Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 6, No. 1, January, 2020

Effects of Steel Fibers Geometry on the Mechanical Properties of SIFCON Concrete

Shahad S. Khamees [a*], Mohammed M. Kadhum [a], Nameer A. Alwash [a]

[a] *Department of Civil Engineering, College of Engineering, University of Babylon, Babylon, Iraq.*

Received 23 September 2019; Accepted 29 November 2019

Abstract

This research aims to shed light on the effect of steel fiber shape, length, diameter, and aspect ratio on the mechanical properties of slurry infiltration fiber reinforced concrete (SIFCON). This study comprised of casting and testing three groups of SIFCON specimens with 6% fiber volume fraction. The first group was reinforced with micro steel fiber, other reinforced by hook end steel fibers, while the last group of specimens reinforced by mixing two shape of steel fiber as hybrid fiber (3% micro steel fiber +3% hook end steel fiber). Silica fume was used as a partial replacement (10%) by weight of cement. 3.7% super plasticizer was used to make the slurry liquid enough to penetrate through the fiber network, while the w/c ratio kept constant at 0.33. It was found from the results achieved that the compressive strength, static modulus of elasticity, splitting tensile strength and toughness are extremely affected by the geometry of fibers because the network of fibers formed and their density depends on the size and shape of fibers. Where the values of micro steel fibers are far outweighing the values of hooked end fibers. It was also deduced from empiricism results that combining long and short fibers gives excellent results.

Keywords: SIFCON; Micro Steel Fibers; Hooked End Fiberd; Modulus of Elasticity; Splitting Tensile Strength; Toughness.

1. Introduction

Notwithstanding very high compressive strength values and several advantages of high or ultra-high performance concrete, these materials stay essentially a brittle composite material. The incorporation of adequate fiber increases the tensile strength with enhanced deformation ability and therefore offers ductility. In traditional fiber reinforced concrete, the volume of fiber is usually limited to 1-3%, owning to the difficulties of placing emerged from the effect of interlocking of high amount of fibers. To produce high-performance concrete with high fiber content and to avoid mixing and packing difficulties, a new type of concrete was produced by Lankard in 1979 called slurry infiltrated fiber concrete (SIFCON) [1-5]. It is a comparatively new material which varies from normal fiber reinforced concrete in respects of composition and fabrication. The production SIFCON include firstly sprinkling the fibers in the mold to its full capacity. Then the network of fiber is penetrated by cement based slurry. To ensure proper slurry infiltration of the fiber bed, vibration is often necessary [1, 6]. The quantity of fibers can be very large, varying from 5 to 20 % and is a function of several parameters, such as the shape, diameter, and aspect ratio of fibers; their orientation; the method used in packing; mold size; and the extent of vibration. SIFCON exhibits good strength and ductility compared to traditional FRC with a high volume fraction of steel fibers [7, 8]. Research into the mechanical properties of SIFCON has shown excellent properties of the material in respect of the strength (tension, compression and shear), ductility and energy absorption capacity [3, 9]. There are many types of steel fiber used to produce SIFCON as shown in Figure 1. Hooked end and

* Corresponding author: shahad93c@gmail.com

http://dx.doi.org/10.28991/cej-2020-03091450