Damage propagation rate and mechanical properties of recycled steel fiber-reinforced and cement-bound granular materials used in pavement structure

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Cement-bound granular mixtures (CBGMs) represent an attractive option to increase load-carrying capacity and sustainability in highway construction. However, reflection cracking of overlying pavement layers due to the low tensile strength of CBGMs represents an important obstacle limiting their use. This study is undertaken to investigate how incorporation, in CBGMs, of recycled steel fibers extracted from old tires, at different cement levels may affect their tensile properties related to pavement design. A combination of three levels of cement and two reinforcement contents (0% and 0.5 by volume of aggregate) was investigated. To comprehensively quantify the benefits of fibers in the presence of variable cement contents, time-dependent fracture and damage propagation were examined quantitatively utilizing a combination of macro-surface cracks, fractal analysis and both image monitoring and processing techniques. The results indicated better tensile strength and toughness after cement and fiber inclusion. Furthermore, increasing the amount of cement accelerates the crack propagation and damage dispersion rate while these two parameters reduced significantly in the case of fiber-reinforced cemented aggregate. All benefits gained from fiber usage are more evident at higher cement contents.