Poster: An investigation into the embodied carbon and associated costs in office buildings utilizing different slab systems

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Abstract

Carbon dioxide (CO2) is the primary greenhouse gas contributing to global warming, and cement production, a key component of concrete, accounts for approximately 8% of global CO2 emissions.

As improvements in energy efficiency continue to reduce operational carbon in buildings, embodied carbon from construction materials and processes is becoming an increasingly critical factor in sustainable design. This research presents a comparative analysis of reinforced concrete (RC) slab systems within the context of a typical office building, focusing on embodied carbon emissions and associated construction costs. The aim is to propose the most environmentally friendly and cost-effective floor system in RC structures. To do so, a 3×3 bay structure is modelled with two span lengths of 5 m and 10 m, and a single concrete grade of C25/30 is employed to assess performance across varying design scenarios. Three common slab systems, including flat slab, beam and slab, and two?way joist slab, are evaluated using Eurocode-based design principles. Non-linear finite element analysis is applied to minimise both embodied carbon and cost while maintaining structural adequacy.

Results indicate that two-way joist slabs generally provide a favourable balance between lower embodied carbon and cost, particularly at longer spans. In contrast, flat slabs offer greater economic efficiency at shorter spans but result in a significantly higher embodied carbon footprint at longer spans. These findings support more informed, span-specific slab system selection in early-stage design, contributing to the development of more sustainable and cost-effective concrete building

Keywords

Carbon Dioxide, Office buildings, Slab systems