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Heat and moisture balance simulation of a building with vapor-open envelope system for subtropical regions

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Abstract

Global warming and the resource depletion induced discussions on sustainable developments within the construction sector. Also the rapid urbanization in subtropical regions is becoming one of the most important global issues. Appropriate measures must be taken in such developments to avoid further damage to the environment. In this study, the heat and moisture balance simulation of building with a sustainable building envelope system for subtropical climate was proposed. In the moisture balance simulation the moisture buffering by the interior materials was taken into account. The prediction of moisture buffer value (MBV) of the interior finishing materials was attempted and validated by measurements. Subsequently, the whole building calculation was carried out and the contribution of the moisture buffering to the indoor comfort and energy consumption was investigated. The MBVs of the mineral-based materials were predicted with high accuracy. However, that of wood-based composite was much higher than the experimental value. In order to create a more accurate model, nonlinear moisture conductance should be accounted when modeling wood-based materials. The heating and cooling demand of a test house was 9.4 kWh/m^2 and 14.5 kWh/m^2, respectively. It was concluded that the utilization of the building envelope system has a high potential to provide sustainable houses in subtropical regions. In order to enhance both energy efficiency and indoor comfort of buildings in subtropical regions, there still is a strong need to develop a holistic method to find the optimum building design considering not only moisture buffering but also all the relevant factors. The presented model will be validated by in-situ measurements in the near future.

Keywords

sustainability,
vapor-open envelope,
heat and moisture balance,
subtropical climate,
moisture buffering

Article History

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1 Introduction

Global warming and the resource depletion induced the discussions on sustainable developments. It is often said that sustainability comprises three pillars, namely ecological, economic, and social sustainability. It has been agreed that the load of the human activities to the environment must be minimized. However, the other two aspects of the sustainability are somehow intricate to assess their real benefit to the society. Nevertheless, it is certainly needed to provide solutions in any field so that substantial measures of so-called strong sustainability can be implemented for the realization of sustainable society. Among all the sectors, construction industry is one of the most important fields since it is contributing by 50% to the greenhouse gasses emission related to the global warming and by 40% to the resource consumption on the global scale (UNEP 2003). Furthermore, many of the human activities take place in the built environments indoors. This means that the comfort and health issues, which needless to say are keys for social sustainability, are also greatly related to the quality of the buildings. Therefore buildings are no doubt one of the most important factors regarding all the aspects of sustainability.

When having an overview of the sustainable construction on global scale, there have been certain developments in terms of ecological issue in countries which have rather

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