Experimental Investigation of Flexural Behavior of One-Way Two-Layer Steel and Polypropylene Fiber Reinforced Concrete Slab

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Abstract

Concrete structures may be subjected to different kinds of static loads that can affect their structural responses such as deflection, loading capacity and, etc. In these conditions, using of various fibers such as polypropylene and steel fibers in the tensile zone can improve their structural behaviors. Hence dividing of slabs into two parts and using of fibers in tensile part of the slab were investigated.
Several experiment tests with many concrete slab specimens made with fibers have been conducted to investigate two-layer concrete slabs, so some of those done experimental one-way two-layer slabs will be presented in this paper. Some diagrams such as P-Δ, energy absorption and, etc. for each slab were studied and analyzed. The results showed that the steel and polypropylene fibers not only increase the strength noticeably, but also they have considerable effect on energy absorption of concrete slabs made with two different layers reinforced with fibers.
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Keywords: One-way slab, two layer concrete, steel fiber, polypropylene fiber

1. INTRODUCTION

Nowadays, use of fiber reinforced concrete (FRC) are most commonly factors for constructing the buildings and other concrete elements such as slabs, bridge, tunnels and, etc. Fibers are mostly used for reducing the concrete brittle manner and improving its mechanical properties too.
This becomes more important when the concrete structures are supposed to some undesirable environmental conditions such as corrosion, uncommon loadings, and, etc. and their characteristics go down. Hereby use of FRC in one layer or two layers forms can be effective. Some of these improvements are about increasing flexural strength, flexural toughness, and energy absorption.
Many researchers have conducted investigations to study different characteristics of fiber reinforced concrete [1]. The mechanical properties of concrete and mortar reinforced with randomly distributed smooth steel fibers were investigated by Shah and Rangan [2]. It was observed that the post-cracking resistance of the material was considerably influenced by the length, orientation and stiffness of the fibers used. Lim and Oh [3] produced beams with SFRC, and the beams were tested in bending load. The increase in flexural strength was about 55% when the fiber content was increased from 0 to 2%. Yazıcı et al. [4] carried out a study on SFRC. The flexural strength of SFRC was higher by about 3–81% than control mixture.

2. EXPERIMENTAL PROGRAM

2.1. SPECIMENS DETAILS

Some of the several two-layer one-way slab specimens were made in Structural Laboratory of Semnan University. These slabs were designed according to ACI 318 [5]. Physical properties of slabs and their schematic forms are given in Table 1 and shown in Figure 1. All of these slabs had 135 cm length with 120 cm net span, 20 cm width and 10 cm height.