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Master Thesis Defense

Entitled

AI APPLICATION IN ARCHITECTURE IN UAE: DEVELOPING AND TESTING ADVANCED OPTIMIZATION MODEL FOR A PARAMETRIC SHADING STRUCTURE AS A RETROFIT STRATEGY OF A MIDRISE RESIDENTIAL BUILDING FAÇADE IN DOWNTOWN ABU DHABI

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Abstract

Artificial intelligence is a phenomenon that influences every aspect of our lives. AI applications have already started to change the methods in different disciplines. Architecture is one of the disciplines that is highly affected by the developments of AI technologies. With the United Arab Emirates heading to employ new technology to lead the country and region development, it is important to explore and develop the application of AI in the strategic disciplines of the country in which the built environment is essential. This study aimed to develop and evaluate an advanced model script (to be used as a tool) using Artificial intelligence tools methods and platforms. This model is used to Optimize an X parametric shading structure (As a midrise building façade retrofitting strategy in Downtown Abu Dhabi) to reach the most energy-efficient design based on the building parameters. Mixed methods were applied in the different stages of this study.

The study was divided into four stages, starting with exploring AI progress in architecture. At this stage, the AI-methods-based tools utilized to develop the advanced model were defined. In the second stage the research context including Abu Dhabi's midrise residential building stock, climate profile, energy consumption, and related codes and regulations investigated, therefore, the case study selected, the needed parameters defined, and an energy simulation model created utilizing Honeybee and Openstudio plug-in tools and validated based on the actual data of the selected case study. In the third stage, the advanced optimization model script was developed using the Grasshopper plug-in for Rhino software. The variable parameters for optimization are defined to be perforation area and depth ratio based on the relevant literature, three trials for developing the optimization script were conducted to define the objective function of the optimization process. However, the optimization advanced model script was tested and validated using the selected case study the energy consumption for the case study was reduced by 26.2% when the generated optimum structure was applied as a shading structure to the southwest faced. At the last stage an adaptability test was conducted by applying the developed optimization model to another case study, the energy consumption was reduced by 30%.

The results of this study are an advanced tool that can be applied to different midrise buildings in Abu Dhabi and automatically adapt to its parameters and optimize a parametric shading structure for the building. The parametric pattern optimization process includes minimization of the total radiation on the building envelope to increase energy efficiency while ensuring adequate values for the daylighting and visual connection.