Assessment of the circularity and carbon neutrality of an office building: The case of ’t Centrum in Westerlo, Belgium

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Abstract. Circular building design is a concept that is gaining great interest from architects, construction professionals, and their clients but is still rarely adopted in practice. One of the earliest design decisions architects and developers should make to design a circular building is to determine the building’s construction system. The choice of constructive and structural systems, such as columns, beams, and slabs, is crucial to upgrade the reuse cycles in the future. Flexible construction systems can make it easier to dismantle the structures and recover, upgrade, modify, or transform building materials. Therefore, this paper assesses the carbon emission impacts of two construction systems for an office building in Belgium using life cycle assessment (LCA) and circularity criteria. One-Click LCA software was used for the calculations. Parametric analysis took place for two construction systems scenarios involving a steel structure and a timber structure. Life Cycle Assessment and comparisons of the various construction systems are made based on ISO 14040, 14044, and CEN/TC 350 standards with a focus on carbon neutrality. The results show that using local plant-based materials such as wood can drastically reduce office buildings’ carbon footprint. Based on the sensitivity analysis results, the overall global warming potential impact is mostly sensitive to the construction material’s weight and reuse and dismantling ability. This paper provides a better understanding of building structural systems; to inform architects about the circularity potential of different construction systems.