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Environmental Impact of a New-Build Educational Building in England: Life-Cycle Assessment as a Method to Calculate Whole Life Carbon Emissions

Authors : Monkiz Khasreen

Abstract : In the context of the global trend towards reducing new buildings carbon footprint, the design team is required to make early decisions that have a major influence on embodied and operational carbon. Sustainability strategies should be clear during early stages of building design process, as changes made later can be extremely costly. Life-Cycle Assessment (LCA) could be used as the vehicle to carry other tools and processes towards achieving the requested improvement. Although LCA is the 'golden standard' to evaluate buildings from 'cradle to grave', lack of details available on the concept design makes LCA very difficult, if not impossible, to be used as an estimation tool at early stages. Issues related to transparency and accessibility of information in the building industry are affecting the credibility of LCA studies. A verified database derived from LCA case studies is required to be accessible to researchers, design professionals, and decision makers in order to offer guidance on specific areas of significant impact. This database could be the build-up of data from multiple sources within a pool of research held in this context. One of the most important factors that affects the reliability of such data is the temporal factor as building materials, components, and systems are rapidly changing with the advancement of technology making production more efficient and less environmentally harmful. Recent LCA studies on different building functions, types, and structures are always needed to update databases derived from research and to form case bases for comparison studies. There is also a need to make these studies transparent and accessible to designers. The work in this paper sets out to address this need. This paper also presents life-cycle case study of a new-build educational building in England. The building utilised very current construction methods and technologies and is rated as BREEAM excellent. Carbon emissions of different life-cycle stages and different building materials and components were modelled. Scenario and sensitivity analyses were used to estimate the future of new educational buildings in England. The study attempts to form an indicator during the early design stages of similar buildings. Carbon dioxide emissions of this case study building, when normalised according to floor area, lie towards the lower end of the range of worldwide data reported in the literature. Sensitivity analysis shows that life cycle assessment results are highly sensitive to future assumptions made at the design stage, such as future changes in electricity generation structure over time, refurbishment processes and recycling. The analyses also prove that large savings in carbon dioxide emissions can result from very small changes at the design stage.

Keywords : architecture, building, carbon dioxide, construction, educational buildings, England, environmental impact, life-cycle assessment
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