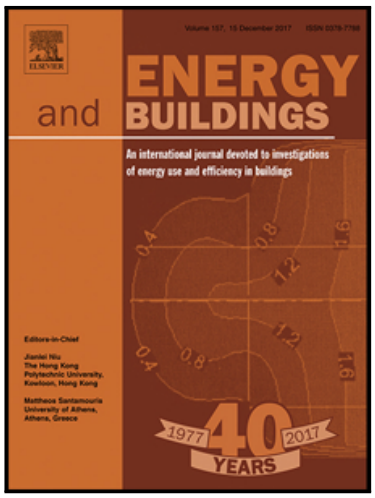

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Investigating relationships between cost and CO_2 emissions in reinforced concrete structures using a BIM-based design optimisation approach

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Abstract

An integrated design approach for the cost and embodied carbon optimisation of reinforced concrete structures is investigated in this paper to inform early design decisions. A BIM-based optimisation approach that utilises Finite Element Modelling (FEM) and a multi-objective genetic algorithm with constructability constraints is established for that purpose. A multilevel engineering analysis model is developed to perform structural layout optimisation, slab and columns sizing optimisation, and slab and columns reinforcement optimisation. The overall approach is validated using real buildings and the relationships between cost and carbon optimum solutions are explored. The study exhibits how cost effective and carbon efficient solutions could be obtained without compromising the feasibility of the optimised designs. Results demonstrate that the structural layout and the slab thickness are amongst the most important design optimisation parameters. Finally, the overall analysis suggests that the building form can influence the relationships between cost and carbon for the different structural components.

Keywords: BIM, FEM, Cost, Embodied Carbon, RC structures, Optimisation