Green Building Design Strategy for a house in Phnom Penh from Life Cycle Assessment

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KEYWORDS — architecture, residential housing, sustainable building, environmental impacts, carbon footprint, affordable housing design.

SUMMARY — Environmentally, buildings account for 40% of global energy use and 33% of greenhouse gas emissions. Many researchers have introduced green technologies to minimize the environmental impact of the building sector and promote green building design. Life cycle assessment (LCA) of buildings is one of the innovative methodologies, which estimates the carbon footprint and environmental impacts generated by a building throughout its whole life cycle.

The innovation of this research is the application of LCA to a case study in Phnom Penh, Cambodia, a hot and humid tropical climate. The chosen case is a very common, most constructed and affordable typology of a townhouse. It is built with reinforced concrete frames and brick masonry walls without insulation. Moreover, LCA is used to define new strategies for green building design in South-East Asia, thanks to the modeling of different scenarios and the assessment of their local environmental impacts. Building carbon and environmental footprints have been modeled in SimaPro software using global Ecoinvent 3 databases, while respecting the standardized international LCA framework. Four scenarios have been implemented and studied on the case study: removing unnecessary materials, replacing existing materials with low carbon ones, using lightweight structure, and applying renewable energy.

The results show that the energy consumptions during the use phase generate the highest influence on the carbon footprint and environmental impacts of the studied house. All the proposed solutions contribute in reducing the global environmental footprint, but generate in some cases an increase of a specific environmental impact category. The strategy defined by combining the four studied scenarios led to about 40% reduction in carbon footprint and 34% decrease in overall environmental footprint compared to the existing house. The defined solutions can be used for future renovation, refurbishment, and design of new houses in Cambodia. The used methodology and types of green design solutions should be useful in all countries of South-East Asia.

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