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**Topic of Research:** Numerical Analysis of Biaxial Voided Slab using Different Void Formers 8nd Composite Rebars.

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## Findings

The primary objective of this study is to identify an alternative to conventional slabs that enhances structural efficiency without compromising stability and durability. Two-way voided slabs (TVS) with composite reinforcing bars offer a superior alternative to traditional slab systems. As construction and infrastructure are crucial to the development of any nation, particularly in developing countries, optimizing building materials is essential. Concrete remains the most widely used construction material due to its strength and durability; however, its high self-weight presents a significant drawback.

To mitigate this issue, researchers have been exploring various solutions, one of which involves incorporating voids or bubbles near the neutral axis to reduce weight while maintaining structural integrity. This study aims to evaluate the feasibility of TVS as a viable replacement for conventional slabs.

In this study, 56 slab models were developed, including 29 with conventional reinforcement and 27 with composite reinforcement using Glass Fiber Reinforced Polymer (GFRP) bars. The finite element (FE) models were created and analyzed using ABAQUS CAE software. The study evaluates key parameters, including weight, Von Mises equivalent stress, equivalent plastic strain, deformation, and cost.

The first finite element (FE) model, SP1, represents a slab without void formers and reinforced with conventional steel bars, while SP11 is a slab without void formers but reinforced with Glass Fiber Reinforced Polymer (GFRP) bars. Additionally, three different void former shapes—spherical, square, and cylindrical—were used to model the slabs, each available in three different sizes.

- Spheres: Diameters of 70 mm, 80 mm, and 90 mm.
- Squares: Side lengths of 70 mm, 80 mm, and 90 mm.

- Cylinders: Diameters of 70 mm, 80 mm, and 90 mm, with a fixed length of 90 mm.
- The center-to-center spacing for FE modeling was set at 210 mm, 310 mm, and 410 mm.

Based on experimental and numerical investigations, the most optimal specimen was SP51, which featured a square-shaped void former with a side length of 70 mm, spaced at 210 mm center-to-center. This configuration, reinforced with Glass Fiber Reinforced Polymer (GFRP) bars, resulted in a **20% reduction in self-weight** and a **22% reduction in cost**. With skilled labor and proper installation, the two-way voided slab (TVS) system utilizing GFRP reinforcement can be effectively implemented in various types of construction. This system not only reduces the overall load transferred to the foundation but also lowers construction costs and enhances the durability of structures by mitigating the deterioration associated with conventional steel reinforcement.