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## Architectural Design towards Energy Optimization: A Case of Residential Buildings in Bangkok

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### Abstract

This paper investigates the thermal perceptual aspect from daily activities. The research uses the cases of small detached houses in Bangkok to examine the best manipulation of architectural elements to optimally provide thermal comfort in the Thai living context applying a multi-facet research methodology. Test result indicates that the various combinations of voids and interior configurations are responding to wind directions, which could obtain the interior air velocity up to 1.5 m/s. The effective range of summer day-time temperature for passive cooling in Bangkok is limited to only 30 - 33°C.

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*Keywords:* Interior architecture; energy efficient; passive design

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### 1. Introduction

The current global energy crisis has called for local actions involving the reduction of energy consumption. The “think globally act locally” (Moberg, 2005) notion brought about awareness and cooperation from the design discipline, where energy-efficient design has become among the crucial

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design elements taken into consideration by architects and designers. In the past, architects had designed interior environment with respect to its local climate and living context. However, the Western designs and ideologies have recently created a huge influence on interior design by aiming to meet residents' use values and ways of lives. As a result, most of the modern designers have adopted the technological aspects from the West to maximize the living comfort and paid little attention to the use of interior environmental management in creating the thermal comfort from passive energy. The principles and techniques of Eastern interior designs are greatly different from the Western perspectives. In the West, the living comfort is induced by the design strategy that creates warm and comfort living ambiance. Meanwhile, in the tropical climate, designing for comfort living environment can be created by decreasing indoor temperature, for instance producing the ventilation through the manipulation of architectural elements and the treatment of interior spatial arrangements.

Each of the remedial choices for energy-efficient design has its pros and cons and they could interact with each other when applied simultaneously. Applicability of combined remedial actions depends much upon the most efficient interaction effect providing the occupants an optimal living thermal comfort. Utilizing the small detached house in Bangkok as a case study, the research endeavours to examine the best manipulation of architectural elements which can optimally serve to provide a thermal comfort in the Thai living context. And finally, the study attempts to derive an interior environmental management model for the optimization of thermal comfort design.

## **2. Theoretical background**

Derived from the literature review, theoretical basis as a foundation of the research framework comprises principles of tropical architectural designs, outdoor thermal conditions, physical requirements for passive designs, human thermal perception and comfort zone, and spatial behavioral pattern of residential usage. The passive means of heating, cooling, and lighting are closely related to building forms. The passive means are the most important energy uses in a building and creating a strong influence on its form. These effects should be known and taken into consideration in the design process (Brown, 1985). The following section presents four lines of thoughts on which the study is based.

### *2.1. Tropical Architectural Designs & Outdoor Thermal Conditions*

In order to create thermal comfort to the interior environment, studies on architectural design need to take into account some crucial elements of outdoor conditions and should also truly understand the particular climatic conditions in that region. Architectural design in the Tropics is typically required to take a serious consideration on its local hot and humid climate, particularly in the coastal zones of South-East Asia. Designing the traditional architecture in the region has been experiencing difficulty from local climatic conditions including high humidity, little naturally air movement in a building, and constantly high temperature during a day and at night. As a result, these local factors have been influencing the varieties of design features adapted to the local climate, especially passive cooling techniques. (Lauber, 2005) The architectural design in the tropical region is usually aimed to reduce the temperature in the interior environment. Three major design techniques that could bring down the indoor temperature include (1) minimizing exposure to direct sunlight, (2) increasing cooling rate during the afternoon, and (3) introducing passive cooling elements to the building.

### *2.2. Physical Requirement for Passive Design*

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