Carbon Emissions Comparison of Reinforced Concrete and Lightweight Steel Framed Structures from a Whole Life-Cycle Perspective: A Case Study of Cafeteria and Production Plant

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Abstract : With the issue of climate warming attracting much concern on a global scale, the potential of the construction industry in sustainable development and reducing carbon emissions is being tapped, gradually becoming a significant force in driving the development of a green economy. In this study, two specific cases, the cafeteria, and the production workshop, are selected as the research objects, utilizing the DongHe Building Carbon Emission Calculation and Analysis Software to compare carbon emissions from reinforced concrete frame structures and lightweight steel frame structures over their entire life cycles. Life cycle assessment (LCA) is adopted as the cornerstone of the study, which helps to carry out systematic research; meanwhile, the method of carbon emission factors is combined to quantitatively analyze the differences in carbon emissions between the two. The findings indicate that carbon emissions of reinforced concrete frame buildings (life-cycle carbon emissions of $3719.08 kgCO_2e/m^2$) are 17.56% higher than those of lightweight steel frame buildings (life-cycle carbon emissions of $2694.93 kgCO_2e/m^2$) in the phase of production of building materials to demolition, and 46.43% higher in the phase of operation of the building. The difference in the former's carbon emissions is mostly attributed to the intrinsic differences between the two building structural frameworks, while the latter is mainly influenced by the differences in energy consumption patterns due to the different uses of the building. The study provides empirical evidence for building design and takes an active part in pushing the construction industry's transition to a low-carbon and sustainable direction.

Keywords : construction industry, life-cycle carbon emissions, lightweight steel frame, reinforced concrete

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