The post-buckling behavior of the composite plates with embedded shape memory alloy subjected to combined loading using finite element method

ABSTRACT

Thin composite structures that are used in aerospace applications can be subjected to buckling failure due to combined mechanical and thermal loadings. This paper presents the work on the thermal post-buckling improvement of composite plates previously subjected to mechanical loading. Pre-strained shape memory alloy wires were embedded within laminated composite plate so that the recovery stress that can improve strain energy of the plate can be induced when the wires were heated. A geometric non-linear finite element formulation of the shape memory alloy composite plate and its source codes were developed. The formulation is based on total strain for the case of mechanical loading and incremental strain for the case of thermal loading. Using the codes, post-buckling paths were determined for quasi-isotropic and anti-symmetric cross-ply composite plates. It was found that by embedding shape memory alloy wires within composite plates, thermal post-buckling paths can be improved significantly even after the degradation of the thermal buckling resistance of composite plates due to the application of the mechanical loading.

Keyword: Shape memory alloy; Strain energy tuning; Non-linear finite element formulation; Thermo-mechanical post-buckling