Strength prediction of epoxy adhesively bonded scarf joints of dissimilar adherends

In this study, strength of epoxy adhesively bonded scarf joints of dissimilar adherends, namely SUS304 stainless steel and YH75 aluminum alloy is examined on several scarf angles and various bond thicknesses under uniaxial tensile loading. Scarf angle, ϑ=45°, 60° and 75° are employed. The bond thickness, *t* between the dissimilar adherends is controlled to be ranged between 0.1 and 1.2 mm. Finite element (FE) analysis is also executed to investigate the stress distributions in the adhesive layer of scarf joints by ANSYS 11 code. As a result, the apparent Young's modulus of adhesive layer in scarf joints is found to be 1.5–5 times higher than those of bulk epoxy adhesive, which has been obtained from tensile tests. For scarf joint strength prediction, the existing failure criteria (i.e. maximum principal stress and Mises equivalent stress) cannot satisfactorily estimate the present experimental results. Though the measured stress multiaxiality of scarf joints proportionally increases as the scarf angle increases, the experimental results do not agree with the theoretical values. From analytical solutions, stress singularity exists most pronouncedly at the steel/adhesive interface corner of joint having 45–75° scarf angle. The failure surface observations confirm that the failure has always initiated at this apex. This is also in agreement with stress-*y* distribution obtained within FE analysis. Finally, the strength of scarf joints bonded with brittle adhesive can be best predicted by interface corner toughness, *Hc* parameter.