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FINITE ELEMENT MODELING OF THE ELASTOPLASTIC BEHAVIOR OF BI-LAYER METALIC COMPOSITES

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Aerospace industry has long favored lightweight materials to optimize fuel efficiency. The use of lightweight materials poses stringent requirements on enhancing aircraft structures in harsh environmental conditions. This in turn prompted many investigations on using cladded and multilayer materials as a potential solution for corrosive environments. Recent interest has been garnered in cladding for its adequate corrosion resistance without significantly compromising cost and performance. To date, the evaluation of these multilayer composite structures is normally established through laboratory testing of small-scale specimens. However, understanding the structural performance of cladded composites can be better accomplished using numerical simulations via finite element analysis (FEA). Utilizing FEA simulation enables the application of the derived knowledge of material properties and elastoplastic behavior to larger-scale structures. This study employs FEA to predict the behavior of cladded materials in the elastic-plastic region. In particular, ABAQUS FEA commercial code is used to model these metals' elastoplastic behavior at large strain levels. Increased precision is achieved by calibrating and comparing the generated stress-strain data obtained from these simulations with experimental measurements. Ultimately, the FEA models for individual metals are used to predict the mechanical response of bilayer materials in the elastoplastic region. Simulation results are in close agreement with their corresponding experimental counterparts, further confirming the model's accuracy and effectiveness. Additionally, a parametric study investigates different cladding scenarios and how they can potentially yield enhanced tensile strength and ductility by optimizing their required cladding thickness. The viability of optimizing a bilayer composite's elastoplastic behavior based on exploring varying combinations of bilayer composites, materials, and thicknesses is also discussed. This research is significant for two reasons: it yields a profound understanding of multilayer materials mechanical performance, and it introduces a FEA simulation technique that enables structural and design optimization of larger-scale structures to effectively fulfill design requirements.

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