

Technical University of Denmark



Sustainability Gains from combining LCA and Parametric Design in Early Design Phases of Structural Design

Collin, Christine; Jensen, Lotte Bjerregaard

Publication date:
2017

Document Version
Early version, also known as pre-print

[Link back to DTU Orbit](#)

Citation (APA):

Collin, C., & Jensen, L. B. (2017). Sustainability Gains from combining LCA and Parametric Design in Early Design Phases of Structural Design. Paper presented at IASS 2017, Hamburg, Germany.

DTU Library
Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Christine Collin, Lotte M.B. Jensen

Technical University of Denmark

Sustainability Gains from combining LCA and Parametric Design in Early Design Phases of Structural Design

The quest for achieving a sustainable building design has for decades focused on Integrated Energy Design (IED/INTEND) – a design method developed to reduce the energy consumption for operating buildings. UN had calculated that up to 40% of the energy consumption in industrialized countries was used for operating buildings. By having a highly informed design process from the start the major part of the reduction could derive from careful planning of geometry, facades design and orientation according to the specific location. These design decisions are typically made during the early design phases and it is thus important to inform these with the highest possible level of technical scientific knowledge. Later design phases will focus on the low-energy systems and lastly energy-producing units could be added to the building. However, research shows that the early design phases have the largest impact on the sustainability profile of a building.

The IED method has been widely implemented in the industry and has along with legislation and sustainability certification systems made the 'low-energy building' mainstream. This state leaves space for looking towards the next level of sustainability which is to base early design decision on accurate LCA (Life Cycle Assessment) calculations. The early design phase involves decisions concerning the basic structural concept and in connection to this the choice of construction material. The study at hand explores how much sustainability can be gained in terms of reduced CO₂ emission by informing the early design decisions concerning the basic structural system with an LCA perspective. Parametric design tools (Rhino Grasshopper & Karamba) is combined with information from LCA software. The case study is a design of an Art Museum in Northern Sweden by Finish architects OOPEAA. The hypothesis of the study was that parametric design could be used for choosing an optimal structural concept and building material, which would pose a 'low-hanging-fruit' in terms of reducing CO₂ emission, by simply using less structural material. Variations of the static system of the museum was studied in terms of structural concepts and choice of material, the variations were evaluated in an LCA perspective. The results indicated that adding more focus to the design of the basic structural concept and choice of structural material and informing these choices by LCA, increased the overall sustainability of the building.