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Postbuckling behavior of functionally graded graphene-reinforced composite laminated cylindrical shells under axial compression in thermal environments

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4 **composite laminated cylindrical shells under axial compression in**  
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6 **thermal environments**  
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19 **Abstract**

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21 The current research deals with the postbuckling behavior of axially-loaded  
22 graphene-reinforced composite (GRC) laminated cylindrical shells under thermal  
23 environmental conditions. The piece-wise GRC layers are arranged in a functionally graded  
24 (FG) pattern along the thickness direction of the shells. The material properties of GRCs are  
25 assumed to be temperature-dependent and are estimated by the extended Halpin-Tsai  
26 micromechanical model. The governing equations for the GRC laminated cylindrical shells are  
27 based on the Reddy's third order shear deformation shell theory and include the effects of the  
28 temperature variation. The nonlinearity effects are taken into account in the sense of von  
29 Kármán nonlinear kinematic assumptions. The buckling loads and the postbuckling  
30 equilibrium paths for the perfect and geometrically imperfect GRC laminated cylindrical shells  
31 can be obtained by solving the governing equations with a singular perturbation technique in  
32 conjunction with a two-step perturbation approach. The results show that the buckling loads  
33 and the postbuckling strengths of the GRC laminated cylindrical shells may be enhanced  
34 through piece-wise functionally graded distribution of graphene reinforcement.  
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52 *Keywords:* Postbuckling; Laminated cylindrical shell; Axial compression; Nanocomposites;  
53 Functionally graded materials; Temperature-dependent properties  
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