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Low Embodied Carbon Buildings: Design Decisions and the role of LCA

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Introduction

Decisions taken as early as during the design of buildings are a factor of vital importance in shaping their carbon impact throughout their whole life cycle. A growing amount of literature has dealt with the significance of the building design process, either by highlighting its influence in the overall building induced carbon impacts or by pointing out the most important stages and decision makers. However, little is known about what happens in practice, within the real-world context and how decisions are actually taken, or even how environmental impacts are considered.

Objective

This work aims to shed light on what is being done in practice, how decisions are actually taken and how carbon impacts are considered during the building design within its unexplored real-world context. Moreover, it seeks to understand the various socio-technical influences that affect and guide the environmental decisions of the stakeholders and their effect on the whole life carbon implications of the building.

Methodology

Mixed methods research approach to understand what happens within the real-life context of the building design process within various locations and cultures in Europe. (Sweden, Cyprus, UK)

Case studies:
- of affordable housing: using documentary analysis and interviews
- Seeking to identify:
  - most important decisions in terms of carbon reduction
  - stages that are taken and why
  - key decision-makers and their influences

Role of LCA

BIM and LCA tools:
- quantify the impact of decisions and various influences.

The life cycle carbon and energy impacts of buildings are subjected to several social and technical influences of the design team.

Whole life impacts are shaped outside or at the early stages of the building design.

Themes identified

Importance of:
- Artifacts
- Legislation and regulations
- Contextual Requirements, Local and National plans
- Long term Strategy and Policy, Political decisions
- Personal profile of stakeholders
- Consciousness and motivation of decision-makers
- Team-Working

Lack of:
- Knowledge
- Experience
- Clear guidance
- Legislation and initiatives on whole life carbon reduction

Discussion

This research deals with the reduction of carbon and energy of buildings and their management during their design and in particular the reduction of the whole life carbon and energy.

Interdisciplinarity: focus, approach and methods, present in most elements of the work;

Socio-technical approach => look at the research questions from different perspectives.

Qualitative and quantitative methods:
- Focus of the study => involvement of various disciplines of engineering, i.e. civil, architecture, materials, mechanical.
- Sociological lens => to look at and interpret the data.
- Research => directly related to the real world settings and practices; using case studies to understand phenomena within their real world context. Looks through social sciences to understand what happens in practice which is main gap in our knowledge. Moreover, results will be used to understand how to change the way buildings are designed and potentially where, how and when to introduce an LCA or another sustainability assessment tool for which previous research only looked at the technical barriers and limitations.

The research is part of the IEA EBC Annex 72 project: Assessing Life Cycle Related Environmental Impacts Caused by Buildings. Relevance to Generation 2050 manifesto of future energy.

Professionals: looks at how to change the standard practice and behaviour of the construction industry towards considering and reducing environmental impacts of buildings, not only in terms of operational energy demand, but also from materials and other operations, ie; evaluate and reduce whole life impacts.

Limited improvements have been observed in the reduction of the embodied impacts (ie those from materials including prior to and during use on site for construction and any future maintenance or the decommissioning of the project) => often neglected, or limited opportunities to decrease it is thought that the most common way of measuring embodied impacts is through Life Cycle Assessment (LCA).

Gaining knowledge from various European cultural contexts, look at the impact of culture and role of guidance and regulations.