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# COMPUTAIONAL MODELING OF INTERFACIAL DEBONDING BETWEEN FRP SHEET AND CONCRETE

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Fiber reinforced polymer (FRP) has been widely applied in the reinforcement of concrete beams. The high tensile strength of FRP laminates is not completely used since premature debonding failure frequently occurs in engineering practice. The loading capacity of strengthened beams is usually govened by the mechanism of interfacial bonding between FRP and substrate. The bond-slip of FRP-to-concrete has been well studied in many experiments, but the computational models need to be further improved for accurately simulating the interfacial debonding failure. In this paper, the interfacial bond-slip of FRP-to-concrete is investigated, and the debonding failure caused by concrete cracks is theoretically derived based on fracture mechanics. An embedded nonlinear spring model is established to simulate the processes of adhesion, slipping and debonding behavior of FRP-to-concrete. The interfacial slipping and debonding is analyzed from the tangential movements of the nodes of spring elements. Different from the models presented in the previous publication, the numerical simulation of debonding behavior caused by concrete cracks is carried out by assigning an initial crack at the bottom of the beam. The crack is assumed initially closed but with uncoupled elemental nodes. With the increase of applied load, the stress concentration are obvious in the interface at the vicinity of the crack. Furthermore, the U-wrap anchorages at the ends of FRP sheet are added in the computational model so that the interfacial debondinng induced by concrete cracks is implemented. From the numerical calculation, it is shown that the maximum interfacial shear stress occurs at the end points of FRP sheet when the model without initial concrete cracks is applied. If two U-wrap anchorages are added at the ends of FRP sheet, the interfacial slipping is decreased greatly. Results obtained from the computational model with concrete crack show that interfacial stresses near the crack is much higher than other positions. The FRP strain within two anchorages is much higher than the average if the anchorages are placed on both sides of the crack, which easily leads to local rupture of the FRP sheet. Compared with the experimental outcomes, the numerical analysis is demonstrated to be feasible and reliable.

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