Numerical homogenization and general nonlinear constitutive law in optimization of bubble deck concrete slabs

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KEYWORDS:. *Bubble Deck Concrete Slab, Numerical Homogenization, Weight Minimization, General Nonlinear Constitutive Law, Ultimate and Serviceability Limit States.*

ABSTRACT

This study presents a novel approach focusing on the optimization of bubble deck slab geometry based on the limit state of load-bearing capacity, diverging from the previous study's emphasis on sensitivity analysis [1] and serviceability limit state [2]. By integrating advanced numerical homogenization techniques with the General Nonlinear Constitutive Law [3,4], this research seeks to find the optimal design parameters of bubble deck concrete slabs to enhance structural efficiency and sustainability. The methodology focuses on evaluating the stress distributions within the slab post-homogenization, utilizing the Finite Element Method (FEM) [5] to accurately predict deflections, curvatures, and ultimately, stress states. This process enables the identification of an optimal slab geometry that not only meets the structural requirements but also adheres to the principles of sustainable construction by minimizing material usage without compromising on performance. The study advances the understanding of bubble deck slab behavior under load, providing a foundation for the development of design strategies that optimize material distribution and structural resilience. Through this focused approach on the limit state of load-bearing capacity, the research aims to contribute significantly to the field of sustainable construction, offering insights into the efficient design of bubble deck slabs for improved structural integrity and resource conservation.

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