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A physically-based multiscale modelling in adhesive damage analysis

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This paper introduced a physically-based multiscale damage modelling technique to study the adhesive damage mechanism. A micro damage scale was introduced into a proposed extended cohesive damage model (ECDM). This micro damage model was used to build up an extended FEA modlling for an adhesively debonding or cohesively fracture analysis at a macro level. As an example, an adhesively bonded bone-cement interface was investigated in this paper. In this investigation, different micro damage scales presented the different bonded qualities of bone-cement interface, which were determined by physically scanned images obtained from fractures tests. In the proposed multiscale modelling, two specified ECDM models were developed as two different enrichment functions to firstly deal with discontinue problems at interfaces and within material domain respectively. The failure mechanism of bone-cement interface under mixed loading, with different bonded qualities, was successfully studied using this proposed ECDM models. This investigation indicated that the effect of bonded quality, presented by micro sizes of pores at interface, on the loading capacity of bone-cement interface can be studied properly using the proposed multiscale modelling techniques. Stochastic approach played a role to link the micro damage law and macro FEA modelling. This multiscale damage modelling technique supplied a potential approach in simulation of multi crack propagation in adhesive composite structures.