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A Review of Embodied Energy (EM) Analysis of Industrialised Building System (IBS)

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Abstract

Sustainable design and construction have become global issues. Therefore, the reduction of carbon emission has become a main focus of environmental strategies around the world. In construction industries, the extraction of materials and the erection of buildings consume embodied energy and emit carbon dioxide (CO₂) that caused negative impacts on the environment. Therefore, it is necessary to consider embodied energy and CO₂ amongst other factors in selecting building materials used in building projects. The paper presents the on-going research which aims to developed life cycle assessment (LCA) methodology for estimation of embodied energy and carbon emission in a building that used Industrialised Building System (IBS) as an innovation construction process for the Malaysian construction industry. The methodology includes calculating environmental impacts of life cycle of building production in terms of embodied energy and carbon emission. For this study, the boundary of the studies and tools had been explained to assess embodied energy and carbon emission.

Keywords: Embodied Energy, Carbon Dioxide (CO₂) Emission, Environmental Impacts, Industrialised Building System (IBS), Malaysian Construction Industry

1. Introduction

Nowadays, strategies in achieving sustainable building have become a global focus in the world. Government of many countries has attracted to take great efforts to prevent or eliminate activities that contribute to climate change due to global warming and unpredictable impacts towards the environment. Therefore, the reduction of carbon emissions has become a primary focus of environmental strategies around the world. In the UK, legislation requires all new residential buildings to be 'zero carbon' by 2016 and non-domestic by 2019. While in Malaysia, carbon emission has to be reduced by up to 40% by the year 2020. Currently, Malaysia is ranked 30th in the world for countries that have the highest amount of carbon emission. According to Nation Master Statistic [1], construction industry contributes 24% of total carbon emission. There are various ways of reducing the amount of carbon emission in the construction industry. In the context of sustainable development, building should be constructed with adequate occupant comfort, limited natural resource use and low environmental impact, seen over the entire of building life cycle [2]. The life cycle of the building includes the production of building material, construction, operation, maintenance, disassembly and waste management. All these stages have to be considered in order to minimize the life cycle primary energy usage and CO₂ emissions. In Malaysia, Industrialised Building System (IBS) is one of alternative to achieve sustainability in the country. In addition, review shows that IBS not only result in energy efficiency, but also can prevent maintenance as well as low in total cost of building construction [3].

Embodied energy and carbon emission mainly due to the extraction, processing, manufacture and transportation of the materials to construction site [2]. However, considerable efforts have concentrated largely on reducing energy used during building operation. Some of the efforts are improved with insulation, reduced air leakage through the house envelope and by heat recovery from ventilation air. These efforts result in minimizing operation energy, but increased in construction materials use and hence increased in energy demands for production [3][4][5]. According to Dixit [6], the focus of current research is on minimizing the energy use of the operation phase, while the amount of energy use of the other phases is often neglected. These imply an increase in materials use and hence increased energy demands for production [7]