

Application of Biomimetic Approach in Optimizing Buildings Heat Regulating System Using Parametric Design Tools to Achieve Thermal Comfort in Indoor Spaces in Hot Arid Regions

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Abstract : When it comes to energy efficient thermal regulation system, natural systems do not only offer an inspirational source of innovative strategies but also sustainable and even regenerative ones. Using biomimetic design an energy efficient thermal regulation system can be developed. Although, conventional design process methods achieved fairly efficient systems, they still had limitations which can be overcome by using parametric design software. Accordingly, the main objective of this study is to apply and assess the efficiency of heat regulation strategies inspired from termite mounds in residential buildings' thermal regulation system. Parametric design software is used to pave the way for further and more complex biomimetic design studies and implementations. A hot arid region is selected due to the deficiency of research in this climatic region. First, the analysis phase in which the stimuli, affecting, and the parameters, to be optimized, are set mimicking the natural system. Then, based on climatic data and using parametric design software Grasshopper, building form and openings height and areas are altered till settling on an optimized solution. Finally, an assessment of the efficiency of the optimized system, in comparison with a conventional system, is determined by firstly, indoors airflow and indoors temperature, by Ansys Fluent (CFD) simulation. Secondly by and total solar radiation falling on the building envelope, which was calculated using Ladybug, Grasshopper plugin. The results show an increase in the average indoor airflow speed from 0.5m/s to 1.5 m/s. Also, a slight decrease in temperature was noticed. And finally, the total radiation was decreased by 4%. In conclusion, despite the fact that applying a single bio-inspired heat regulation strategy might not be enough to achieve an optimum system, the concluded system is more energy efficient than the conventional ones as it aids achieving indoors comfort through passive techniques. Thus demonstrating the potential of parametric design software in biomimetic design.

Keywords : biomimicry, heat regulation systems, hot arid regions, parametric design, thermal comfort

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