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USE OF LIFE CYCLE THINKING FOR ENVIRONMENTAL IMPACT ASSESSMENT OF BUILDING MATERIALS: NEW DEVELOPMENTS IN THE LEED CERTIFICATION SYSTEM

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ABSTRACT

The present paper reports on the state of the art of Life Cycle Assessment (LCA) as a tool for the assessment of building components and analyzes its application in the environmental certification system of buildings LEED. We considered the LEED version 3 for New Constructions and Major Renovations compared to the new principles approached in the LEED for Building Design and Construction version 4, to be released in 2013. A summary table was built as well as a discussion on the environmental assessment methods used by these certification systems. The analysis revealed that the version 3 uses exclusively the assessment by the recognition of product attributes, such as cost, durability, renewability and recycled content, while the new version already shows some approaches based in life cycle thinking.

INTRODUCTION

To a better assessment of the overall impact of a building during its lifetime, a life cycle assessment of the building and its materials and components has proved to be a valuable tool (Verbeeck and Hens, 2010). The life cycle of a building comprises the production of building materials, building construction, operation, maintenance, disassembly and waste management (Gustavsson and Joelsson, 2010), thus the LCA methodology is an important part of the environmental assessment methods of buildings.

Earlier studies of Erlandsson and Borg (2003) Haapio and Viitaniemi (2008) and Nibel et al. (2005) have discussed the LCA methodology for buildings, but there are still lacks regarding environmental indicators, complexity of LCA studies communication for users, assumptions, simplifications and adaptations for various purposes (Bribián et al., 2009).

Concerning the environmental assessment of building materials - within the main building environmental certification systems - the recognition of product attributes, such as cost, durability, renewability, and recycled content still prevails. Such approach deals with attributes alone, even if they are mostly in conflict and interfere with each other (Silva, 2007). Thus the attributes approach lacks an overview of the overall impact of a product.

This paper reports on the evolution of lifecycle thinking application from the LEED version 3 building environmental assessment certification system (USGBC, 2009) to version 4 (USGBC, 2012), to be launched in 2013.

METHODS

The purpose of this study is to build a summary and a discussion on the methods used by LEED certification systems versions 3 and 4 for the environmental assessment of building components through data collected from the literature review, focused in the evolution of their strategies of application of LCA methodology.

The LEED version 3 for New Constructions and Major Renovations will be compared to the new principles approached in the LEED for Building Design and Construction version 4, to be released in 2013.

RESULTS AND DISCUSSION

In the LEED version 3 certification system, all the credits related to the issue addressed in this study apply the attributes evaluation.

The first, "Materials with recycled content", evaluates the use of materials so that the sum of the pre-consumer and post-consumer recycled content constitutes 10-20% of the material, whose score varies according to the achieved percentage.

The credit "Regional materials" assess if the distance from the extraction site and production plant is shorter than 500 miles from the construction site for at least 10-20% of the materials.

In the evaluation of "Rapidly renewable materials", the objective is to use products with rapidly renewable main raw materials (products of vegetal origin, with renovation cycles of less than 10 years) for at least 2.5% of the total cost of materials and building systems.

The use of certified wood is also evaluated in at least 50% of the wooden systems.

There are also some credits concerning the evaluation of building materials comprised in the Indoor Environmental Quality category. Some of them, which also use the attributes method, regard the VOC (volatile organic compounds) emissions from materials, such as adhesives and sealants, paints and coatings and flooring systems.

In the LEED version 4 all these credits comprised in the Indoor Environmental Quality category which use the attributes method regarding the VOC emissions from materials were fused in one single credit called “Low-emitting interiors”.

Although the aggregation of various credits into a single one related to VOC emissions seem like a simplification, further observation of their requirements leads to the conclusion that such a unified credit remains applying the same evaluative criteria present in the previous version.

Despite such credits within the Indoor Environmental Quality category, described above, all other credits regarding evaluation of construction materials and components in LEED version

4 are placed in the Materials and Resources category, and all of them have an intrinsic life cycle thinking concept.

The most embracing credit under such point of view is "Building Life-Cycle Impact Reduction", which proposes the implementation of a comprehensive LCA study in the whole building for new constructions that are not reusing any existing building. Such credit is already consolidated in the rating system to be launched in 2013 and it is not open to any public comments anymore.

Still there is one concern regarding such credit which is not a prerequisite and thus, not obligatory. For this reason it will still be possible to the user to drop such credit choosing to attend easier scoring ones. This issue can be pointed as a weakness of the system, once, due to its complexity, there is a clear tendency of users for skipping LCA based assessment. In any way, the optional presence of an LCA credit in the rating system will allow an empirical evaluation of real user behaviour facing the possibility of application of LCA.

Finally all other credits concerning environmental assessment of materials and components are comprised in the broader subject "Building product disclosure and optimization", and are divided in "Environmental Product Declarations", "Sourcing of raw materials" and "Material ingredients". Despite the fact that such credits assess some specific product attributes, they do so through the application of LCA and Life Cycle Thinking, seeking a holistic approach of the impacts associated with these attributes.

At this point an especial attention should be given to the "Environmental Product Declarations" (EPD) application. There is an effort in several countries of the world on the proliferation of EPD of various industrial products, including the construction intended ones. The EPD is based on the LCA of such products pointing to potential environmental impacts which require more attention in a region/country. The encouragement of the use of the EPD within certification systems of buildings do not only imply a legitimate form of quantitative environmental assessment, but also stimulate the realization of EPD by major industries involved in the production of building materials and components.

CONCLUSIONS

Many changes have been applied to the LEED version 3 rating system in its transformation into version 4. Most of them regard the inclusion of full sustainability issues and regional assessment criteria.

Regarding the environmental assessment of construction materials changes also have been identified regarding the application of LCA methodology. The overall analysis has revealed that the version 3 uses exclusively the assessment of building materials by the recognition of product attributes, such as durability, renewability and recycled content, while the version 4 already shows some new approaches based in life cycle thinking and even an optional credit for the implementation of a full LCA of new constructions.

At this point it is important to stress that the weakness of the attributes approach lies in the fact that these attributes are treated in isolation and lack the whole concept of impact. In the

other hand the life cycle thinking promotes a more integrated evaluation, assessing such materials holistically throughout their life cycle.

Thus it is already possible to conclude that the LEED version 4 rating system will have a significantly better assessment methodology regarding the implementation of life cycle assessment in material-related evaluative credits. It is also important to highlight that such implementation is still probative and optional, and may be considered as a first step towards a more complete and holistic building environmental assessment rating system.

The evaluation of the methods used to apply the LCA within LEED may contribute to the understanding of how to replicate it in other rating systems, and must be the subject of further research.

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