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Khalid H. Almitani, Ramzi Othman

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Analytical solution of the harmonic response of visco-elastic adhesively bonded single-lap and double-lap joints

Khalid H. Almitani, Ramzi Othman*

Mechanical Engineering Department, Faculty of Engineering, King Abdul-Aziz University, P.O. Box 80248, Jeddah 21589, Saudi Arabia

*Corresponding author: Rothman1@kau.edu.sa (Tel.: +966 2 640 0000.)

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Abstract

This paper describes a new analytical solution for adhesively-bonded single-lap and double-lap joints based on an improved shear-lag model. The derived equations assume that all substrates are of the same material. In the case of single-lap joints, the substrates have equal thicknesses. In the case of the double-lap joints, the outer substrates' thickness is half the thickness of the inner substrate. The proposed solution takes into account the visco-elastic behavior of the adhesive and substrates. The analytical solutions of aluminum and polymer single-lap joints are compared to finite element solutions. Good agreement is then observed. Subsequently, a parametric study is undertaken and shows that the natural frequencies are sensitive to the material and geometrical properties of the adhesive layer and the substrates. Mainly, it is reported that substrates' damping attenuates more the resonances heights than the adhesive damping does.

Keywords: lap joint; adhesives; visco-elastic; harmonic response; analytical solution.

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