

Bi-material bonded joints with thick bond-lines

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Relevant Working Groups: WG2

Objectives / Description / Main outcomes

This STSM allowed a scientific collaboration on the topic of crack onset under mode I loading conditions in single- and bi-material bonded joints with thick adhesive bond-lines. The fracture onset is dominated by the singular stress field around the pre-crack tip up to a certain bond-line thickness. For higher bond-line thicknesses, geometric discontinuities (such as corners) and material discontinuities (such as adherend-adhesive interfaces) create local singularities where the threshold stress is attained first. To overcome this situation, a critical pre-crack length must be defined, $a_{0 \text{ critical}}$.

The critical length depends on the geometry and materials of the bonded joint, such as the bond-line thickness. For a 10 mm thick bond-line, we found out the following empirical relation: $\lambda^{-1}/a_{0 \text{ critical}} \leq 2$.

The parameter λ^{-1} is the characteristic length defined to solve the differential equation of a beam supported by e.g. an elastic medium. This parameter is function of the geometry and mechanical properties of the adhesive bond-line and adherends.

Several authors have shown that the T-stress is one of the parameters affecting the crack path selection. Therefore, we addressed the evolution of the T-stress at the crack tip with increasing bond-line thickness. The results showed an increase on the T-stress with increasing bond-line thickness. This trend is in agreement with other authors' results. However, satisfactory quantitative agreement has not been reached.

The research is now focused on the study of the process zone effects by means of analytical and numerical methods. Experimental strain fields from DIC system are used to validate analytical and numerical results. The final outcome of this collaboration will be a scientific manuscript, which is currently in preparation.

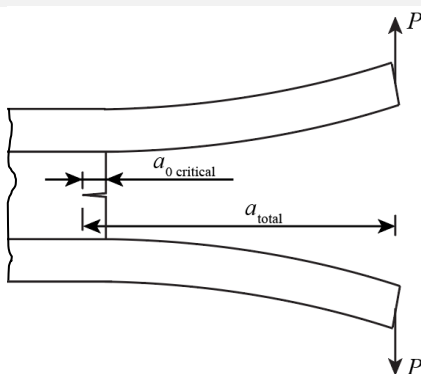


Figure 1: Illustration of $a_{0 \text{ critical}}$

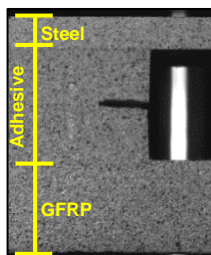


Figure 2: Experimental $a_{0 \text{ critical}}$ steel-GFRP bonded joint

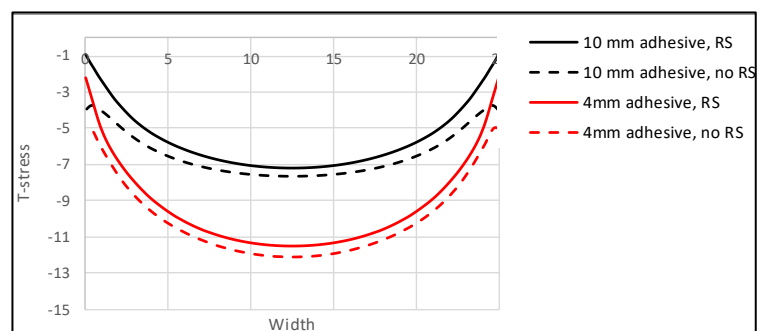


Figure 3: T-stress distributions for steel-steel DCB specimens with different bond-line thicknesses.