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ANALYSIS AND EXPERIMENTAL INVESTIGATION OF THERMAL-STRESS-FREE FASTENERS
UNDER THE MULTI FACTORS

Abstract

Paper mainly considered Coefficient of Thermal Expansion (CTE) along with temperature, the difference between longitudinal and latitudinal CTE, temperature gradient through the thickness on the influence of the shape of thermal-stress-free fasteners. Expression for thermal-stress-free shapes was presented by fitting equation on the condition of CTE along with temperature. Shapes were derived by the form of material coordinate transformation on the condition of difference between longitudinal and latitudinal CTE. Based on deformation compatibility of the structure curvature, design principles of shapes were presented on the condition of temperature gradient through the thickness. Theoretical analysis was verified by finite element analysis and off-axis tensile test. Analysis results show that (1) shapes are axisymmetrical and related to initial temperature under the correlation between CTE and temperature. (2) Shapes are not axisymmetrical but spheroidal when the difference occurred between longitudinal and latitudinal CTE. (3) When the temperature gradient occurred along the thickness, the condition of thermal-stress-free is that the ratio of conductivity is equal to square of the ratio of the CTE for two materials.