FLEXURAL TOUGHNESS OF HIGH-STRENGTH STEEL FIBER-REINFORCED CONCRETE

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High-strength concrete is useful for a number of applications in construction. One drawback of the material is its relatively high brittleness which can lead to sudden and catastrophic failure. A potential improvement in ductility could be achieved by incorporating fiber reinforcement. In this paper, results from an experimental program to characterize flexural strength and flexural toughness for high strength concrete with compressive strength of 103 MPa (15,000 psi) reinforced with steel fibers are presented. The experiments were performed according to ASTM C1018 and Japan Society of Civil Engineers standard test methods for measuring flexural toughness of fiber-reinforced concrete.

Crack mouth opening control method was found to provide the most stable crack growth and is recommended for the testing of the relatively brittle high-strength concrete. The I_5, I_{10}, I_{CMOD5} and I_{CMOD10} fracture toughness values were relatively insensitive in distinguishing fiber performance. The I_{20}, I_{30}, I_{CMOD20} and I_{CMOD30} values exhibited greater sensitivity to fiber volume and fiber type than I_5 and I_{10} values. The JSCE toughness index increased with fiber volume and beam size. The JSCE index is better than the ASTM C1018 procedure in distinguishing the difference in performance due to varying fiber volume percentages. Hooked-end fibers seemed to be superior to the crimped fibers in increasing the flexural toughness, flexural strength, and first-crack strength of the composite. An apparent size effect appears to exist as smaller beams tended to give larger values of first-crack strength and flexural strength than the larger beams.

Keywords: Fracture toughness; fiber-reinforcement; bending strength; mechanical properties; high-strength concrete