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Experimental Investigation about the effect of Various Type Fibers on the Mechanical Properties of concrete

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Abstract

This paper presents the results of an experimental program about effect of addition of some type of fibers such as steel, UK Shogun and PP on the mechanical properties of concrete specimens. Various tests has been conducted such as flexural strength, flexural toughness, splitting tensile strength and splitting tensile toughness and then about 6 specimens was produced in the laboratory. The tests were carried out based on ASTM-C1018 and ASTM-C1116 code recommendations. The result of splitting test indicates that steel fiber was more effective. Flexural bending test of specimens has proved that pp fibered specimens were less effective than to other specimens. Comparative energy dissipation diagrams of specimens indicate that at the first steps of displacement, steel fiber was more effective, but with spending of test process, the UK Shogun fiber specimens and then PP fiber was more effective.

Keywords: Fiber concrete, energy absorption, compressive strength, flexural strength

1. INTRODUCTION

Concrete is a widely used material in structural engineering all over the world. Its history begins since cement was introduced. Unreinforced concrete was a brittle material, with a low tensile strength and a low strain capacity. A revolutionary improvement of concrete properties was using steel bar reinforcement allowing getting tensile forces. Reinforced concrete (RC) became an alternative to other materials that were used in bending elements. Scientists worked intensively to find appropriate ways for increasing compressive strength of concrete in order to decrease the dimensions of structural elements and their self weight leading to more economical design solutions. As a result of these research activities, using high-strength concrete elements became a common trend in modern construction.

Fiber reinforcement is usually randomly distributed throughout the whole element, but it can be also used in a part of the element's section, for example in composite elements like two-layer beams [1, 2] or in high-strength concrete columns, covered by fiber reinforced concrete [3]. Steel, textile, organic, glass and other kinds of fibers are widely used to improve performance of concrete for about 90 years [4].

For design purposes a very detailed knowledge about the tensile carrying behavior of fibered concrete is required. It is affected by various parameters like fibers' geometry and content, bond strength between fiber and binder matrix, strength of the matrix, shrinkage of the concrete orientation of fibers, etc. [5]. Effectiveness of fibers added to concrete can be investigated experimentally or numerically. The routine laboratory testing methods are impact test, compressive test, tensile and flexural tests, etc. [6].

Because of its attractive properties the use of steel fiber reinforced concrete has constantly increased during the last decades. It is currently applied not just in regular civil and industrial buildings, but also in many other fields like airport and highway pavements, earthquake and impact resistant structures, tunnels, bridges, hydraulic structures, etc. Fiber reinforced high strength concrete is applied not just in new buildings, but it is also used for retrofitting of existing structures [7].

Different types of fibers, made of steel, glass, polypropylene, graphite, asbestos, Kevlar, textiles, etc can be used in fiber-reinforced concrete (FRC). Steel fibers are available in lengths between 6 and 80 mm and with a cross section area between 0.1 and 1.5 mm2. It corresponds to a diameter between 0.15 and 1.2 mm. The tensile strength is normally in a range between 300 and 2400 MPa [8,9] with a specific gravity at appropriately 7800 kg/m3. They are of circular or rectangular cross sectional shape and are produced by cutting or chopping steel wires or by shearing sheets of flattened metal sheets and steel bars. The fibers are