Abstract No 2

Finite Element Stress Analysis and Strength Evaluation of Stepped-lap Adhesive Joints of Dissimilar Adherends under Static Tensile Loadings

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Stepped-lap adhesive joints have been used in mechanical structures. However, Design method of the stepped-lap adhesive joints has not yet been fully elucidated. In our research, stress distributions of the stepped-lap adhesive joints of dissimilar adherends subjected to static tensile loadings are analyzed in elastic deformation ranges using three dimensional finite-element method. Steel and Aluminum are chosen as Adherend material. In addition, the stress distributions in the joints of similar adherends under static tensile loadings are analyzed, too. The FEM code name employed is ANSYS. The effects of Young's modulus of the adhesive, the adhesive thickness, the number of butted steps, the scarf angle of the adherends and aspect ratio of the adherends (between the width and the thickness) on the stress distributions at the adhesive interfaces are examined in elastic deformation range. The characteristic of the joints of similar adherends are also clarified. The optimal design method for the joints under static loadings are presented from comparisons of above effects. As the results, it is found that the maximum value of the maximum principal stress σ_1 occurs at the edge of the butted adhesive interface between the adhesive and steel adherend, the maximum value of stress σ_1 decreases as Young's modulus of the adhesive increases. Strain distributions of stepped-lap adhesive joints of both similar and dissimilar adherends under static loadings are also analyzed in elasto-plastic deformation ranges using three-dimensional FEM calculation. A method for estimating the joint strength is proposed using obtained strain distributions at the adhesive interfaces. For the verification of FEM calculations, experiments to measure the strains in the joints under static tensile loadings were carried out using strain gauges. A fairly good agreement is found between the calculated and the measured results concerning the strains. In addition, the joints strengths of both similar and dissimilar adherends under static loadings were also conducted.