

Original Article/Research

The impact of sustainable building envelope design on building sustainability using Integrated Performance Model

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Abstract

Sustainable design is a design approach put in place to promote the environmental quality and the quality of building indoor environment by reducing negative impacts on building and the natural environment. Also, it is a design philosophy that seeks to incorporate sustainable development concept in terms of initiatives and values into sustainable building envelope design. However, the problem remains as to what constitutes sustainable development concept required for sustainable envelope design. Therefore, this paper is aimed at examining the role of sustainable development concept in sustainable envelope design by investigating the impacts of sustainable envelope design on building sustainability using Integrated Performance Model. This was validated by comparing the energy efficiency performance from selected case studies of buildings with sustainable development concept and building envelope without sustainable development concept. It is expected that the incorporation of sustainable development concept in terms of initiatives and values will enhance the energy performance of building envelope development and bring about building sustainability.

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1. Introduction

The concept of sustainable development has evolved greatly since it was introduced by Brundtland Commission in 1987 (WCED, 1987). Now it is being used for various purposes in the society by professional. In the process of this development, different meanings have been used to define sustainable development concept. In all, there is a

consensus that the environment, society and economic are the important factors for achieving sustainable development concept. Yet the concept of sustainable development is still unclear and difficult to understand. Many dimensions have been attributed to sustainable development concept and sustainable building design (Lombardi, 1999; Ding, 2005). The idea of sustainable development concept was discussed at United Nation Conference on environment and development held at Rio de Janeiro in 1992 (UNCED, 1992; Hughes, 2000). The Summit was the first international conference attended by world leaders on environmental issues to promote international cooperation for global agreements and partnerships for environmental protection (Harding, 1998). As such, numbers of important conclusions were reached at the summit and the Rio declaration where they highlighted 27 strategies

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for achieving sustainable development goal. In spite of this discussion and international deliberations, the concept of sustainable development is still complex, multi-dimensional and ambiguous to understand within the context of just environmental issues (Lombardi, 1999; Ding, 2005). There is still a challenge of defining what actually constitute sustainable development concept and values that can be used for sustainable design and assess the sustainable performance of the building envelope. Therefore, it is necessary to examine the role of sustainable development concept in sustainable envelope design by investigating the impacts of sustainable envelope design on building sustainability.

2. The role of sustainable development concept in sustainable enveloped design and building sustainability

The concept of sustainable development has been analysed in theory and application from different perspectives (Dasgupta, 2007; Tvaronavicius and Tvaronaviciene, 2008; Sobotka and Rolak, 2009). Zavadska and Antucheviciene (2006) defined sustainable development as “a set of indicators in the multi criteria analysis to include environmental, social and economic aspects of sustainability”. Burinskiene and Rudzkiene (2007) provides information dealing with economic, ecological and social components of sustainable development with analysis focusing on the aggregated indicators on air pollution variation, income, energy consumption and selected social indicators. In their analysis, there exists the recognition for sustainable development with aggregated indicators (Roome, 2001; Schaltegger and Synnestevedt, 2002; Li et al., 2009). One of the important goals of sustainable development is to reduce the impacts of building development on the environment. Burinskiene and Rudzkiene (2007) explained the association between the increase in the economic efficiency and decrease in the environmental impact. One of the key indicators that reveal economic efficiency is the amount of energy consumed for production. The previous studies confirmed the causality between energy consumption and changes in socio economic structures (Schaltegger and Synnestevedt, 2002; Rutkauskas, 2008). Also, Stefan and Drago (2011) analyse structural indicators of economic efficiency and energy intensity as determinants of sustainable development for the selected 33 European countries. This means that the goal of sustainable development can be achieved through the combination of energy efficiency and economic efficiency. Recently, the concept of sustainable development has emerged as a new framework for achieving the sustainable development goal in building development and construction industries (Ding, 2005). The concept promotes the balance of economic, social and ecological systems for any development (Ding, 2005). It is firmly established in government policies, legislation and in most private organisation environmental policies (Harding, 1998). According to Cooper (2002) sustainable refers to as “capable of being maintained indefinitely within limits while development means the pursuit of continuous

growth”. This assertion contradicts the present scenario as most developments tend to destroy sustainability. However, Ofori et al. (2000) argued that as long as development continues to take place in the society, the economic growth and environmental issues will continue to be major issues for sustainability. Besides, Boughey (2000) argued that sustainability indicates economic growth which could continue without long time damage to the natural environment or general human well-being. This viewpoint indicates that economic growth will continue to thrive while the environment will never be deprived, or used, at all. However, it is highly unlikely that this will happen as economic growth requires the consumption of environmental resources to sustain its activities. In spite of all these views, the most recognised definition for sustainable development concept came from Brundtland Commission report on the environment and development conference held at Rio de Janeiro in 1992 (UNCED, 1992; WCED, 1987). Sustainable development concept was defined as “development that meets the needs of present generations without compromising the ability of future generations to meet their needs and aspirations” (UNCED, 1992; WCED, 1987). The four aspects as emphasised in the report are to: eliminate poverty and deprivation; to conserve and enhance natural resources; to encapsulate the concept of economic growth, social as well as cultural variations into a development; and finally, to incorporate economic growth and ecology into decision making. Thus suggests that many factors are involved in achieving the sustainable development goals. HKU (2010) describes environmental sustainability as ecosystem integrity and bio diversities, economic sustainability centred on growth, development, accessibility, stability and equity, while social sustainability centred on community wellbeing. Lautso et al. (2004) emphasises the environmental sustainability, economic efficiency and social sustainability as central to comprehensive sustainable development. It means that sustainable development deals with the concepts of environment, futurity and equity, with the emphasis that the welfare of future generation must be considered in any decision making process. However, economic growth with an emphasis on aspects such as financial stability and material welfare creation is the ultimate goal to secure rising standards of living and increase the capability of providing goods and services to satisfy human needs. Furthermore, in order to achieve sustainable development, emphasis must be placed on energy and material efficiency (Dincer and Rosen, 2007). Just as the importance of efficient use of energy and resources to sustainable development and the society has been stressed (Goldemberg et al., 1988; MacRae, 1992; Dincer and Rosen, 2007). This means sustainable development does not just require that energy resources be made sustainable, but that they should be used efficiently. This shows the need to incorporate energy and resource efficiency into sustainable development of building envelope to ensure building sustainability. In spite of a different meaning ascribed to sustainable development, the concept

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