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Flexural Behavior of Self-Compacting Concrete Beams Strengthened with Steel Fiber Reinforcement

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Abstract
Steel fiber self-compacting concrete (SFSCC) is an innovative material that can flow underneath its own weight in the fresh state, thus eliminating any need for mechanical vibration and complexity of the formwork, and which employs the benefits of steel fibre addition in the hardened state. Hence, this study evaluated the performance of a self-compacting concrete (SCC) under the effect of filler addition and then investigated the effect of steel fiber (SF) addition on flexural behavior, splitting tensile strength, compressive strength, and modulus of elasticity. Fourteen reinforced concrete beams were tested under monotonic loads: two sets of six SCCs (with and without SFs) and two normal concretes (NCs). Ultimate capacity, deflection, crack pattern, and mode of failure were recorded. The present experimental and theoretical results were compared in accordance with ACI 318 codes to assess the applicability of the aforementioned methods to predict the flexural strength of SCC specimens. The results of the tests carried out on fresh concretes indicate excellent deformability without blocking. Moreover, the flexural strength in beams increases with increasing concrete compressive strength, longitudinal steel reinforcement ratio, and SF amount.

Keywords: Concrete structure, failure mode, flexural strength, self-compacting concrete, steel fibers.

List of Symbols
f_y : Yield stress, MPa

f_u : Ultimate stress, MPa

E_c : Modulus of elasticity, MPa

E_{exp} : Experimental modulus of elasticity, MPa

f_{cu} : Ultimate compressive Strength, MPa

f_c' : Compressive strength, MPa

f_t : Splitting tensile strength, MPa

f_r : Modulus of rupture (Flexural Strength of Concrete), MPa

f_{ct} : Compressive strength of tested mixtures, MPa