INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Buildings consumes large amount of energy and resources right from the inception to construction, operation, discard and disposal. Most of the energy consumed by the buildings is produced from fossil fuels which result in carbon emissions that lead to climate change. The current research is mainly in pursuit of the research question, 'What opportunities exist for improvement in the energy performance of buildings during various stages of their life cycle'.

Most studies in the past conducted energy analysis of low-rise buildings, adopted narrow system boundaries in terms of stages of building life cycle, lacked geographical representativeness, and restricted the scope of study to building portion only while ignoring the mechanical electrical and plumbing (MEP) services and site development features from the scope of their studies. This resulted in formulation of sub-optimised energy efficiency strategies. Therefore, the current study is intended to cover the identified research gaps and is aimed to carry out life cycle energy analysis of a high-rise residential building project.

The study has been conducted using the case study method of research. The selected case study is a large high-rise residential building project. Primary data has been collected as documentary evidence in terms of contract documents, facility management records and semi-structured interview. The data was analysed using quantitative analyses techniques, namely, input-output based hybrid analysis method, simple arithmetic, and input-output analysis method.

MEP and site feature sub-systems consumed from 20% to 55% of the total energy during various stages of life cycle. Hence, the influence of these non-building subsystems on energy performance of building projects can no longer be ignored. The total embodied energy of the building project including recurring embodied energy is found to be nearly 32% of the life cycle energy, with operating energy accounting for the balance 68%. Therefore, approaches to minimise the life cycle energy will have to consider both embodied energy as well as operating energy, unlike past studies which primarily focused on improving the operational energy efficiency of buildings.

The findings of the study emphasise the need to consider all the stages of the life cycle and all components of a building project in the system boundary when conducting the life cycle energy analysis. Findings also seek policy initiatives to mandate the provision of environmental product declarations (EPDs) by the manufacturing industry and the establishment of an institutionalised framework for data capture and data sharing on construction projects. The study concludes while recommending several strategies for improvement in energy performance during various stages of the building project life cycle. Additionally, the study suggests a few areas for further research.