Parallel Parametric Simulation for Optimizing Non-Conventional Solar Screens: An Approach for Balancing Daylight and Thermal Performance in Hot Arid Climates.

Asmaa Hassan ,Ahmed Abdin, Sherif Ezzeldin.

Abstract

Growing interest in digital design tools and generative systems in the architectural discourse, especially parametric systems and optimization algorithms, has the potential to be of greater value if capable of expanding their scope from form generation tools to a more ecological-conscious approach by coupling them with performance simulation tools within a collaborative methodology. The work presented in this paper is a part of a comprehensive study aim to compare between parametric simulations and Genetic Algorithms as a tool to optimize and analysis the effect of non-conventional solar screens on daylight, thermal and energy performance for south fa-ades. This paper focused on the parametric simulation study of a non-conventional solar screen driven by daylight and thermal performance. It integrated simulation tool with parametric design using DIVA, and Grasshopper respectively. The simulations were conducted for a south-oriented office spaceôs fa-ade in Cairo, Egypt. The screen various parameters; sizes, rotation angles, scale ratios, and protrusion values were modelled parametrically and aligned to this fa-ade. Daylight analysis was conducted using Daylight Dynamic Performance Metrics specifically; Spatial-Daylight-Autonomy (sDA300/50%) and Annual-Sunlight-Exposure (ASE1000/250hr), that comply with both LEED v4 and the new IES approved method, and Daylight Availability. While thermal analysis based on a comparison approach of the thermal performance results to a specific base case. Moreover, the screen shading coefficient was calculated to overcome the current limitations of thermal simulations in sufficiently recognizing the complex geometries such as the proposed screen. Finally, the simulations relied on parallel computing algorithm, which saved time by 8 times more than the default runs. Meanwhile, an algorithm inside Grasshopper was specially developed for this study to overcome current limitation of running parallel thermal runs. The paper presented a comprehensive analysis using an exhaustive search method for the effect of the screen parameters on daylight and thermal performance.

SDBE 2017, International Conference for Sustainable Design of the Built Environment, London, United Kingdom. 2017, December