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The Fire Exposure Effect on Hybrid Reinforced Reactive Powder Concrete Columns

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Abstract

This paper offers an experimental investigation of the fiber reinforced reactive powder concrete columns' behavior after exposure to fire and improvements made to improve column resistance against fire. This study is mainly aimed to study the experimental behavior of hybrid reinforced columns produced by reactive concrete powder (RPC) and exposure to the flame of fire at one side and subjected to eccentric load. The experimental methodology consists of sixteen RC columns that organized into four groups based on the variables used in this research: (SF) steel fibers, (PP) polypropylene fibers, (HB) hybrid fibers, (PPC-SF) hybrid cross-section (steel fiber reactive powder concrete core with polypropylene fiber reactive powder concrete cover). All columns were tested under 60 mm eccentric load and the burn columns were exposed to fire for different duration (1, 1.5 and 2) hours. The results indicated that (SF-RPC, PP-RPC, HB-RPC, PPC-SFRPC) columns exposed to a fire flame for the period 2 hours, lost from their load capacity by about (54.39, 40.03, 34.69 and 30.68) % respectively. The main conclusion of this paper is that the best fire resistance of the column obtained when using a hybrid cross-section (steel fiber reactive powder concrete core with polypropylene fiber reactive powder concrete cover).

Keywords: Reactive Powder Concrete (RPC); Hybrid Cross Section Column; Hybrid Fibers (HB); Exposed to Fire and Eccentric Load.

1. Introduction

The reinforced concrete column is a structural member utilized mainly for standing compressive loads, consisting of concrete with an embedded steel frame for reinforcement purposes. There are rarely axially loaded columns in practice since there is always some bending. The moments that happened in the continuous construction along with unavoidable building imperfections will cause eccentricities and then caused a bending in the member. The strength of the column is controlled by the strength of the used material (in particular, the compression strength of the concrete) and the cross-section geometry [1]. The demand for stronger, products with lower space-consuming has increased as construction and material costs increase. Newly, in Bouygues, France, developed a very high strength and high ductility cement-based composite, known as reactive powder concrete (RPC) [2]. RPC is a cemented material characterized by high-performance characteristics for example low shrinkage creep and permeability, ultra-high strength and increased protection against corrosion [3]. However, the need for high-strength structures always comes with an issue in fire resistance for the structure. It was disclosed collectively that the greater strength of the blend will cause a reduction in the composition's fire resistance. In high temperature, the high-performance concrete compositions which are usually denser tend to be more likely to fail because of their high brittleness. High performance concrete shows greater deterioration than ordinary strength concrete, for example concrete spalling and cracking [4]. Nowadays, many fire accidents have occurred around the world, with the use of fresh cement developments (lately RPC) to build load-carrying

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