

Basic Creep and Fracture Response of Fine Recycled Aggregate Concrete

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Abstract:

Recycling concrete aggregates represents a sustainable approach for concrete production. Yet, a major hurdle towards the insertion of recycled concrete aggregates in industry is the lack of durability data regarding recycled aggregate concrete. In particular, creep is an essential measure of durability and a major concern for concrete structures. We investigate the durability of recycled aggregate concrete with a focus on basic creep and fracture response. To this end, we conduct creep indentation tests using a nanohardness Tester equipped with a Berkovich diamond indenter. In addition, we perform microscopic scratch tests using a scratch tester equipped with a Rockwell C scratch probe. We find that the creep behavior of fine recycled concrete mortar obeys a logarithmic law. The macroscopic logarithmic creep modulus for fine recycled concrete aggregate mortar is five times smaller than that of the natural sand mortar due to the higher microporosity, larger volume fraction of low-density C-S-H, and lower fraction of hard aggregates of fine recycled concrete aggregate mortar. Moreover, the fracture toughness of fine recycled concrete aggregate mortar is 20% lower than that of natural sand mortar. The fracture micromechanisms for fine recycled concrete aggregate mortar include microcracking, crack deflection, crack ligament bridging, and crack debris bridging.