Zukunft Bau

ABSTRACT

Design2Eco

Extended Title: “Life Cycle Considerations in the design process of office and administration buildings: basis for decisions and optimization potential for early planning phases”

Initial situation

The decisions that have the greatest influence on the sustainability of buildings are taken in the early design phases of buildings. However, at this stage information about the building’s economic and ecological quality for its entire life cycle is not integrated in the design process. Therefore a simple system to estimate environmental impacts and costs simultaneously throughout the life cycle of buildings is developed to support decisions.

Topic of the research project

As a first step, the framework conditions and system boundaries are defined to harmonize the calculation of the Life Cycle Assessment (LCA) and Life Cycle Costs (LCC) as far as possible. Based on research and own calculations the indicators global warming potential (GWP), consumption of non-renewable primary energy (PENRT), and acidification potential (AP) are chosen as leading indicators and compared to the results of the LCC in Euro. Five completed sample projects of the project partner ATP sustain GmbH are chosen which fulfil at least the energy performance standard EnEV 2009 (energy saving ordinance) and are comparable in construction and usage. For these projects detailed life cycle assessments and life cycle costing were performed. Both LCA and LCC are categorized into cost groups (German: “Kostengruppen” (KG), following DIN 276) and into functional units (structure, interior fit-out, façade etc.). The most influential factors are derived from these calculations and identified as “strategic parameters”.
To further analyze the importance of the calculation framework, the overall results are calculated for a variation of parameters. For this purpose for example the length of the considered life cycle period is varied and an additional scenario for the exchange of interior fit-out is considered. Furthermore the building services (KG 400) are calculated in detail. Thereby it was determined, that the KG 400 can add more than 20% to the environmental impacts of the construction (KG 300). Also the importance of energy generating systems and the composition of different building components was considered.
Amongst the functional units the building’s structure is found to be the most significant part for the life cycle assessment whereas the interior fit-out with its costs for cleaning and exchanging materials has the highest impact on life cycle costs.
Following this analysis, a methodology for early planning phases is developed, which allows a comparison of various options. The results of LCA and LCC calculations for a small number of building parts is multiplied with their respective total area to forecast the results of detailed calculations. This forecast method is validated using the detailed calculations of the five sample objects. Subsequently, the method is applied to a sample building which is currently being designed. Summarizing the results from the previous analyses, simplified recommendations for early design phases are developed dependent on strategic building characteristics.

Conclusion

The case study shows that through the choice of appropriate building components 22% of the global warming potential of the construction can be saved without additional life cycle cost for the building. Generally, the choice of energy supply and energy performance standard, the choice of materials for the building’s structure, and of the concept of the interior fit-out have the greatest influence on the overall economic and ecological performance.
Further research is required on the evaluation of the end of life phase of buildings both for LCC and LCA. A significant lack of data for the building’s MEP and HVAC systems’ economic and ecological performance and hence for the building operation is identified.

Key Data

Short title: Design2Eco: Life Cycle Considerations as basis for decisions in early planning phases

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Total costs: 150.946,06 € €

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Project duration: 18 Months

IMAGES/ILLUSTRATIONS:

5 - 7 Druckbare Bilddaten als eigene Datei (*.tif, *.bmp, ...) mit der Auflösung von mind. 300 dpi in der Abbildungsgröße (z.B. Breite 10 - 20cm). Bilder frei von Rechten Dritter.
Bildnachweis jeweils: (alle Bilder sind eigene Darstellungen der Autoren)
Bild 1: Titelbild_neu.png
Simplified systematics for life cycle assessment and life cycle cost of buildings
Bild 2: 181022_Funktionale Kategorien.png
Correlation cost groups – functional units
Bild 3: Zahnräder.png
Mutual influence and dependencies of generic project parameters
Bild 4: 181123_Einflussfaktoren_LCC.png
Strategic parameters life cycle costs (LCC) – illustration of project results
Bild 5: 181123_Einflussfaktoren_GWP.png
Strategic parameters global warming potential (GWP) – illustration of project results
Bild 6: 2018-11-28_Konstruktion-Strategie.png
Strategy for optimization of LCA and LCC for the construction
Bild 7: 2018-09-26_Versorgung-Strategie.png
Strategy for optimization of LCA and LCC for the life cycle phase B6 (building operation)