World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:16, No:07, 2022

FE Modelling of Structural Effects of Alkali-Silica Reaction in Reinforced Concrete Beams

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Abstract : A significant degradation factor that impacts the durability of concrete structures is the alkali-silica reaction. Engineers are frequently charged with the challenges of conducting a thorough safety assessment of concrete structures that have been impacted by ASR. The alkali-silica reaction has a major influence on the structural capacities of structures. In most cases, the reduction in compressive strength, tensile strength, and modulus of elasticity is expressed as a function of free expansion and crack widths. Predicting the effect of ASR on flexural strength is also relevant. In this paper, a nonlinear three-dimensional (3D) finite-element model was proposed to describe the flexural strength degradation induced byASR.Initial strains, initial stresses, initial cracks, and deterioration of material characteristics were all considered ASR factors in this model. The effects of ASR on structural performance were evaluated by focusing on initial flexural stiffness, force–deformation curve, and load-carrying capacity. Degradation of concrete mechanical properties was correlated with ASR growth using material test data conducted at Tech Lab, UTS, and implemented into the FEM for various expansions. The finite element study revealed a better understanding of the ASR-affected RC beam's failure mechanism and capacity reduction as a function of ASR expansion. Furthermore, in this study, decreasing of the residual mechanical properties due to ASRisreviewed, using as input data for the FEM model. Finally, analysis techniques and a comparison of the analysis and the experiment results are discussed. Verification is also provided through analyses of reinforced concrete beams with behavior governed by either flexural or shear mechanisms.

Keywords : alkali-silica reaction, analysis, assessment, finite element, nonlinear analysis, reinforced concrete
Conference Title : ICSE 2022 : International Conference on Structural Engineering
Conference Location : Paris, France
Conference Dates : July 19-20, 2022