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Courtyard as a passive cooling strategy for sustainable low-energy housing in hot-arid climates: A case study on Phoenix, Arizona

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The environmental issues such as global warming, climate change and environmental pollutions are defining challenges for the 21st century. Studies show that the reduction of the energy demand for heating and cooling as the most energy consumers in building sector, is the key factor in the low energy houses. This paper focuses on the courtyard housing typologies, which were traditionally known for their distinctive passive cooling performance and can contribute meaningfully towards achieving a sustainable building design with high energy efficiency in all regions particularly in hot-arid climates. The goal is to propose an optimized low-energy design model for courtyards regarding orientation, geometrical properties and the materials, to provide the maximum thermal comfort for residents. After a comprehensive literature review, the Design Builder software package was employed to develop a three dimensional numerical building model to simulate a courtyard house in BW climate of Phoenix in Arizona as a research case. The model was verified using data from previous research including indoor and outdoor temperature and residents' thermal comfort and close agreement was achieved. The effects of three main design variables were studied including orientation, geometrical properties (dimensions and proportions) and materials, on residents' thermal comfort in the courtyard to achieve most efficient design. Interactive correlations between the design variables were quantified and an optimization was conducted using Rhinoceros plug-in Grasshopper in order to maximize thermal comfort for residents and minimize energy consumption related to building heating and cooling. A nonlinear equation were derived based on the optimization investigation to be used in designing courtyard houses in hot-arid climate which can aid designers to design most-efficient low-energy courtyard houses in this region.

Biography

Farzaneh Soflaei is an Adjunct Faculty in Morgan State University in Maryland- United States since September 2015. She earned her PhD in Architecture (Sustainable Urban Design and Theory) from Tsinghua University in Beijing-China, in 2013. She also obtained a PhD in Architecture (Sustainable Building Design) from Azad University in Tehran- Iran, in 2006 where taught as a Lecturer and Assistant Professor from 2001 to 2009. Sustainability has always her key research interest; she has published 20 conference proceedings, 10 peer-reviewed journal papers and 2 books, which were cited 97 times based on Google Scholar. In addition, she has served as reviewer for several Elsevier peer-reviewed journals including *Building and Environment, Energy and Buildings, International Habitat Journal* etc., and is also very eager to write and submit grant proposals (particularly to the NSF and DOE, but also, if possible to the NIH), in collaboration with other scholars, universities, institutions and organizations.

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