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Integrating building information modelling with sustainability to design building projects at the conceptual stage

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Abstract

Lately the construction industry has become more interested in designing and constructing environmentally friendly buildings (e.g. sustainable buildings) that can provide both high performance and monetary savings. In general, sustainability integrates the following three related components: (1) environmental, (2) economic, (3) social well-being. Incorporating these components at the conceptual stage is achieved by using sustainable design, through which designers must identify associated materials and systems based on any selected certification (rating) system. The use of building information modelling (BIM) concepts helps engineers design digital models that allow owners to visualize the building before the physical implementation takes place. To apply BIM concepts, designers use tools to create 3D models of buildings where the design materials and systems are selected from the built-in database of these tools. Designers will not be able to quantify the environmental impacts of these materials to support the decisions needed to design sustainable buildings due to the following reasons: (1) a lack of information about the sustainable materials that are stored in the database, (2) a lack of interoperability between the design and analysis tools that enable full life cycle assessments (LCAs) of buildings. This paper presents a methodology that integrates BIM and LCA tools with a database for designing sustainable building projects. The methodology describes the development and implementation of a model that incorporates a database in which information about sustainable materials is stored and linked to a BIM (3D) module along with an LCA module and a certification and cost module. The goal of this model is to simplify the process of creating sustainable designs and to evaluate the environmental impacts (EI) of newly designed buildings at the conceptual stage of their life. An actual building project is presented in order to illustrate the usefulness and capabilities of the developed model.

Keywords

green buildings,
sustainability,
BIM,
LCA,
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construction cost estimating

Article History

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1 Introduction

Achieving a cost-effective building project requires the evaluation and comparison of all the costs and benefits that will occur over its anticipated economic life. In economic terms, a building design is deemed to be cost-effective if it has a lower life cycle cost, which covers its construction and operating costs. The components of a building's life cycle cost include the initial design and construction cost, ongoing operations and maintenance costs, parts replacement, disposal costs or salvage value (WBDG 2012). In order to meet the requirements of a cost-effective building design, the financial criterion of the selected materials should be taken into consideration.

Studies indicate that lately, the demand for sustainable buildings with minimal environmental impacts is increasing (Biswas et al. 2008). Notably, the construction industry today needs to adopt new technologies for building design to reduce pressures on the environment. An example of these technologies is the green building approach. Incorporating sustainable principles at the conceptual stage is attained by using sustainable design in which designers need to identify associated materials and components based on the selected green building certification system. Building information

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