Genetic Algorithm for Multi-objective Optimization External Louvers in High-performance Office Buildings

Mohammadjavad Mahdavinejad [1], Mojgan Arbab[2], Maryam Arbab[3]

Abstract

Daylight has always been a major factor in the design of architects and engineers especially in daylightophil architecture. It is significant to concentrate on improving the comfort of the interior by optimizing the natural light level today is one of the important issues in the reconstruction and improvement of space, especially in office buildings. The quality of light and visual comfort in office spaces has a direct relationship with the level of employee satisfaction. On the other hand, with the increase in energy consumption, the need for optimization and efforts to reduce its consumption, especially in developing countries, has been increasing, which has led designers to use renewable energies. Solar energy among renewable energies plays an important role in providing lighting requirements. The optimal use of solar energy not only provides for users a favorable environment but also reduces energy consumption for cooling and heating of the environment. Combinations of external shading devices as facade shading systems are essential aspects of the optimization of day lighting in building design. There are different types of shading to create optimal conditions in the interior spaces. One of the effective ways of designing shading is to take into account the weather conditions and the state of the sun and the amount of light demand. As a result, one of the important factors in improving the energy efficiency of a building is controlling the amount of light entering the space, and the only part of the building that directly enters the sunlight is the window, so using the Louvers to control the amount of penetration of sun radiation is indispensable in space. A louver, which is one type of sunshade system, is mainly configured to acquire adequate solar radiation and control over lighting. There are many ways to analyze and design the exterior facade of the building and the window system, where the difference in design and design materials has a strong impact on the internal comfort and external beauty of the building. The use of daylight in a wide range of Iranian cities, including Tehran, is due to the geographic location and high sunny hours during the year. The main objective of this research is to optimize daylight through the use of external louvers and measure the amount of lighting in the interior. The purpose of this research is using artificial intelligence and algorithmic programming in order to estimate the proportions and specifications of external louvers and to propose a model for designing the southern openings of office space for smart energy consumption and providing the level of light required for the interior. The method of research is logical reasoning, hence, using administrative spatial simulation, parametric projection of louvers and optimization of parameters (rotation, length, distance from the window, reflection and number of louvers) using a genetic algorithm to design louvers of the window which is located in the south has been analyzed according to solar radiation conditions in Tehran. The results indicate that the use of external louvers is highly effective in controlling and improving the quality of lighting.

Keyword: Optimization, daylightophil architecture, artificial intelligence, light control system, high-performance architecture, Genetic algorithm

[1] Associate professor, Faculty of Art and Architecture, Tarbiat Modares University, Tehran, Iran
2 Master Student, Department of Architecture, Tarbiat Modares University, Tehran, Iran.
3 Master Student, Department of Architecture, Tarbiat Modares University, Tehran, Iran.