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Influence of AAR-Induced Expansion Level on Confinement Efficiency of CFRP Wrapping Applied to Damaged Circular Concrete Columns

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Abstract : The alkali-aggregate reaction (AAR) in concrete has a negative influence on the mechanical properties and durability of concrete. Confinement by carbon fiber reinforced polymer (CFRP) is an effective method of treatment for some AAR-affected elements. Eighteen reinforced columns affected by different levels of expansion due to AAR were confined using CFRP to evaluate the effect of expansion level on confinement efficiency. Strength and strain capacities (axial and circumferential) were measured using photogrammetry under uniaxial compressive loading to evaluate the efficiency of CFRP wrapping for the rehabilitation of affected columns. In relation to uniaxial compression capacity, the results indicated that the confinement of AAR-affected columns by one layer of CFRP is sufficient to reach and exceed the load capacity of unaffected sound columns. Parallel to the experimental study, finite element (FE) modeling using ATENA software was employed to predict the behavior of CFRP-confined damaged concrete and determine the possibility of using the model in a parametric study by simulating the number of CFRP layers. A comparison of the experimental results with the results of the theoretical models showed that FE modeling could be used for the prediction of the behavior of confined AAR-damaged concrete.

Keywords : ATENA, carbon fiber reinforced polymer (CFRP), confinement efficiency, finite element (FE)
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