Energy Efficient Operation of University Hostel Buildings Under Indoor Environmental Quality Requirements

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ABSTRACT

This paper investigates the influence of Indoor Environmental Quality [IEQ] requirements associated with occupation regimes on the criterion of energy demands for Heating, Ventilating and Air-Conditioning (HVAC) central systems installed in Cairo, Egypt. This paper focuses on the effects of occupation rate profiles with IEQ thermal parameters such as air dry-bulb temperatures and local air velocities. It is applied as a case study “10-Stories Hostel of 6000 m^2 built-up area” that is utilized by immigrant students that migrate to Cairo for their University studies. They are termed here in this work as Egyptian Citizens [EC]. The occupation rate schedules and operation profiles for each source of heat inside space shall be incorporated to simulate the reality. These profiles and schedules should be added to the local energy code as a guideline for designers. Although in this case study the obtained results from simulation program match the total actual energy bills, sometimes, with multi-use apartments additional factors. The effect of Effective Temperatures [ET^*] (temperature for constant thermal sensations) is vital as it can lead to reduce the cooling capacity by increasing the room temperature against indoor relative humidity for the same comfort sensation. These two concepts will save on the project total energy demand, in addition to introducing new design criteria for acceptable indoor conditions.

Keywords: Effective Temperatures, Energy Efficiency vs. IEQ, Energy Simulation, IEQ Criteria for Energy Codes, Residential Buildings

1. INTRODUCTION

The present work is a step in a larger and more comprehensive National program that is currently going on in Egypt to analyze the thermal comfort sensation of different Egyptians of different age groups, weight, and sex. The references indoor environmental parameters of Fanger (1972), Fanger et al. (1988), and Fanger (2002) are made and previous research work by authors along these lines were published elsewhere, Medhat (2005) and Khalil et al.
International codes and standards that relate to thermal comfort are mostly based on their prescriptive values on laboratory studies for thermal parameters; these may differ in reality. There are other non-thermal parameters that may strongly influence human thermal comfort and sensations and are worthy of investigations (Medhat et al., 2009). The present work is however devoted to investigate the effects of air dry-bulb temperatures, relative humidity, fresh air requirements, and local air velocities, on yearly energy demands in different climatic zones in Egypt. Field investigations were carried out on air conditioned public buildings in Cairo-Egypt used to house those students that leave their own home towns and immigrate to Cairo for University education. Cairo is considered the most densely populated place, and is highly venerable to air pollution in Egypt. As shown on Figure 1, Egypt densely populated area can be divided to seven climatic zones covering all governorates. Cairo is located in zone 6.

Present investigations were obtained on central air-conditioned residential hostel building in Cairo, where the following conditions and requirements prevail:

1. 6 working days operation per week for minimum 10 working hours per day.
2. Occupancy intensity rate is generally more than 30 healthy persons.
3. The candidates subjected to tests (test objects) should be available for three hours or more maintaining same activity level.
4. The building should contain two chambers (rooms) in which dry-bulb and wet-bulb temperatures can be adjusted to yield the same thermal feeling (sensations).
5. Each of the test chambers should have independent air-conditioning systems that allow for individual control of air flow and thermal parameters.
6. Full coordination with the site engineers, to facilitate the control of indoor conditions and collecting questionnaires.

Figure 1. Climatic zones classifications for Egypt
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www.igi-global.com/article/profiling-of-prosumers-for-the-needs-of-electric-energy-demand-estimation-in-microgrids/132480?camid=4v1a

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