Fracture mechanic modeling of fiber reinforced polymer shear-strengthened reinforced concrete beam

ABSTRACT

A numerical method is developed to model shear-strengthening of reinforced concrete beam by using fiber reinforced polymer (FRP) composites. Tensile crack is simulated by a non-linear spring element with softening behavior ahead of the crack tip to model the cohesive zone in concrete. A truss element is used, parallel to the spring element, to simulate the energy dissipation rate by the FRP. The strain energy release rate is calculated directly by using a virtual crack closure technique. It is observed that the length of the fracture process zone (FPZ) increases with the application of FRP shear-strengthening. The present model shows that the main diagonal crack is formed at the support in the control beam while it appears through the shear span in the shear-strengthened beam. Another important observation is that the load capacity increases with the number of CFRP sheets in the shear span.

Keyword: Polymer–matrix composites (PMCs); Fracture; Finite element analysis (FEA)