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Numerical analysis of damage evolution in adhesive of bonded composite Material

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Abstract : Adhesives play important roles in bonded composite repair as it ensures the transfer of load between the composite patch and the cracked aluminum component. Also, it holds the two structures together. The damage of the adhesive can thus reduce significantly the efficiency and the durability of the bonded composite repair. The adhesive damage models using critical zone have proven their effectiveness due to simplicity and applicability of the damage criteria in these models. The scope of this study is the estimation of the adhesive damage and failure in bonded composite repair of aircraft structures using modified damage zone theory. The effect of this damage on the repair efficiency was analyzed. In order to achieve these objectives, non–linear finite element analyses of adhesive joints considering the material nonlinearity of the adhesive layer were performed. The obtained results show that adhesive damage is principally located at the free edges of the patch and over the crack region. The damage zone ratios depends on the applied load, it affects the repair efficiency when its value approaches the critical value of 0.22.

Keywords : damage zone theory, composite repair, Crack, cohesive failure, Finite Element Method, damage ratio, stress intensity factor