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Destructive and Nondestructive Tests for Concrete Containing a Various Types of Fibers

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Abstract

Fibers have been considered an effective material that was used to improve the concrete's weak properties, namely its tensile strength, ductility, and crack resistance. Thus, the current study highlights two major objective, the former is the fibers shapes and types on the mechanical properties of the fresh and hardened concrete while the latter explores the impact of the fiber contents on the concrete mechanical properties developments. To achieve these targets six types of fibers (five of them made of steel and the last was polyolefin fibers) with various shapes are utilized. The tests were carried out to investigate the fibers shape and material contribution in the concrete mix properties improvement. The samples were subjected to destructive and non-destructive tests such as workability, compression, bending, and splitting. The non-destructive tests include ultrasonic pulse velocities and the Schmidt Hammer test. Three kinds of fibers (two of steel and one of polyolefin fiber) are used with variable content ratios of 0.5, 0.75, 1.0, and 1.5% to study the fiber content effect. Generally, the workability of fresh concrete has a reverse relationship with fiber presence and fiber content ratios. The compressive capacity, splitting and flexural strength has a direct proportion with fibers contents. The hooked steel fibers appeared the best results in terms of shape comparison.

Keywords: Fibers; Compressive Test; Tensile Strength; Concrete Additive.

1. Introduction

Today, concrete and its production represent the cornerstone of construction and infrastructure work. However, it is still considered a brittle material. There are many research studies that propose variable solutions to tackle this problem. Different types of fibers, such as steel, carbon, alcohol polyvinyl, glass, and metal fibers, are suggested as additive materials to increase the ductility of concrete and reduce cracking, for example, polypropylene and acrylic [1]. Due to its low cost, fresh and hardened concrete properties like compression, tension, and workability were developed by adding polyolefin and polypropylene as well as plastic fibers [2-4]. The shape, such as embossed, straight, and crimped, and the material of the fibers, like waste polyethylene and steel, were conducted to have a crucial effect on the concrete characteristics [5, 6]. The recycled steel fibers were substantially used to develop the shear and flexural properties for both normal and self-compacting concrete (SCC), the steel fibers have waved shapes and contents, and the concrete beams casted with steel fibers were explored [7-9].

The concrete beams flexural characteristics with steel fibers had explored intensively to obtain the fibers impact on the beams bending strength [10-12]. To provide the best and main benefits of the structural strength the polyolefin fibers are used for such purposes. Based on the major advantages such as increasing structural strength, polyolefin fibers are commonly used [13, 14]. An analytical and experimental study that deals with reinforced concrete beams under bending with steel fibers to predict the fibers' impact on the flexural behavior of those beams [15].

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