Experimental Study on Engineered Cementitious Composite

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ABSTRACT

Engineered Cementitious Composite (ECC) is a kind of high-performance fiber-reinforced cementitious composite materials (HPFRCCs) reinforced with short fibers and characterized by tight multiple cracking. These characteristics of ECC make it applicable to increase the capacity and the ductility of structural elements so that structural design is economic and sustainable. This paper presents an extended evaluation of Engineered Cementitious Composites (ECC) for the use in the strengthening of masonry infilled reinforced concrete frames. ECC is a mixture of cement, fly ash, water, sand, quartz powder and poly-vinyl alcohol fibers with a better quality of tensile strain rather than common ECC. The fine sand and quartz powder used in this study as filler were instead of the typically used sand to improve ECC behavior. Also, to show the effect of fly ash on ECC properties, five different mixtures were considered with various fly ash ratios. Different mixtures of ECC using fine aggregates produced in Iran were selected to find out how the aggregates and fly ash would affect ECC performance. The results show that the optimized mixture has the best characteristics including tensile strength and strain. Also, the best values of tensile strength and tensile strain are 3.5 MPa and 6% respectively.

Keywords: *Engineered Cementitious Composites, Optimization, Experimental Study, Retrofit*

1. Introduction

ECC has very high ductile behavior in tensile loads and is known as a special kind of HPFRCC that invented at the University of Michigan in the early 1990s for the first time [1]. This material is known by high ductility more than 3% and multiple cracks with about 60 μm wide. A typical tensile stress-strain curve of ECC and multiple cracks is shown in Figure 1 [2]. Plain concrete and fiber reinforced concrete have strain-softening after initial cracks. However, ECC exhibits material property like steel with tensile strain-hardening behavior. High ductile behavior is due to the interactions among fiber, matrix and fiber-matrix interface [3]. Also, ECC shows good durability and high tensile strength due to self-controlled cracks.

Thus ECC can be used in many structures to extend service life, reduce the maintenance and repair cost. Recently, ECC is highly used in decks [4], structural elements in high-rise buildings to improve their seismic behavior, and in repair application [5, 6].