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Design and simulation of a new energy conscious system, (ventilation and thermal performance simulation)

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Abstract

This paper presents the results of simulating the ventilation and thermal performance of a new passive cooling and heating system. The new system was integrated into the roof of a typical contemporary North African house, which was modelled and mounted inside a wind tunnel, for natural ventilation simulation. Thermal performance of the new system was simulated using a new computer programme (BTS), developed by the author. Results are presented in terms of indoor temperature and CATD and HATD, which are newly introduced concepts in defining the building cooling and heating loads. © 1999 Elsevier Science Ltd. All rights reserved.

Keywords: BTS; CATD; Cooling; Heating; HATD ventilation; Wind tunnel

1. Introduction

Design of the new system simulated in this paper is discussed elsewhere in this journal. One of the aspects of the new system is to promote natural ventilation through the living space, particularly during summer. The system is also designed for providing cooling and heating through utilisation of renewable energy sources. There is a number of tools used to predict natural ventilation through buildings, among them is the boundary layer wind tunnel. This technique is based on the simulation of physical models of buildings. Thermal performance on the other hand is best simulated using computerised methods. Simulation of the summer and winter

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performance of the new system was carried using a new computer programme, (BTS) specifically developed by the author for the assessment of the system's various components.

2. Testing the new system inside the wind tunnel

The present experiment was conducted to investigate the performance of the new system with respect to wind induced ventilation, according to the following:

1. Testing the building model inside the wind tunnel (without the system) standing isolated within a simulated rural wind environment.
2. Testing the building model alone within a rural wind environment, but with the new system fitted on its roof.
3. Testing the building model with the new system, in a suburban wind environment.
4. Tests were performed according to eight wind directions and a number of configurations and with windows fully closed or fully opened. This was to study each element in the system under two building operation patterns.

3. Discussion of results and conclusions

Fig. 1 illustrates the wind pressure coefficients measured at two points, one at a height equal to the dome apex and another just above the floor of the living space

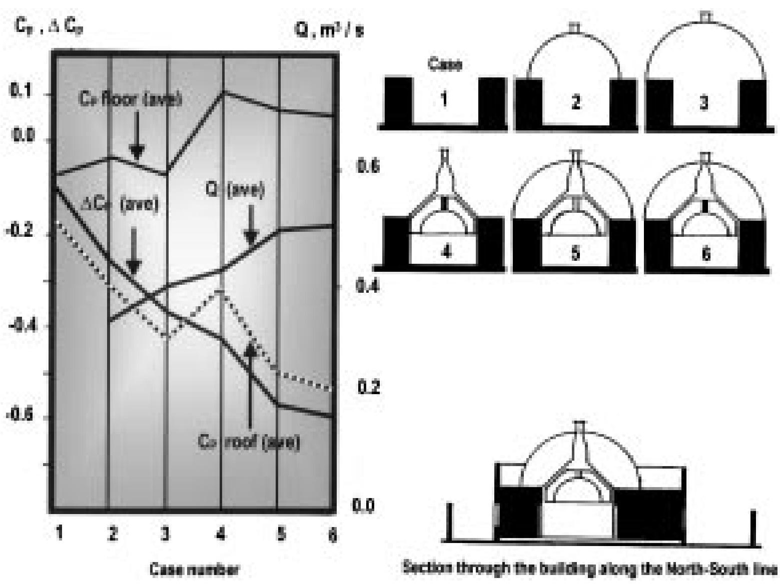

Fig. 1. Pressure coefficients (C_p), pressure drop (ΔC_p) and ventilation rate (Q) through the building with all vents closed (isolated with and without Gadi system).