



The comparative study of the thermal behaviour of various prefabricated dome materials in hot and dry climates of Iran (a case study of Yazd and Isfahan)

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Abstract

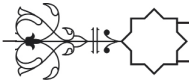
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The mosque has served as a ritual space for Muslims since the emergence of Islam; in every era it has been designed and constructed based on terms and conditions of performance and the technology. But there are almost some fixed and unchanged elements that distinguish the mosque from the other places. In the mosque architecture, the dome is considered as an important symbol and element, and in addition to the concepts hidden in the space of the dome, many designers suppose its existence as a reason for the symbolic architecture of Islam. Therefore, the study of the construction of domes seems necessary, while today the progress of the construction and implementation methods doubles the need for understanding their structures. Meanwhile, in a place like the mosque, it is required to provide the user comfort in terms of the minimal situation to improve the spiritual state of the worshippers, which is needed additionally in the hot and dry climate due to the distance between the natural conditions and the scope of the human welfare. The mosque is at least a safe place where the audience or prayer tries to upgrade his/her spiritual modes and preferably in the zones of hot and dry climate people try twice more to go to the mosque for the development of their spiritual modes and natural comfort. For this purpose, the present study compares three kinds of materials in the prefabricated domes and evaluates the traditional materials (brick) in comparison with the concrete and fiberglass structures. The method of prefabricating was selected from the operational details of the Dk domes Company that has constructed many domes in the Islamic world, including Wilayah mosque of Kuala Lumpur and the form of samples was taken from the Imam Mosque of Isfahan. Thermal behaviour is one of the effective factors for the user comfort and has been selected as the research variable and the samples were analysed based on the behavioural differences. This study aims to find which type of dome provides better response in terms of the studied parameters in hot and dry climates. The paper is to answer the following questions by the utilization of software analyses:

- 1) Which dome has appropriate thermal behavior in the hot and dry climate zones?
- 2) Is it possible to construct a dome such as the dome of The Imam Mosque in Isfahan by the implementation of the modern systems?





The paper has been classified into two sections including- The main subject and the case study to answer precisely the above questions. Firstly, the concept of the thermal behavior is evaluated; performance of dome roofs and the thermal studies and then the domes made of prefabricated concrete, brick and fiberglass are analyzed. The research methodology is descriptive analytic of the case study, quantitative and empirical aspects of the samples through more precise calculations. The analyses were done with Ecotect software in the cities of Yazd, and Isfahan and the results show that in the selected cities, the brick provides more hours of comfort in the climatic conditions of Yazd and the concrete structure of the dome provides more comfort in Isfahan. In both cases, regarding energy exchanges in the dome structure during the night and day and the total of the year, the concrete moderates the temperature and the brick and fiberglass create medium and maximum behavioural differences respectively.

It is concluded that brick dome structures provide more comfort for the prayers to the mosque for the advancement of their spiritual modes in Yazd but concrete domes in Isfahan. In both samples, the concrete is moderator of the temperature; both brick and fiberglass changed the thermal behavior of the domed roof to average and maximum levels respectively both round-the-clock and annually. Whereas the concrete always has a mild linear behavior; always develops uniform conditions even when you need temperature differences to reduce the thermal load in the mosque. It seems that such a moderate behavior is not so suitable in hot and dry zones for the existence of more powerful parameters in these zones. The temperature differences are more in hotter and dryer zones at night and during the day in cold and hot seasons. Concrete can't provide comfort for the prayers due to the constant load of thermal energy and the energy convection. The dome roof made of fiberglass material provides less comfort out of 8760 hours in a year. The concrete dome can produce more comfort than that of the fiberglass in Isfahan with 0.9 percent difference in comfort condition than that of the fiberglass. But in Yazd, the difference in comfort condition is 1 percent for the domes made of brick, then it is concluded that the concrete domes provide more comfort for the prayer in Yazd. Generally, it is concluded that brick is more suitable for hot and dry climate zones; although with a very trivial change in the weather, the concrete showed better thermal behavior than that of brick both in Yazd and Isfahan.

Keywords: thermal behaviour, prefabricated dome, brick, concrete, fiberglass.

