

# OPTIMAL SOLAR DESIGN BASED ON 3D BIM MODEL ANALYSIS FOR ZERO ENERGY RESIDENTIAL BUILDING IN THE TROPICS

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# 学 位 論 文 概 要

## Dissertation Summary

学位請求論文 (Dissertation)

題名 (Title) Optimal Solar Design Based on 3D BIM Model Analysis for Zero Energy Residential Building in the Tropics  
熱帯地域における3次元BIMを用いたゼロエネルギー住宅のためのソーラーデザインの最適化に関する研究

専攻 (Division) : Environmental Design

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主任指導教員氏名 (Chief supervisor) : Prof. Zhenjiang Shen

学位論文概要 (Dissertation Summary)

This research is focused on optimisation of solar design in the tropical area by employing Building Information Model (BIM) to achieve zero energy residential building. The method proposed in this research is expected to be useful for planner and building designer in evaluating the possibility of solar energy integrated with building from the earlier stage of the design phase. The research began by evaluating daylighting strategies in the tropical residential building. This work is scheduled to be published in International Review for Spatial Planning and Sustainable Development; Volume 7 Issue 2 in 2018<sup>1)</sup>.

Beside evaluating passive solar design through daylighting in the tropics, this research also evaluating photovoltaic potential in generating electricity which can be placed on residential building envelope. The analysis performed by 3D Insolation colour rendering for a practical analysis purposed which is very useful for planner and building designer especially in making decision from the conceptual design stage. The differences between photovoltaic potential investigated in this research from other similar studies are in consideration of present energy consumption and future demand as a balancing point for the photovoltaic panel reserved area. This research has been published in International Review for Spatial Planning and Sustainable Development; Volume 5 Issue 4 in 2017<sup>2)</sup>.

After the potential of photovoltaic implementation in the tropical residential building is verified, this research was advancing to investigate the optimal location of photovoltaic placement in the building envelope. Study of optimal location is completed by employing the 3D modelling analysis using BIM Revit Solar Analysis. Three models of the detached house were included in the analysis represented existing residential building in study case location. This study contributed by proposing a new method for practical analysis employing BIM 3D modelling for predicting energy generation from photovoltaic panel based on the optimal location of building envelope. Furthermore, this research demonstrated important parameters for tropical building design optimisation for photovoltaic energy production obtain from the available area of building envelope. This work has been published in Journal of Cleaner Production; Volume 195, p 1422-1436 in 2018<sup>3)</sup>.

Photovoltaic placement on the tropical building envelope deliver problems related to temperature effect impacted to a reduction in photovoltaic efficiency. Thus, the appropriate photovoltaic technologies that suitable with the tropical climate should be considered. Another issue is concerned about the heat energy released from the photovoltaic panel that affects the indoor thermal environment of the installed building. Based on these issues, our research was moving forward by proposing the photovoltaic panel as a second-skin roof. This study is expected to contribute by providing a recommendation of photovoltaic technology and system for the domestic building in the tropical area. Furthermore, this research recommended an optimal roof design which accounted for energy generation from photovoltaic as well as indoor thermal condition. This work has been presented and submitted to 2016 SPSD International Workshop <sup>4)</sup>.