ENVIRONMENT, ENERGY AND HEALTH IN HOUSING DESIGN

L. Morawska, and **M. Jamriska**
International Laboratory for Air Quality and Health, School of Physical and Chemical Sciences, Queensland University of Technology, Brisbane, Australia

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Summary

One of the basic objectives of housing is to provide shelter for humans. However, in addition to fulfilling this basic objective, people expect much more from houses, including in the first instance functionality and ability to serve the purpose of various activities and also to be aesthetically desirable. There are a number of features of houses that are most directly related to human health and well-being. These include: temperature, humidity, air quality, air movement, light and noise. It has been demonstrated that the quality of the indoor environment is directly related to health and well-being and is linked to a large number of health effects such as communicable respiratory illness, allergy and asthma symptoms, and sick building symptoms. With an increasing world population, and thus a dramatic increase in building inventory, particularly in the numerous mega-cities of the world, it became evident that houses and the way they are operated have also a profound impact on the local and global environment. Thus the existence of links between housing design, human health and well-being, and the environment have been established beyond any doubt.

This chapter provides a general overview of different aspects of housing design, maintenance and operation and their impact on human health and well-being, as well as on the environment, particularly from the point of energy consumption. It also discusses factors that need to be considered to ensure that houses are designed in a way that are

healthy and comfortable for their occupants, and that the impact of the housing on the environment through energy consumption, greenhouse gas emissions, material use and urban climate is minimized.

1. Introduction

On the list of necessities for humans to function, a house takes one of the top places. Archaeological records show that shelters existed almost everywhere where signs of human civilizations have been discovered. Those shelters often differed significantly between regions of the world, in order to accommodate the requirements of different climatic conditions, and also as a result of variation in materials available for building purposes. Humans used caves and tree trunks as shelters, and erected shelters from timber, leaves, stones, animal skins and ice, to name the most important building materials used by early civilizations. Some of these are still utilized by contemporary builders.

The purpose of housing throughout history has been to provide shelter for humans and to enable them to live under the conditions that are right for bodies to function. This means in the first instance the right temperature, but obviously protection against other meteorological factors like rain/snow, wind, high humidity, and also environmental factors such as insects or air pollution. Gradually, other purposes of houses have been added to its basic function as a shelter. Those included different activities conducted in different buildings, or protection against other humans.

People of early civilization were very dependent on the natural environment, which they inhabited and thus their houses were part of that environment adapted for living purposes or were constructed in harmony with the environment. Over the millennia, with the development of science and technology, new building materials were manufactured and advanced building designs developed. These gave humans a perception of freedom from environmental constraints in building planning and construction. With an increasing world population, and thus a dramatic increase in building inventory, particularly in the numerous mega-cities of the world, it became evident that houses and the way they are operated have a profound impact on the local and global environment. The local effects include a so-called *heat island* over the city or *urban dust domes*, meaning accumulation of heat energy and dust, respectively, as a result of human activities. On the global scale, the energy used by the housing sector is a major fraction of the global energy consumed, and the greenhouse gas emissions related to this sector, particularly CO_2, are a major fraction of the total greenhouse gas emissions.

There is concern not only about the effect houses have on the environment, but also on the health and well-being of people occupying the houses. In the modern age humans spend over 90% of time indoors, often in environments effectively isolated from outdoor influences. The most susceptible segments of the population: the very young, old and sick spend close to 100% of their time indoors. The concentration levels and number of pollutants could be much higher indoors than outdoors due to the presence of indoor-specific sources. These include a large range of building materials and products, furnishings, consumer products, cooking, heating, tobacco smoking, etc. The global

energy crisis has produced efforts to reduce energy consumption and to isolate the indoor from the outdoor environment, which in turn has been shown to result in additional deterioration of indoor air quality and the quality of the indoor environment.

Over the last few decades the links between housing design, human health and well-being, and the environment have been established beyond any doubt. Figure 1 is a schematic representation of the existing links between humans, buildings and the environment.

By definition, 'environment' encompasses "all factors (living and non-living) that actually affect an individual organism or population at any point in the life cycle". 'Environment' is also sometimes used to denote a certain set of circumstances surrounding a particular occurrence. While protection of human health and well-being is one of the main foci of environmental protection, there is a need for a systems approach to environmental issues to ensure that any protective measures adopted would help to sustain the whole environmental system and not only its individual compartments. The aim of environmental protection is to minimise the impacts of contaminants on the environment.

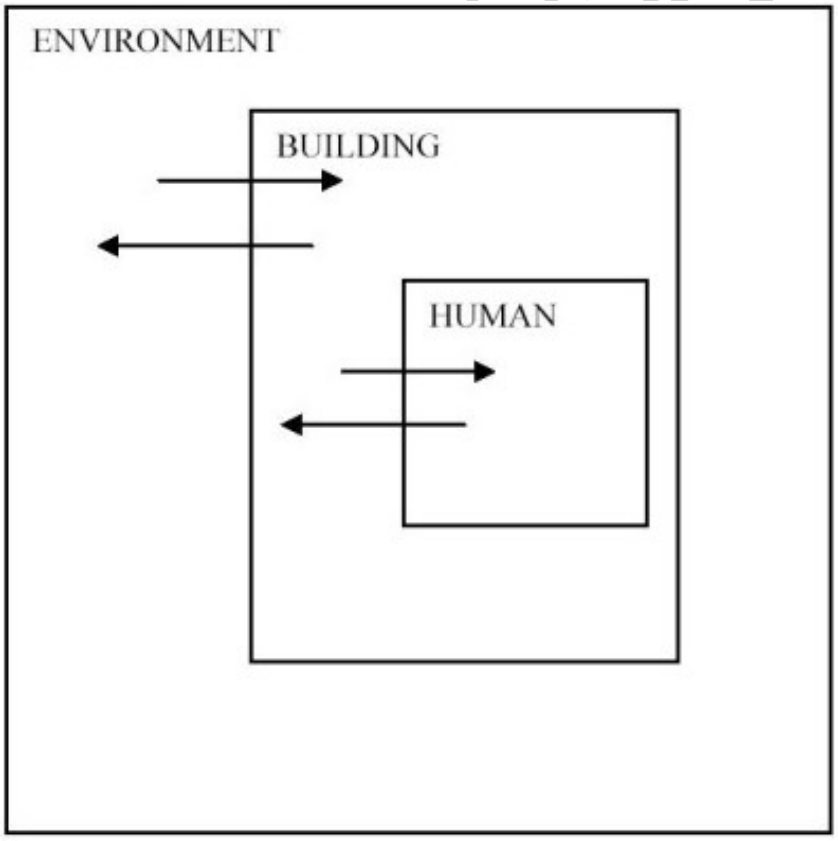

Figure 1. A schematic representation of the existing links between humans, buildings and the environment. The arrows indicate the direction of the impact.

This chapter provides a general overview of different aspects of housing design, maintenance and operation and their impact on human health and well-being, as well as on the environment, particularly from the point of energy consumption.

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Biographical Sketches

Dr Lidia Morawska is a Professor at the School of Physical Sciences, Queensland University of Technology (QUT) in Brisbane, Australia and Director of the International Laboratory for Air Quality and Health at QUT. She conducts fundamental and applied research in the interdisciplinary field of air quality and its impact on human health and the environment with a specific focus on fine and ultra fine particles. Dr Morawska received her doctorate at the Jagiellonian University, Poland for research on radon and its progeny. Prior to joining QUT she spent a number of years in Canada working first at McMaster University in Hamilton as a Fellow of the International Atomic Energy Agency, and later at the University of Toronto. Dr Morawska is an author of over eighty journal papers, book chapters and conference papers. She has also been involved at the executive level with a number of relevant national and international professional bodies and has been acting as an adviser to the World Health Organization. She is currently the President of the International Society of the Indoor Air Quality and Climate.

Milan Jamriska is a Research Associate at the School of Physical and Chemical Sciences, Queensland University of Technology in Brisbane, currently conducting research in the area of air filtration devices. He completed his university degree at the Faculty of Physical and Nuclear Engineering, Czech Technical Universities, Prague, Czechoslovakia in 1986. During 1986-1989 he worked at the Czechoslovak Academy of Science in research on semiconductors. In 2001 he completed his PhD study 'The effect of ventilation and filtration on reduction of indoor exposure to submicrometer pollutant particles', for which he received several prestigious awards from QUT and Clean Air Society of Australia and New Zealand. He has participated in four International Conferences and is author of over 40 journal papers, book chapters and conference papers. Dr Jamriska is a member of the International Society of the Indoor Air Quality and Climate and Clean Air Society of Australia and New Zealand.