Design Strategy of a Compact Unglazed Solar Thermal Facade (STF) for Building Integration Based on BIM Concept

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Abstract

This paper discusses the specific design strategy of a novel compact unglazed Solar Thermal Facade (STF) for building performance research in architectural practice. It identifies the basic role of such STF in the building performance simulation and analysis. A dedicated design strategy based on the BIM (building information modelling) concept for application of the proposed STF is then developed in details. This research work clarifies the necessary steps in ensuring that the environmental/economic factors and energy-efficiency strategies of the STF are integrated with the building design and analysis process at the early stage.

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Keywords: Design strategy; Solar thermal façade; BIM

1. Introduction

Energy demand in present world is growing continuously, and the buildings are responsible for the use of large amount of energy, which accounts for more than a third of the total energy supply [1]. Buildings are thus one of our potential opportunities for energy conservation and environment protection. With regards to building application, the utilization of renewable energy is, without a doubt, one of the most encouraging ecological avenues especially towards the sustainable and resilient city development. Solar
energy, as a major renewable and eco-friendly energy source with the most prominent characteristic of inexhaustibility, is promising currently to offer potential solutions for sustainable development. Compared to solar photovoltaic systems, solar thermal technology exhibits great advantages of higher cost effectiveness with much shorter payback period, more mature and reliable domestic applied technology with massive production globally, and potential in large scale building application [2]. It has been forecasted that solar thermal technologies will experience a boom of a growing solar fraction demand in buildings with available applications of heating, cooling, hot water supply, or even power production [2]. Under this circumstance, a compact unglazed solar thermal façade (STF) is proposed as shown in Fig.1. The single-embossed metal structure engenders not only high heat transfer performance owing to finned absorbing surface and crossflow over the pin fins but also great feasibility in assembly of either parallel or series flow pattern [3]. The proposed STF could be made at the standard modular size to form up the building external decorator for both horizontal and vertical installation, which could be applied as either wall/roof or balcony external cover/claddings.

![Fig. 1 Schematic of the compact unglazed STF integration](image)

2. The role of STF in high performance building integration

Generally, there are three main methods for the high-performance building design, as the passive design strategies, the employment of advanced building technologies and the application of renewable energy systems [4]. Passive design strategies include factors of shading, response to building orientation, solar heat gain, natural ventilation, and daylight effect etc. Active design approaches include use of energy-efficient building systems and advanced building technologies where appropriate, such as mixed-mode ventilation, heating and cooling systems, hot water supply, and power systems. Renewable energy systems should be used to supplement energy demand with renewable sources. As a multi-function technology, STF can be employed as shading or rainscreen in the aspect of passive design strategy, an advanced building envelop to buffer the overall building energy load in the aspect of active building technology, as well as delivery of solar thermal as a renewable energy system. As a result, these characteristics endow the proposed STF as a subset of the three main methods that provides one of the most appropriate solutions for the high-performance building design.

3. Importance of building performance simulation and analysis
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