Abstract

The construction industry is a globally important sector due to its significant contributions to growth and economic success. The operation of this industry incorporates concrete as one of its essential components. Additionally, expanding urban areas and developing rural areas are expected to increase demand for concrete. This increase in demand will negatively affect the environment through pollution or the lessening of natural resources. Therefore, it is essential to incorporate eco-friendly substitutes into the concrete manufacturing process. Regarding this, Coconut Shells (CS) have been a successful and widely used alternative material for lightweight concrete production. Nevertheless, it has been documented that using CS in concrete production causes a significant decline in concrete mechanical characteristics. In contrast, Silica Fume (SF) enhances concrete mechanical properties. Thus, this study incorporated silica fume as a CS concrete modifier. The aim was to produce sustainable, normal-strength concrete with reduced structural self-weight. To achieve this, CS partially replaces the fine aggregate at 0, 10, 20, and 30%, while SF partially replaces cement at 0, 5, 10, and 15%. The concrete properties were evaluated, including slump, density, compressive strength, flexural strength, tensile strength, scanning electron microscopy, and energy dispersion spectroscopy. The findings indicate that 10% is optimal for individual material replacements. Adding 10% SF to 10% CS concrete improved the compressive, tensile, and flexural strength by 30.87, 20.04, and 38.63%, respectively, and microstructural properties. The 10% CS-10% SF concrete yielded comparable qualities to conventional concrete, with an improved strength-to-weight ratio of 1.32%.