ABSTRACT

Development of an Integrated Performance Model for the Assessment and Design of Sustainable Residential Building Envelope in Trinidad and Tobago

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The thesis addressed this research question: Can an integrated framework be developed to assess the sustainable performance of the building envelope and design a sustainable envelope to achieve building sustainability? Environmental concerns and the continual drive for sustainable buildings has led industries to look more closely at sustainable development and the sustainability of proposed and existing residential building envelopes. To make decisions, building designers need to predict and assess the sustainable performance of their ideas with respect to various criteria, such as comfort, aesthetics, energy, environmental impact; economics etc. However, with increased awareness and knowledge of environmental impacts, there is need to make building envelope sustainable in order to avoid adverse environmental effects. Among these is the selection of sustainable envelope design. Besides, many of the existing assessment methods charged with the task of assessing building sustainability have shortcomings such as lack of life cycle performance assessment framework for life cycle cost, life cycle energy efficiency, life cycle embodied energy, life cycle carbon emission, thermal energy, inability to connect performance value with weight, inadequate coverage of sustainability issues associating with buildings, lack of multi criteria analysis framework and lack of consideration for social issues. Hence, this research was aimed at addressing these issues in Trinidad and Tobago by developing an Integrated Performance Model for incorporating sustainable development values into the building envelope design. A survey was conducted to facilitate the incorporation of sustainable development values into building envelope design selection and consequently, a set of sustainable performance criteria were developed. The criteria developed were evaluated and aggregated into a composite sustainability index known as the Integrated Performance Index (IPI) developed from the combination of six (6) conventional evaluation techniques. The techniques include Analytical Hierarchy Process (AHP), entropy method, multi criteria analysis (MCA), life cycle cost analysis (LCCA), Life cycle assessment (LCA) and Life cycle energy analysis (LCEA). The model effectiveness was demonstrated by its application to the sustainable envelope design selection process using case studies of building envelope projects with different envelope design alternatives. The validation process was carried out by means of an experimental investigation involving three physical building envelope models focussing of material performance and experts' review through survey methodology. The findings obtained indicate that the model is effective and suitable for sustainable practice and design in Trinidad and Tobago, and the wider Caribbean region. Finally, recommendations for policy makers and areas for further research were identified.

Key words: Joseph Ayoola Iwaro, envelope, sustainable, performance, assessment and design