



Energy Saving through Urban Design

A Microclimatic Approach

Mohamed M. El Nahas

B. Sc., M. Sc. (Ain Shams (Cairo))

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Abstract

This thesis investigates the impact on residential energy use for climate control of urban design variables such as building density, spacing and orientation. Energy use for heating/cooling is predicted in a range of urban configurations that are compatible with the following climate-adapted design objectives: wind shelter and solar access in winter and urban ventilation and shading in summer. It is hypothesised that this range of urban configurations would have roughly the same total heating/cooling energy use.

As the urban configuration influences the microclimate at a particular urban site, some climatic elements such as solar radiation, air temperature and wind speed need to be modified to be site-specific. Climate modifier models are adopted and/or developed to make these climatic elements more closely approximate the urban microclimate. A heating/cooling model is proposed as a simplified description of use-patterns of heaters and coolers in buildings. Energy use of dwellings in hypothetical urban sites is predicted in three Australian cities located in the temperate region.

The results support the hypothesis and show that higher urban densities and deeper canyons than those based on solar access criteria will not result in a noticeable increase in the residential heating/cooling energy use in moderate and cool-temperate climates. A unique aspect of the results is based on quantifying the heat island effect as a counterbalance to reduced solar access in medium-density developments. In addition, the advantageous shading effects of high-density developments result in notable energy savings in warm-temperate climates.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to the copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

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To my dearest parents,
my adored wife,
and my beloved kids.

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