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Minh-Chien Trinh, Seung-Eock Kim

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Nonlinear thermomechanical behaviors of thin functionally graded sandwich shells with double curvature

Minh-Chien Trinh[1], Seung-Eock Kim[1*]

[1]Department of Civil and Environmental Engineering, Sejong University

209, Neudong-ro, Gwangjin-gu, Seoul 143-747, Korea

* Corresponding author. Tel.: +82-2-3408-3291; Fax: +82-2-3408-3332. E-mail address: sekim@sejong.ac.kr (S.E. Kim).

Abstract

Analytical closed-form solutions for thermos-mechanical stability and explicit expressions for free- and forced- vibration of thin functionally graded sandwich shells with double curvature resting on elastic bases are investigated for the first time in this study. A core layer of ceramic and two cover layers of functionally graded materials constitute the shell structure. Governing equations are derived from the classical shell theory using Hamilton's principle admitting Volmir assumption and von Karman nonlinear displacement fields. Theoretical solutions are achieved by using the Bubnov-Galerkin procedure in solving differential equations. Parametric studies showing the effects of temperature-dependent features, material constituents, initial geometry imperfections, external thermos-mechanical loadings, elastic bases, and geometry configuration on static and dynamic behaviors of the shells are performed. Thin functionally graded sandwich spherical, cylindrical, and hyperbolic paraboloid shells are studied. Snap-through phenomena under load-control conditions are recognized in thin functionally graded sandwich cylindrical shells. The fourth-order Runge-Kutta method is employed to numerically solve dynamic problems and four analogies are drawn to validate theoretical formulations.