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Influence of Coir Fibre and Fly Ash Content on Strength and Toughness of Geopolymer Concrete

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ABSTRACT

Geopolymer concrete, synthesized from aluminosilicate materials such as fly ash, has emerged as a sustainable alternative to conventional Portland cement concrete due to its reduced environmental impact and superior long-term performance. The inclusion of coir fibre, a natural lignocellulosic fibre derived from coconut husk, can further enhance the structural performance by improving toughness, ductility, and crack resistance. This study focuses on understanding how varying percentages of coir fibre and fly ash content influence the strength and toughness of geopolymer concrete. Fly ash contributes to improved workability and long-term compressive strength, while coir fibre counteracts the brittle nature of geopolymer concrete by bridging cracks and enhancing energy absorption during failure. Experimental investigations reveal that an optimum combination of fibre and fly ash content significantly enhances compressive, tensile, and flexural strength while maintaining adequate workability. Excessive fibre addition, however, may reduce compressive strength due to poor compaction and fibre clustering. The synergistic effect of coir fibre and fly ash ensures that geopolymer concrete not only achieves higher post-cracking performance but also exhibits improved toughness, making it suitable for structural elements subjected to dynamic loads.