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REVIEW

# A study of the impact of environmental loads that penetrate a passive skylight roofing system in Malaysian buildings

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**Abstract**
A passive skylight system is a significant building design element that provides an ideal condition for interior spaces. However, the use of this system is limited to specific climatic regions because of its considerable effect on the indoor environment. Malaysia is a tropical country that has favorable natural benefits, such as solar geometry and natural light, which can brighten building interiors throughout the year. However, harnessing this benefit affects spaces, especially those in single-story buildings, because of excessive natural loads. This study reviews a concept to understand the passive behavior of solar radiation in the form of light and heat that falls on, interacts with, and is emitted from a skylight system in a single-story building. The study method is theoretically based on descriptive analysis to assess design requirements. The review shows that designs grounded on the physical aspects of climate (influenced variables), materials (design variables), and human comfort (affected variables) in one process (ESI) can develop the architectural way of thinking rather than estimate the condition based on a limited perspective. This assumption indicates that the adoption of this concept in the preliminary design stage will enable designers to balance the building environment effectively.


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## 1. Introduction

The roof skylight system is a construction technique that enables natural light from the sun to pass through roofs or horizontal surfaces of building interiors with limited openings from walls. This construction system is a critical part of a building envelope, which is in contact with most external environmental conditions compared with any other building element, such as windows, walls, and roofs. The roof skylight system is generally prevalent in temperate and cold climates to capture the heat from sunlight under cold weather conditions, such as in late autumn and winter, to reduce energy consumption.

However, the requirement is reversed in tropical regions that have only two seasons: hot and wet. This feature is also a difficult design restraint that tropical architects neglect in their designs, especially for domestic buildings. Additionally, studies on the tropics are unclear regarding the theoretical evaluation of the environmental performance of roof skylights systems because of incomplete research on this approach. A considerable number of studies and books on different climatic regions have not clearly addressed any systematic concept to evaluate the environmental load imposed on skylight systems. Most existing books and guidelines (McNicoll and Lewis, 1994; Heschong and Resources, 1998; Muneer and Kinghorn, 2000; Ruck et al., 2000; Edmonds and Greenup, 2002; Boyce et al., 2003; Mardaljevic, 2007; MS 1525: 2007; Boubekri, 2008; Szokolay, 2008; National Association of Rooflight Manufacturers, 2009; Kittler et al., 2012) have only discussed strategies and types, but a holistic approach toward tropical architecture remains lacking.

As a result, research on with the assessment of the effect of sun energy on tropical roof skylight systems can be viewed as a contribution, not only to the quality of building interiors, but to the improvement of the architectural way of thinking to go beyond the estimation of conditions based on a limited perspective.

## 2. Process

A roof skylight system under solar radiation is subjected to the diverse effect contributing to varying environmental behavior. Such behavior will therefore either increase or decrease the strength of the indoor load. This observation gives rise to the need to identify the effect of the sun load that falls on, interacts with, and is emitted from a skylight system. Figure 1 shows the basic theoretical concept of the load process influenced by the external environment, modified by the mediator (roof skylight system), and transferred from the system to the indoor environment, which consequently affects performance outcomes. To clarify a critical part of the concept, we should understand that the direct load from the sun imposed on the external environment differs from the indirect load modified by the roof skylight in the indoor environment because these loads represent actions and reactions in buildings that are controlled by a medium. Targeting the characteristics of each parameter will therefore enable the identification of the keys for evaluation.

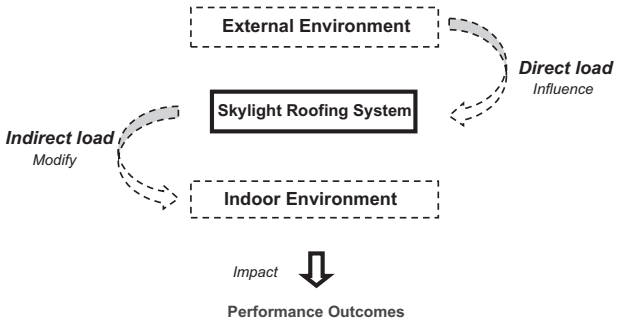


**Figure 1** Theoretical concept of the load process.