmandu Valley is located between 27°36' to 27°50' north latitude and 85°7' to 85°37' east longitude at an altitude of about 1340 meters measured from sea level.

Air temperature in the Kathmandu Valley reaches a mean monthly maximum of 29.30°C and a mean monthly minimum of 0.90°C. The annual mean temperature of the Valley is around 16.50°C. The average diurnal temperature range is 10.90°C. Relative humidity is somewhat high but the value falls during the day and varies between 36% and 100% and is strongly dependent on ambient temperature, with the highest humidity values normally occurring around dawn (Showa Shell Seiku K.K., 1998).

The annual average rainfall is around 1300 mm. Severe downpours can be experienced during the months of March through September, primarily due to seasonal monsoon winds. The prevailing wind pattern in the Valley is westerly and the average wind speed is 0.6 m/s (Showa Shell Seiku K.K., 1998).

The average hours of sunshine is 6.3 hours, and varies between 3.3 hours and 8.4 hours (HMG, Department of Meteorology). The least hours of sunshine is recorded in the month of July, and is due to the monsoon rainfall. The Kathmandu Valley receives an average hours of sunshine of more than 6 hours per day from October to May, which is good for passive solar heating in the cooler months. The average annual global solar radiation in the Valley is at around 1510 kWh/m^2, i.e., the daily average of 4.13 kWh/m^2 (Showa Shell Seiku K.K., 1998).