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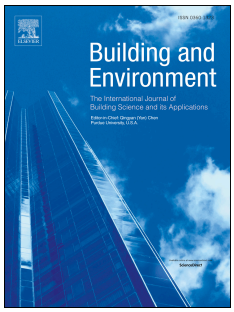

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OPTIMIZATION OF A FIXED EXTERIOR COMPLEX FENESTRATION SYSTEM CONSIDERING VISUAL COMFORT AND ENERGY PERFORMANCE CRITERIA

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Abstract

Shading devices control daylight transmission through fenestration systems, which influences the occupant's visual comfort and the building's energy performance. Fenestration systems containing a light-redirecting layer, such as shading devices, are known as complex fenestration systems (CFSs). Despite the increased optimization in the building performance simulation field over the last decade, few studies have focused on optimizing CFSs. Instead, the majority of studies have focused on minimizing energy consumption and neglected visual comfort metrics in the objective/cost function. This paper aims to optimize a fixed exterior CFS component of offices located in Montreal (Canada), Boulder (USA), Miami (USA) and Santiago (Chile). The studied CFS comprises a set of opaque, curved, and perforated horizontal louvers. The optimization problem minimizes a cost function that includes two visual comfort criteria (spatial daylight autonomy (SDA) and annual sunlight exposure (ASE)) and the total energy consumption. The CFS's design variables are the percentage of perforations, tilt angle and spacing of the louvers. The GenOpt optimization engine with the hybrid PSO-HJ algorithm is coupled to *mkSchedule*, Radiance and EnergyPlus to perform integrated lighting and thermal simulations. The main findings are that a CFS optimized solely based on total energy consumption does not meet the visual comfort metrics; however, including visual comfort metrics in the cost function enables such goals to be achieved by trading-off energy consumption. Moreover, the optimization process is efficient and robust, as the optimized CFS solutions are close to the exact solutions and the simulations' number to find optimum CFSs is reduced by 97%.