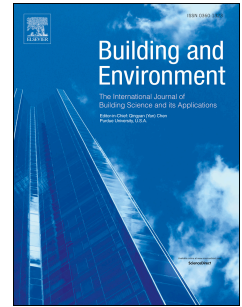


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Optimization of a fixed exterior complex fenestration system considering visual comfort and energy performance criteria

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

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11    **Abstract**

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

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