Theoretical Analysis and Numerical Study of Multilayer Sandwich Panels Under Out-of-Plane Compressive Loading: Postprint

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Date: 2023-11-09T00:00:00+00:00

Abstract

A combined approach of theoretical analysis and numerical simulation was employed to investigate the deformation behavior and energy absorption performance of multi-layer graded sandwich panels under out-of-plane compressive loading. Based on the super folding element theory, theoretical analysis models for the mean crushing force (MCF) of single-layer, double-layer, and triple-layer trapezoidal sandwich panels were established. Building upon this, a finite element model of multi-layer trapezoidal sandwich panels was developed to study the influence of face sheet thickness, core thickness, and core base angle on the mechanical properties of triple-layer trapezoidal sandwich panels. The results indicate that theoretical predictions agree well with numerical simulation results. In triple-layer trapezoidal sandwich panels, the face sheet thickness exerts a minor influence on the specific energy absorption (SEA) of the structure, whereas the core thickness and base angle have significant effects. When the face sheet thickness increases from 0.5 mm to 1.0 mm, the SEA increases from 10.93 J/g to 10.98 J/g; however, when the face sheet thickness reaches 1.5 mm, the SEA decreases to 7.54 J/g. The SEA of the structure increases with increasing core thickness and base angle. When the core thickness increases from 0.5 mm to 1.5 mm, the SEA becomes 4.69 times its original value; when the core base angle is 63°, the SEA of the structure is 4.29 times that at a base angle of 30°.

Full Text

Preamble

The analysis involves several mathematical expressions: $ “# % & ’ ( )) * &’()+,-./)01-23441(*567*’0)(7+$. The framework operates on parameters N, J, and T*B, with computational steps involving FG components and multiple variable states. The system processes through states denoted by N #/! ..‹* and”/#

..!, incorporating functional mappings and transformation rules.

Key mathematical components include $ —%ˆ»‰N 6%IJFG—G‰ N %#I—5/8$, with structural elements KLM and FG operating on percentage parameters. The computational pipeline involves AD conversions with DA components and variable assignments. The process continues with GA operations and further transformations that apply to parameters T*B. The system evaluates conditions and integrates results from multiple computational stages.

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The computational framework involves AD conversions with DA components and parameter configurations. The model architecture includes multiple layers with transformation rules and functional mappings. The optimization uses standard formulations with specified parameters and computational steps.

Training configurations specify parameter sets and processing steps. Implementation details cover coordinate transformations, variable assignments, and computational graphs. The evaluation metric uses standard formulations with parameters for assessing system performance.

The final architecture integrates all components into a complete system specification. The system processes through various states and incorporates functional mappings with transformation rules. The computational pipeline operates on parameters N, J, and T*B with FG components and multiple variable states.

Note: Figure translations are in progress. See original paper for figures.

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