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Investigation on the Mechanical Properties of Fiber Reinforced Recycled Concrete

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Abstract

The flexural strength of conventional concrete material is known to be enhanced by incorporating a moderate volume-fraction of randomly distributed fibers. However, there is limited information on describing the influence of fiber volume-fraction on the compressive and flexural strength of recycled coarse aggregate concrete (RCA-C) material. This paper reports on experimental test results of the RCA-C material replaced with 0, 30, 50 and 100% recycled aggregate and 0, 0.5, 1 and 1.5% steel fiber volume fraction. Three-point flexural tests of notched prism specimens were completed. The mechanical properties in compression were characterized using cube specimens. Significant improvement in compressive and flexural strength of RCA-C was found as fiber content increased from 0 to 1.5%. The experimental test results of RCA-C were further evaluated to investigate the influence of fiber content on flexural toughness. According to test results, the addition of steel fibers to RCA-C material appreciably increased the flexural toughness.

Keywords: Recycled Concrete, Recycled Aggregate, Steel Fiber, Compressive Strength, Flexural Strength, Toughness.

1. Introduction

The use of recycled coarse aggregate concrete in buildings and bridges has received significant attention over the recent years. However, there has not been enough research to characterize the mechanical properties of this material in compression, flexure, and tension. Some standards prohibit the structural use of recycled coarse aggregate concrete, as the mechanical response of this type of concrete is not well established [1]. However, the British Standard Code allows replacing 20% of the total aggregate in the concrete with crushed aggregate [2]. Likewise, the German code allows the use of 25% to 40% recycled aggregate as replacement. However, aggregate size less than 2 mm is not allowed [3].

Past researches has indicated that, compared to conventional concrete (CC), the recycled aggregates feature more porous texture, lower density, smaller modulus of elasticity, higher shrinkage and water absorption as well as reduced resistance to freezing and thawing [4, 5]. The response of RCA-C concrete material is primarily affected by the crushed aggregate material quality and quantity [6]. Thus special care shall be taken to ensure a high quality crushed aggregate is used in the RCA-C material.

According to Li and Limbachiya [7, 8] slight changes in the mechanical properties of RCA-C with 20% to 30% aggregate replacement were observed. However, the higher recycled coarse aggregates content would significantly result in loss in the compressive strength of the RCA-C [9, 10]. This is most probably attributed to the increased porosity in the concrete texture and the weak transitional zone between the recycled aggregate and cement matrix [11].

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