Thermomagnetic viscoelastic responses in a functionally graded hollow structure

Author(s):

Allam, MNM (Allam, M. N. M.)[1]

E-mail: mallam@mans.edu.eg;

1] Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt

Tantawy, R (Tantawy, R.)[2]

E-mail: rania_eltantwy@yahoo.com

2] Mansoura Univ, Dept Math, Fac Sci, Dumyat 34517, Egypt

Abstract:

This paper presents an analytical solution for the interaction of electric potentials, electric displacements, elastic deformations, and thermoelasticity, and describes electromagnetoelastic responses and perturbation of the magnetic field vector in hollow structures (cylinder or sphere), subjected to mechanical load and electric potential. The material properties, thermal expansion coefficient and magnetic permeability of the structure are assumed to be graded in the radial direction by a power law distribution. In the present model we consider the solution for the case of a hollow structure made of viscoelastic isotropic material, reinforced by elastic isotropic fibers, this material is considered as structurally anisotropic material. The exact solutions for stresses and perturbations of the magnetic field vector in FGM hollow structures are determined using the infinitesimal theory of magnetothermoelasticity, and then the hollow structure model with viscoelastic material is solved using the correspondence principle and Illyushin's approximation method. Finally, numerical results are carried out and discussed.

KeyWords: Functionally graded material; Viscoelasticity; Perturbation of magnetic field vector; Magnetoelasticity

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On the simple and mixed first-order theories for plates resting on elastic foundations

Author(s):
Zenkour, AM (Zenkour, A. M.)[1,2]
E-mail: zenkour@gmail.com
[1] King Abdulaziz Univ, Fac Sci, Dept Math, Jeddah 21589, Saudi Arabia
[2] Kafrelsheikh Univ, Fac Sci, Dept Math, Kafr Al Sheikh 33516, Egypt
Allam, MNM (Allam, M. N. M.)[3]
E-mail: mallam@mans.edu.eg;
[3] Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt
Shaker, MO (Shaker, M. O.)[4]
Radwan, AF (Radwan, A. F.)[4]
[4] Tanta Univ, Fac Sci, Dept Math, Tanta 31527, Egypt

Abstract:
This article investigates the bending response of an orthotropic rectangular plate resting on two-parameter elastic foundations. Analytical solutions for deflection and stresses are developed by means of the simple and mixed first-order shear deformation plate theories. The present mixed plate theory accounts for variable transverse shear stress distributions through the thickness and does not require a shear correction factor. The governing equations that include the interaction between the plate and the foundations are obtained. Numerical results are presented to demonstrate the behavior of the system. The results are compared with those obtained in the literature using three-dimensional elasticity theory or higher-order shear deformation plate theory to check the accuracy of the simple and mixed first-order shear deformation theories.

KeyWords: DIFFERENTIAL QUADRATURE METHOD; FINITE-ELEMENT FORMULATION; VARIATIONAL FORMULA; LAMINATED PLATES; FREE-VIBRATION; DYNAMIC-RESPONSE; THICK PLATES; BEAMS
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Bending of a fiber-reinforced viscoelastic composite plate resting on elastic foundations

Author(s):
Zenkour, AM (Zenkour, A. M.)[1]
E-mail: zenkour@gmail.com
[1] Kafrelsheikh Univ, Fac Sci, Dept Math, Kafr Al Sheikh 33516, Egypt
Sobhy, M (Sobhy, M.)[1]
[1] Department of Mathematics, Faculty of Science, Kafr El-Sheikh University, Kafr El-Sheikh 33516, Egypt
Allam, MNM (Allam, M. N. M.)[2]
E-mail: mallam@mans.edu.eg;
[2] Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt

Abstract:
Composite structures on an elastic foundation are being widely used in engineering applications. Bending response of inhomogeneous viscoelastic plate as a composite structure on a two-parameter (Pasternak's type) elastic foundation is investigated. The formulations are based on sinusoidal shear deformation plate theory. Trigonometric terms are used in the present theory for the displacements in addition to the initial terms of a power series through the thickness. The transverse shear correction factors are not needed because a correct representation of the transverse shear strain is given. The interaction between the plate and the foundation is included in the formulation with a two-parameter Pasternak's model. The effective moduli and Illyushin's approximation methods are used to derive the viscoelastic solution. The effects played by foundation stiffness, plate aspect ratio, and other parameters are presented.

KeyWords: Bending response; Viscoelastic composite plate; Elastic foundation; Sinusoidal shear deformation plate theory.

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Bending analysis of FG viscoelastic sandwich beams with elastic cores resting on Pasternak's elastic foundations

Author(s):
Zenkour, AM (Zenkour, A. M.)[1]
E-mail: zenkour@gmail.com
[1] Kafrelsheikh Univ, Fac Sci, Dept Math, Kafr Al Sheikh 33516, Egypt
Sobhy, M (Sobhy, M.)[1]
Department of Mathematics, Faculty of Science, Kafr El-Sheikh University, Kafr El-Sheikh 33516, Egypt
Allam, MNM (Allam, M. N. M.)[2]
E-mail: mallam@mans.edu.eg;
[2] Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt

Abstract:
The investigation of bending response of a simply supported functionally graded (FG) viscoelastic sandwich beam with elastic core resting on Pasternak's elastic foundations is presented. The faces of the sandwich beam are made of FG viscoelastic material while the core is still elastic. Material properties are graded from the elastic interfaces through the viscoelastic faces of the beam. The elastic parameters of the faces are considered to be varying according to a power-law distribution in terms of the volume fraction of the constituent. The interaction between the beam and the foundations is included in the formulation. Numerical results for deflections and stresses obtained using the refined sinusoidal shear deformation beam theory are compared with those obtained using the simple sinusoidal shear deformation beam theory, higher- and first-order shear deformation beam theories. The effects due to material distribution, span-to-thickness ratio, foundation stiffness and time parameter on the deflection and stresses are investigated.

Keywords: FUNCTIONALLY GRADED BEAMS; FINITE-ELEMENT FORMULATION; SHEAR DEFORMATION-THEORY; COMPREHENSIVE ANALYSIS; COMPOSITE BEAMS; FREE-VIBRATION; PLATES; INTERFACES; CYLINDERS; BEHAVIOR
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EFFECT OF TRANSVERSE NORMAL AND SHEAR DEFORMATION ON A FIBER-REINFORCED VISCOELASTIC BEAM RESTING ON TWO-PARAMETER ELASTIC FOUNDATIONS

Author(s):

Zenkour, AM (Zenkour, A. M.)[1]

E-mail: zenkour@gmail.com

[1] Kafrelsheikh Univ, Fac Sci, Dept Math, Kafr Al Sheikh 33516, Egypt

Sobhy, M (Sobhy, M.)[1]

[1] Department of Mathematics, Faculty of Science, Kafr El-Sheikh University, Kafr El-Sheikh 33516, Egypt

Allam, MNM (Allam, M. N. M.)[2]

E-mail: mallam@mans.edu.eg;

[2] Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt

Abstract:

This article investigates the effect of transverse normal and shear deformations on a fiber-reinforced viscoelastic beams resting on two-parameter (Pasternak's) elastic foundations. The results are obtained by the refined sinusoidal shear deformation beam theory and compared with those obtained by the simple sinusoidal shear deformation beam theory, Timoshenko first-order shear deformation beam theory as well as Euler-Bernoulli classical beam theory. The effects of foundation stiffness on bending of viscoelastic composite beam are presented. The effective moduli methods are used to derive the governing equations of viscoelastic beams. The influences of several parameters, such as length-to-depth ratio, foundation stiffness, time parameter and other parameters on mechanical behavior of composite beams resting on Pasternak's foundations are investigated. Numerical results are presented and conclusions are formulated.

KeyWords: Pasternak's foundations; Viscoelastic composite beam; Transverse normal and shear deformation; Refined sinusoidal beam theory

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