Methodology to characterize the mechanical behavior within the adhesive joints

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Résumé

Over the last decades, adhesive bonding has found many engineering applications such as marine, automobile, aerospace, and construction [1–3]. The joining of two or more components allows for structures to perform their operational requirements, transferring forces from one surface to another. The choice of this assembly method is mainly due to the advantages that adhesive bonding provides over mechanical fixing techniques (bolting, welding, and screwing) including reductions in weight, lower manufacturing cost, the variety of materials that can be bonded, a uniform stress distribution of the load, better fatigue properties, etc. The behavior of the adhesive is given by the stress as a function of the strain. Due to the non-uniform distribution of the stress and strain within the adhesive during modified Scarf test, it is not possible to easily describe the mechanical behavior of the assembly (). For instance, it is possible to develop an inverse methodology to identify a non-linear model. However, this method necessitates several non-linear Finite Element calculations to identify a model. Moreover, using *DIC* it is possible to measure the relative displacement of the substrates near the adhesive joint in order to get the macroscopic behavior (Load /Displacement). To attain a direct characterization of the adhesive behavior, first, it is necessary to obtain the stress within the adhesive joint. This is possible by calculating the stress of the substrates near the adhesive joint. The strain in the substrates is calculated from the displacement measured from *DIC*. Using this strain and the substrate elastic properties, the stress is directly calculated under plane-stress hypothesis. Finally, the strain within the adhesive can be calculated after a slight correction, in order to have only the strain with the adhesive joint (where, represent the relative displacement of the substrate, between the interface adhesive/substrate and the middle part of the *DIC* post-treatment zone). To validate the approach presented in the previous section. An elastic-plastic constitutive law is directly identified from the stress-strain curve and then injected in a finite element model of the modified Scarf test, in order to compare the experimental macroscopic response (Load /Displacement) and the one obtained from the *FEA* model. Comparisons between FEA and the experimental results show, globally, a good correlation for both cases normal and tangential directions.

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