ENERGY EFFICIENT DESIGN TOWARDS ENERGY CONSERVATION FOR TERRACED HOUSING IN MALAYSIA

Noor Aziah Mohd. Ariffin

ABSTRACT

Malaysia has experienced rapid economic development in the past four decades. This has resulted in substantial population growth and rapid urbanization, which in turn has resulted in the increased demand for housing. Through both public and private sector developments, driven by successive Malaysia Plans, the country to date has produced more than four million units of housing, a majority of which are medium density terraced houses. It would seem that no attention was given to designing the houses to minimize energy consumption taking cognizance of the hot humid climatic conditions that prevail throughout the year. As a consequence residential energy consumption has increased due to what seemingly are inconsiderate design decisions with regard to energy issues, compounded by an increase in the use of air-conditioning to maintain thermal comfort.

This thesis seeks to ascertain the means by which energy consumption for cooling purposes in medium density terraced houses in Malaysia can be minimized. Given the nature of the climate, which is mostly invariant and outside the comfort range throughout the year, it considers those design factors such as orientation and other design improvements to try to find alternate design strategies that will reduce residential energy consumption while maintaining thermal comfort. The study utilizing questionnaires and on-site temperature monitoring, surveyed a terraced housing development in a recently completed new development close to the capital city Kuala Lumpur, to assess the impact of orientation on thermal comfort and energy consumption. It found that thermal conditions within the houses surveyed exceeded international (ASHRAE-55 and ISO7730) and local (MS1525) thermal comfort standards and even the revised standards based on an adaptive approach. It also found that energy consumption of the houses is not influenced by the varying orientations, but rather, is dependent on the affordability of the households. Using data from the field study a Base-Case building design model was created and its annual energy consumption to maintain thermal comfort established. An exhaustive enumeration thermal simulation analysis was undertaken to predict the improvements in annual energy consumption through investigating the effect of changes to parameters such as insulation in walls and roof and various glazing types for all orientations from due North (0°) to 350° at 10° intervals.

The parametric analysis determined that there were a range of orientations that could produce optimum results. It further established that the use of 50 mm insulation in roofs, 25 mm insulation in walls and tinted double-glazing for windows could produce a potential annual savings of up to 21% in

energy consumption. Through statistical analysis a mathematical formula was established to predict the penalties for orientations other than optimum. Cost analysis on the internal return rate of investments also suggests the payback period of capital expenditure of each improvement option undertaken. These findings not only provide housing designers with suggestions for designing to minimize energy consumption while maintaining thermal comfort but also indicate the penalties as they move away from the ideal.

Further studies are required to confirm the theoretical results. Work also needs to be undertaken with the other housing types that are being built. This work could also lead to the formulation of a Malaysian standard for energy consumption in housing and possibly a housing energy rating scheme. Potentially these results can also be generalized to existing housing stock in terms of energy efficient retrofitting and to other locations with similar climatic characteristics.

Curtin University of Technology