

Energy Efficient Urban Planning

Over half of the global population lives in urban settlements (UN 2009) and a very large proportion of worldwide energy is consumed in the cities. The most of energy consumption in a city generally belongs to buildings and transport inside the city. The urban planning and urban design affects both of them.

Energy consumption in buildings (via heating, cooling and lighting) is a significant portion of worldwide energy consumption, so that residential and commercial buildings are responsible for over 40% (EIA 2008) of worldwide energy consumption. A reduction in energy consumption of buildings would, therefore, have a significant impact on the overall consumption. Urban planning and design characteristics of the buildings, neighborhood units and the city have a big effect on the energy consumption of buildings. The energy consumption of buildings can be decreased through proper urban planning and urban design.

This research will deal with the effect of architectural and especially urban factors on energy consumption of buildings, which is not widely researched until yet. Energy efficiency through urban planning and design is cost-neutral, emission free and do not need additional technologies.

Among buildings with various occupancies, this research will focus on residential buildings. The residential buildings consume energy in different ways including heating, cooling, lighting, demand hot water, mechanical ventilation, cooking and energy consumption of household appliances, etc. The urban and architectural design affects more effectively the heating, cooling and lighting energy consumption of buildings. Therefore these three fields will be considered in this work.

The heating, cooling and lighting energy consumption of residential buildings is dependent on the design and the form of residential units. The design of the residential units are affected through two groups of factor including 1) architectural factors¹ and 2) urban planning/design factors. However, in a wide area, the architectural and urban factors overlapped each other.

On the other hand, some of architectural factors such as “building orientation”, “building elongation”, “the number of stories”, “compactness of building” and “the area of common walls with neighboring buildings” are directly dependent on urban planning and urban design.

This work primarily aims to identify which urban planning factors reduce the heating, cooling and lighting energy consumption of the buildings. This research studies only the effect of urban design on energy consumption of buildings. Therefore, throughout this research the urban design and urban design factors are to be treated as independent variables, and annual energy consumption of buildings ($\text{kWh/m}^2\text{a}$) as dependent.

For the study of the effect of urban design factors on energy consumption of buildings, simulation with proper simulation software tools will be used at both building and urban scales.

External validity of this research is to decrease the energy consumption of building sector only through urban planning/design while minimizing applied resource demands. This has several ecological and economical advantages.

¹ - The effect of architectural factors on energy consumption of buildings is investigated in the past (Climate and Energy Responsive Housing in Continental Climates, ISBN: 978 3 7983 2144 1). It has shown that the energy consumption of buildings can effectively be decreased through an optimized architectural design.