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Use of Waste Tire Rubber Alkali-Activated-Based Mortars in Repair of Concrete Structures

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Abstract : Reinforced concrete structures experience local defects such as cracks over their lifetime under various environmental loadings. Consequently, they are repaired by mortars to avoid detrimental effects such as corrosion of reinforcement, which in long-term may lead to strength loss of a member or collapse of structures. However, repaired structures may need multiple repairs due to changes in load distribution, and thus, lack of compatibility between mortar and substrate concrete. On the other hand, waste tire rubber alkali-activated (WTRAA)-based materials have very high potential to be used as repair mortars because of their ductility and flexibility, which may delay the failure of repair mortar and thus, provide sufficient compatibility. Hence, this work presents a pioneering study on suitability of WTRAA-based materials as mortars for the repair of concrete structures through an experimental program. To this end, WTRAA mortars with 15% aggregate replacement, alkali-activated (AA) mortars, and ordinary mortars are made to repair a number of concrete beams. The WTRAA mortars are composed of slag as base material, sodium hydroxide as an alkaline activator, and different gradations of waste tire rubber (fine and coarse gradations). Flexural tests are conducted on the concrete beams repaired by the ordinary, AA, and WTRAA mortars. It is found that, despite having lower compressive strength and modulus of elasticity, the WTRAA and AA mortars increase the flexural strength of the repaired beams, give compatible failures, and provide sufficient mortar-concrete interface bondings. The ordinary mortars, however, show incompatible failure modes. This study demonstrates the promising application of WTRAA mortars in the practical repairs of concrete structures.

Keywords : alkali-activated mortars, concrete repair, mortar compatibility, flexural strength, waste tire rubber
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