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EVALUATING THE PARAMETERS OF CONSTITUTIVE LAWS OF CDP AND XFEM MODELS FOR MODELING FLEXURAL CRACKS AND PEELING IN RC BEAMS

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In bending tests of RC beams, the significance of tensile concrete is usually questioned due to its low flexural strength. However, the importance of studying the formation of flexural cracks comes from its further propagation to lead to localised strains (on rebars); while some notch test procedures have shown that such cracks are greatly affected by the location and percentage of internal rebars [1]. Studies [2,3] have also identified that the formation of flexural cracks play a key role in externally plated RC beams to lead to peeling failure (at plate-end) or interfacial debonding (along mid-span). Such premature failures are not only detrimental to the composite action between plate and beam, but are also critical to the catastrophic collapse of structure; and are, therefore, highly undesirable. Therefore, such complex problems cannot be understood well without predicting flexural cracks, mainly together in terms of their location, numbers and load of formation, which have been continuously ignored in literature or taken for granted.

Since for quasi-brittle materials or deformation-softening materials, such as concrete, due to formation of micro cracks it is favourable to adopt energy equilibrium consideration for analysis. It can be obtained from experimental work and/or necessary theoretical solutions (which may be already available) or numerical calibration technique such as FE simulation. Current study shows suitability of using XFEM traction-separation model with Concrete Damaged Plasticity model (CDP) to predict flexural cracks, using ABAQUS. RC beams, subjected to 4-point loading, are picked from literature covering a wide range of material and geometrical variables. Bond parameters for XFEM and CDP models are evaluated in terms of basic parameters. Considering a level of non-uniformity of result patterns associated with this problem, multiple regression analysis is performed to reach desired relations of bond parameters. The suitability of these relations is further demonstrated against plated beams particularly failing in peeling.

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