Assessment and Simulation Methods for Green Building Planning

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1 ABSTRACT

Steering measures of the future will be based on life-cycle analysis. It is expected to experience a similar effect as currently seen by Energy Performance Certificates. The introduction of the Energy Performance Certificate led to a significant improved energy efficiency of new buildings during the past years. These improvements were not exclusively driven by using more insulation material, but also by better planning (compacter shapes) and more efficient materials and technical equipment.

The European wide research in the area of LCA uses different methods, whereby the comparability, which is mandatory for steering measures, is affected. At the moment no environmental evaluation system is available that enables LCA in an efficient way in the planning phase of buildings.

Today a concept for a simple creation of an integral LCA of a building using standardized interface to existing data sources is missing. This LCA should be applicable during the different stages of the planning process (application, lodgement and tendering). This enables the consideration of LCA-aspects during early planning stages already.

The concept should be aligned with stakeholders to achieve an Austrian-wide homogeneous incorporation of this LCA-concept in funding guidelines and regulation of construction and renovation buildings.

To improve the planning process and to ensure the comparability of the LCA-results, a standardised interface to existing data structures has to be elaborated. Thereby the effort for creating LCAs is reduced and simulation of different variants is facilitated. This improves the possibilities for building optimization during the planning process.

Current LCA assessments provide several indicators, which can only be correctly interpreted by experts. Based on existing assessment concepts, standards (e.g. CEN TC 350) and stakeholder's expectations, a proposal of a uniform set of indicators shall be defined. The quality of the decision process will be boosted by an interpretation guideline, which helps the planner and decision maker defining the essential indicators.

Another sector, which is faced with huge amount of data and several participants of the planning process, is the automotive sector, which already provides an established system for data management and LCA. The acquired knowledge creating LCAs in this sector shall be analyzed and transferred to the concept.

During the preparation of data for the LCA-approach, the available LCA-data for materials and production processes shall be evaluated according to the method, data quality, level of transparency and the up-to-dateness. Appropriate to the system boundaries, the consumption during the usages phase of the building shall be broken down and aligned using sampled data from already existing buildings.

2 LIFE CYCLE ASSESSMENT IN THE BUILDING AREA

In the early 90ies standards for life cycle assessment (LCA) were developed with the aim to describe and analyse the environmental impact of products, processes and companies in a standardised way. Because of the complexity of buildings it was impossible to do a LCA according to the standards and so the evaluation of buildings was done with criteria and points using check lists. A few years later research results in the area of LCA of buildings were presented, and gave the hope that LCA could be used in practical application.[1, 2]. Today LCA of buildings is increasingly establishing as tool and getting a fix component in the standardisation of sustainable buildings. [3]

By now several buildings evaluation systems have been developed worldwide. These systems are using some aspects of LCA like the consideration of life cycle stages „Cradle to Grave" or „Cradle to Cradle", but because of the complexity of buildings they are following a streamlined approach. Also, this is the case in Austria, where the environmental evaluation tools use a streamlined approach by focusing just on single life

cycle stages or include just specific parts of a building or only specific impact categories like global warming potential.

2.1 Currently State of Development and Existing Problems

In Austria, among other systems the building evaluation system Total Quality (TQ) was developed. Since 2003 the pilot phase was finished and the service for evaluation and certification was offered in Austria. Like in other countries, this evaluation system is constantly improved in line with new requirements and knowledge. In 2008 the system was revised and renamed in Total Quality Building (TQB). Based on the work of TQ the development of the klima:active standard started in 2005. This building standard was available in 2008 for both, residential building and office building. Within the framework of klima:active the main focus is on reducing the emissions of CO2 and on the supply of a comfortable indoor environment.

In April 2008 the organisation Sustainable Building Alliance (SB Alliance) registered in Paris was established. The executive board consists of Alain Maugard (President CSTB , France), Dr. Martin Wyatt (BRE Group, UK) and José Joaquim do Amaral Ferreira (FCAV, Brasil). Dr. Eva Schminke (DGNB, Germany) has a status as observer. The Aim is to bundle the activities in the area of building evaluation and promote the use and development of collective standards, even with the problem of national specifications. The environmental evaluation systems implemented in Austria to reduce the CO2 emissions are using a streamlined LCA approach. This streamlined approach focuses on selected life cycle stages (e.g. the use phase) or evaluates some aspects just in a qualitative way.

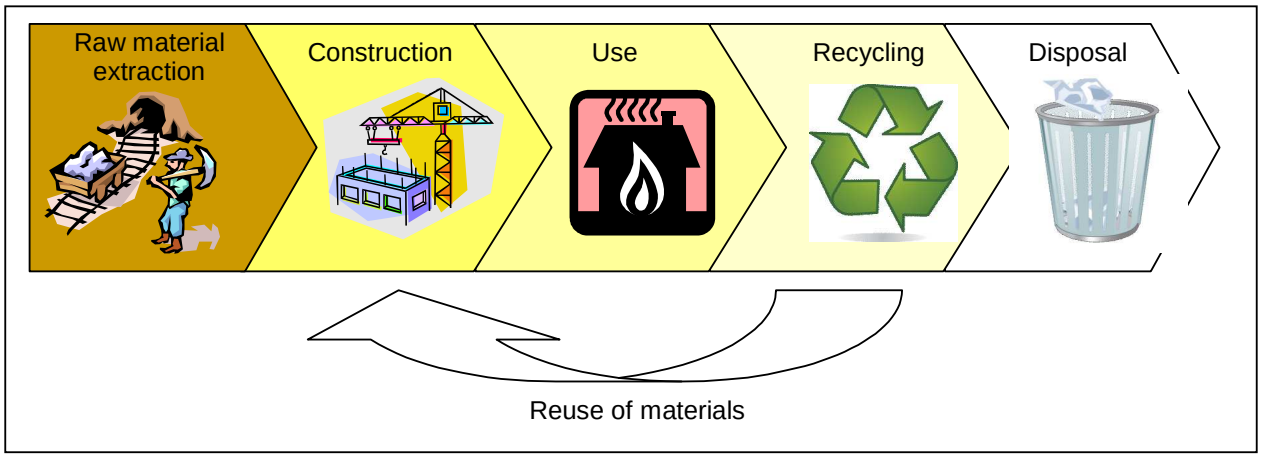

Fig. 1: Life cycle stages of a building

LCA considering all life cycle stages (see fig. 1) has the advantage that all emissions beginning with raw material extraction and construction and ending with the disposal are considered. Funding guidelines that implement the results of such a LCA in the planning phase do not have just the effect, that the CO2 emissions are reduced. Also resource management will benefit, because recycling relevant criteria supporting a higher material reuse will be already considered in the planning phase. This results in a further improvement of climate aims of the Kyoto protocol, because of further reductions of CO2 that can be reached by the use of resource efficient materials.

Due to the complexity of buildings a total LCA was not considered in the funding guidelines up to now.

2.2 Solution

To enable the use of LCA as tool in daily life it is necessary to combine the already developed methods and data with the existing data systems in the planning phase.

In the meantime the basis for doing an extensive LCA of a building is available because of different research and standardisation initiatives of the last years. This basis can be used in daily use approach. Therefore the following steps are required:

- Harmonising methodologies for life cycle assessments
- LCA/LCC data for building materials and building processes
- Guidelines for Interpretation

- Data exchange among trades

This results in a LCA concept that enables to manage the complexity of data of buildings and makes LCA available in a easy way in the planning phase for architects and decision makers. This is the basis for a nationwide development of directives for the awarding of funding for the construction and restoration of buildings.

2.2.1 Harmonising Methodologies for Life Cycle Assessments

Current methodology for the calculation of the IBO list of ecological generic data for building materials have to be adjusted to the new standards of CEN TC 350 if required. A detailed documentation of the new methodology has to be written. In the future this shall assure that LCA can be done by different companies in the same way and warrants a fast grow of the LCA database. A further step to reproducible results is the definition of possible options like assumptions in the use or end of life phase.

2.2.2 LCA data for building materials and building processes

LCA data for building materials and building processes have to be updated, harmonised, and collected. The collection comprises:

- LCIA data for the production of building materials and of materials for building services
- LCIA data for the service life of building materials and of materials for building services
- LCIA data for transport, building, and deconstruction processes
- LCIA data for building waste management processes

2.2.3 Guide for Interpretation

The results of a state of the art LCA can just be interpreted with expert knowledge. A guide for interpretation has to be written to support designers and decision makers in determining the relevant indicators for LCA/LCC assessments.

2.2.4 Data Exchange Among Trades

To accomplish data exchange across different trades an interface for LCA data have to be proposed. This can be based on existing data interfaces like the IFC interface [4] or new development. This format should contain ecological and economical data along with technical data.

3 OUTLOOK

The approach shown in point 2 was the basis for a tender in the founding line “Haus der Zukunft plus” (Austrian Federal Ministry for Transport, Innovation and Technology). This tender was done in cooperation with IBO – Oesterreichisches Institut für Baubiologie und -oekologie, AEA – Austrian Energy Agency and POS – Sustainable Architects. The publication of the evaluation result is expected in June 2010. If the evaluation is positive it is planned to test the data exchange in a pilot project starting in 2011.

4 REFERENCES

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