



Evaluation of mechanical properties of fiber reinforced recycled concrete

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Abstract

The purpose of this study is to analyze the effect of size and level of recycled aggregates on the mechanical properties of concrete and improve them by the fibers. For this purpose, in the first phase, the results show that the replacement of fine recycled aggregate at the level of 30% has no significant reduction effect on the compressive strength of concrete and so this can be selected as the optimum recycled mix design. In the second phase, the results show that the addition of polypropylene and steel fibers considerably improve the tensile and flexural strength of the recycled concrete.

Keywords: recycled concrete, recycled aggregate, mechanical properties, steel fiber, polypropylene fiber.

1. INTRODUCTION

In recent years, waste treatment activities are included in the global perspective of environmental sustainability and have become an increasingly important issue in nowadays society. There is, consequently, a gradual change in the concept of waste: from scrap to resource, from problem to opportunity [1]. The use of construction and demolition (C&D) waste as a source of aggregate for the production of new concrete has become more common in the recent decade. C&D materials consist of the debris generated during the construction, renovation and demolition of buildings, roads, bridges and other structures. C&D waste is a general term for a diverse range of materials that, when segregated, can include high-value materials and resources for new construction. The increasing charges for landfill due to solid waste generation, on the one hand, and the scarcity of non-renewable natural resources for aggregate, on the other hand, encourage the use of waste from construction sites as a source for aggregates [2-4].

C&D materials include asphalt, brick, concrete, metals, timber, plastics, etc. This paper focuses on the recycled concrete aggregate (RCA) which is made using broken used concrete such that after destructed concrete crushing, the concrete contaminants such as reinforcement, paper, wood, plastics and gypsum are screened and removed. The concrete made with such RCA is called recycled concrete.

RCA has a lower quality compared to natural aggregate (NA) because of some amount of mortar that is attached to the stone particles in RCA. RCA compared to NA has the following properties: more water absorption [5-8], less bulk density [9, 10], less relative density [9], more abrasion loss [9, 11, 12], more crushability [9], more amount of dust particles [9], more amount of organic impurities because of possibly earth mixing with concrete after building destruction [9], and some amount of harmful chemicals that are released when workers are extracting the recycled aggregates [9]. Despite the mentioned weaknesses of RCA, the un-hydrated cement of the original concrete available in the RCA may play a positive role for its use in structural concrete. In addition, the specific surface of the aggregates in the case of use of RCA is greater and result in the improving binder/recycled aggregate interface [13].

Use of the recycled aggregates in concrete may undermine some mechanical properties of concrete. Addition of fiber to concrete is considered as a solution in this study, in order to improve the weakness of recycled concrete compared to conventional concrete. Fibers can improve the strength and deformation