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Collaboration between Energy4Living and UHasselt

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The collaboration between Energy4Living (E4L) and the LCA and LCC for Circular Buildings PhD project aims to improve the design of circular buildings by assessing the impact of circular design on life cycle assessment (LCA). Energy4Living is a company that focuses on the design of circular and energy efficient buildings, while we have expertize in LCA for buildings. The collaboration is a perfect match that can bring significant benefits to both parties.

The concept of circular design aims to create buildings that are environmentally sustainable, socially responsible, and economically feasible. Circular design encourages the use of renewable materials, minimal waste generation, and recyclability. However, the impact of circular design on the overall LCA of a building is not yet well understood. During the PhD project we will assess the impact of circular design on the environmental performance of buildings.

The collaboration will be a two-way learning experience. Energy4Living will benefit from the LCA PhD student's expertise in analyzing the environmental performance of buildings. While we will learn about circular design principles and how they can be applied to buildings. The collaboration will help both parties gain a deeper understanding of the interplay between circular design and LCA and provide valuable insights into designing more sustainable buildings.

Life cycle assessment (LCA) for buildings is becoming increasingly important, particularly in the European Union where several countries have introduced legislation that mandates a carbon budget for buildings. Norway, Sweden, the Netherlands, Denmark, and France are among the countries that have taken steps to limit the environmental impact of buildings. In addition, the European Union has been pushing for the inclusion of LCA as a mandatory criterion in public procurement for buildings. These developments highlight the importance of LCA in the design and construction of sustainable buildings.

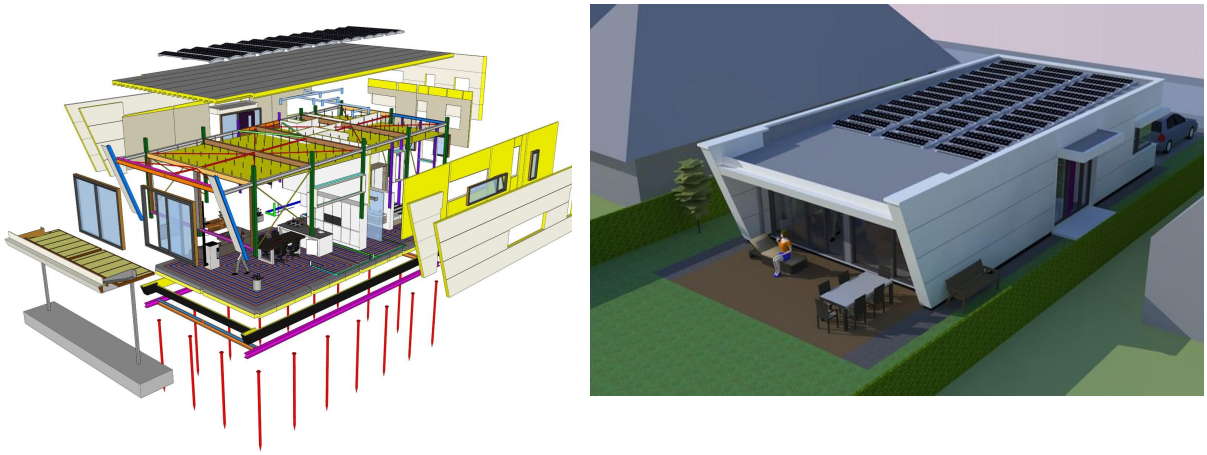

Figure 1: Case study BIM model

The collaboration will involve several stages. First, we worked with Energy4Living to identify the key circular design principles used in the design of buildings. Second, we performed a detailed analysis of the impact of circular design on the environmental performance of buildings using the LCA methodology. The analysis will consider a range of environmental indicators, such as carbon footprint, water use, and waste generation. Third, we will work with Energy4Living to identify opportunities for further improving the environmental performance of the building through circular design. Finally, the results of the analysis will be disseminated to the broader research community through peer-reviewed publications and conference presentations. The first paper resulting from this collaboration is in its final rounds of revisions and will present a novel method for accounting for design-for-disassembly metrics in building-level LCA.

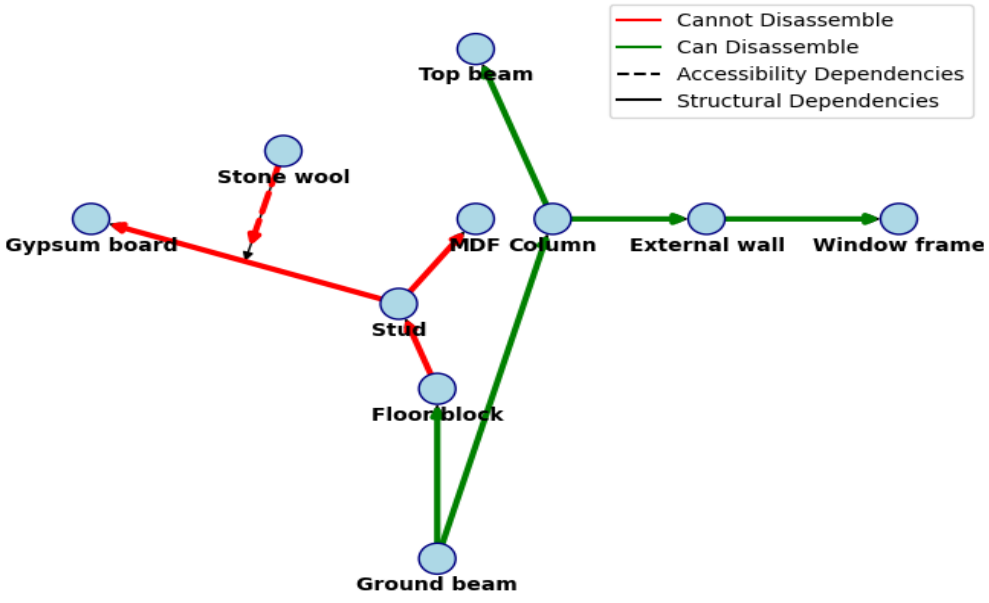

Figure 2: Dependency Analysis

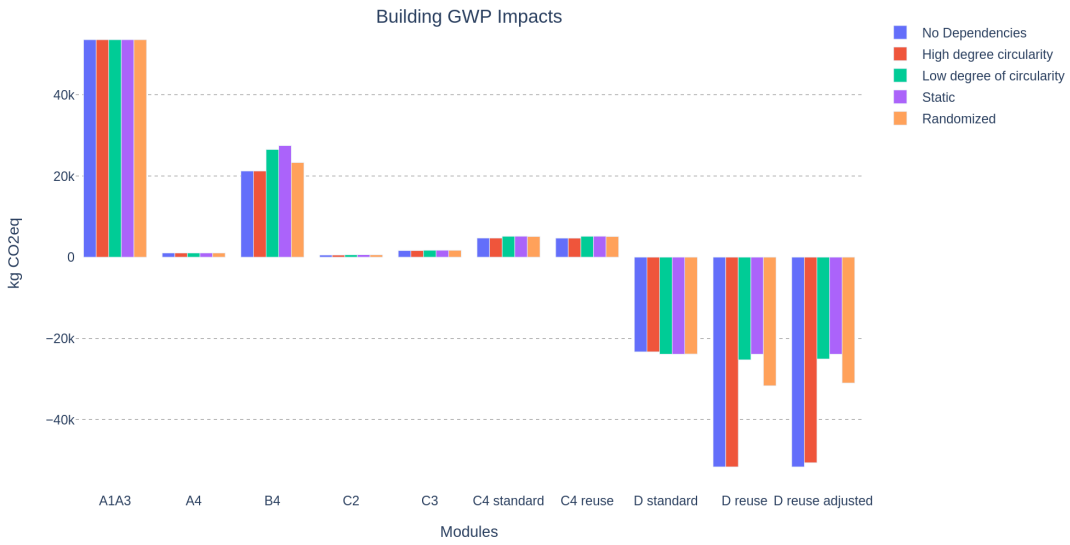

Figure 3: LCA results

We have analyzed one case study of a single family house in the Netherlands (Figure 1) in order to optimize future designs. We first conduct a circularity assessment (Figure 2) were we analyze the building's system as a whole, we investigated which connections can be disassembled and which ones cannot. We then conduct the LCA based on the results of the circularity assessment. In figure 3 we can see the impact different design alternatives have of the amount of kg CO2eq produced from the production of materials. The benefit of circular design is at the end of life of the buildings. This circular design can results in up to 55% of reductions in kg COeq at end of life and 13% reduction during the use phase.

Further research is needed to conclude which design alternative leads to the best results, Figure 4 shows the uncertainty in the LCA results. However, in the category of kg CO2eq we can say with a high degree of confidence that circular design practices lead to better overall results. Future studies will combine LCA with LCC to investigate the optimal design based on LCA and economic feasibility.

Furthermore, the PhD project is part of a Marie Curie-funded project called SAPIENS, which is supported by the European Union's Horizon 2020 program. SAPIENS focuses on sustainable public procurement and aims to promote the integration of sustainability into public procurement practices. Involvement in this project provides an additional dimension to the collaboration with Energy4Living, as it enables the project to leverage insights from both sustainable procurement and circular design perspectives, further enhancing the project's overall impact.

In conclusion, the collaboration between Energy 4 Living will bring significant benefits to both parties. Energy4Living will gain a deeper understanding of the impact of circular design on the environmental performance of buildings The collaboration will provide valuable insights into designing more sustainable buildings and will contribute to the broader research community's knowledge of circular design and LCA.