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Adaptive Opportunities Analysis Based on Thermal Satisfaction in Historical Houses of Esfahan (Case Study: Qajar era: Kianpour and Balqis Houses)

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Abstract

Extended Abstract: Thermal comfort is a condition of perception in which 80% of people in an environment have a desirable and satisfactory thermal sensation, defined by a feeling of satisfaction and contentment with the surrounding temperature. Because humans are not inactive in controlling the temperature conditions of their environment, they can adapt the thermal environment around them to their needs through the opportunities that the environment provides. Adaptability is a qualitative concept that enhances user comfort and ensures thermal satisfaction across physical, physiological, and psychological dimensions.

For thermal adaptation, adaptive opportunities defined as a set of solutions designed by the architect in the building, allow the user to overcome the cold or heat of the air with the help of architecture.

Incee traditional Iranian buildings are an example of sustainable architecture, this article seeks to analyze a sample of historic houses in Isfahan, examine the role of adaptive opportunities in controlling environmental conditions in line with Human activity, and evaluate the impact of this factor on the Predicted Mean Vote (PMV). The research method, given its nature, is a combination of experimental strategies, case studies, and simulation. The statistical population was purposefully selected from the Qajar era Kianpour and Belghis houses in the hot and dry climate of Isfahan to explain the opportunities for adaptation

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contemplated in these houses.

The discussion began with the definition of thermal comfort and user adaptation solutions, explored through library and document studies. It included design solutions and architectural features of Qajar-era housing that enhance adaptive opportunities in hot, dry climates. Ecotect 2011 and the Ladybug tools extension in Rhinoceros 7 were used to calculate the PMV and simulate the current situation in two modes: with and without adaptive opportunities. The results show that architectural solutions that increase opportunities for user adaptation can impact the Predicted Mean Vote and the predicted percentage of dissatisfaction as a dependent variable of the PMV. It is important to note that this effective difference in the simulation only shows the effect of limited use of adaptation opportunities such as combined ventilation (increasing adaptive opportunity) or only natural ventilation (not using adaptive opportunity). If more solutions that extend the scope for adaptation, as explained in this study, are included in the design and used by users, it will increase thermal adaptation and reduce the percentage of thermal dissatisfaction among users. Utilizing architectural solutions to uplevel the scope for adaptation of users, not only in traditional houses in the hot and dry climate of Iran but also in modern housing, plays a significant role in redefining the quantitative limits of thermal comfort.

This study uses simulations to examine how adaptive opportunities can enhance thermal satisfaction in modern housing, drawing insights from the climate-responsive design of traditional Iranian buildings. By integrating these approaches, we can better generalize the benefits for contemporary users. In addition to what was said, according to the results obtained, suggestions can be made for improving the thermal conditions of historical houses (if they are renovated and reused) or modern housing. In winter, improving the insulation of buildings can help retain heat. Using more efficient heating systems or increasing the heating capacity of the current system can lead to a 15-20% improvement in the Predicted Mean Vote. Using passive solar methods for daytime heating in winter, improving shading in summer, using vegetation, using materials with high thermal capacity, and optimizing the combined ventilation system with a focus on reducing humidity can lead to improvement in the average thermal rating index. Finally, it should be noted that this simulation, limited to the north and south-facing rooms, may not be fully representative of the thermal performance of the entire building. Factors such as humidity, air velocity, and radiation that affect thermal comfort are not reported in these data, and can significantly impact the results. However, this study clearly shows that increasing adaptive opportunities, energy optimization, and improvement of heating systems in historic buildings is essential and can lead to significant improvements in the thermal comfort conditions of the occupants. There are other studies and specialized areas in line with this research that can be measured and evaluated in future research as study topics in line with increasing the scope for adaptation to achieve thermal comfort and satisfaction.

Keywords: Thermal comfort, Adaptability, Estimation of average thermal rating, Historical houses of the Qajar period, Isfahan