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Influence of clamped-clamped boundary conditions on the mechanical stress, strain and deformation analyses of cylindrical sport equipment

Yuhao Yang*[1] and Mohammad Arefi[2]

[1]Guangzhou Sport University, Guangzhou 510630, Guangdong, China
[2]Faculty of Mechanical Engineering, Department of Solid Mechanics, University of Kashan, Kashan 87317-51167, Iran

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Abstract. The higher order shear deformable model and an exact analytical method is used for analytical bending analysis of a cylindrical shell subjected to mechanical loads, in this work. The shell is modelled using sinusoidal bivariate shear strain theory, and the static governing equations are derived using changes in virtual work. The eigenvalue-eigenvector method is used to exactly solve the governing equations for a constrained cylindrical shell The proposed kinematic relation decomposes the radial displacement into bending, shearing and stretching functions. The main advantage of the method presented in this work is the study of the effect of clamping constraints on the local stresses at the ends. Stress, strain, and deformation analysis of shells through thickness and length.

Keywords: clamped-clamped cylindrical pressure vessel; shear deformable model; stress/strain analyses; thickness stretching; virtual work principle

1. Introduction

Stress and deformation analysis of the structures are used as necessary requirement before failure analysis and yield criterial analysis of the structures. The stress and strain analyses of the cylindrical shell subjected to pressure are very important for designer of this structures. The main problem in stress and strain analysis of the structures is predicting the effect of boundary conditions on the elastic responses. The cylindrical shells are used in various industrial applications such as chemical reactors, weapon instruments and aerospace technologies. For accurate modeling the cylindrical shell, the shear deformation theory should be used. In this work, a higher-order shear deformable model is used for more accurate modeling the shear stress and strain at both ends of the cylindrical shell with clamped-clamped boundary conditions. Although there are some important works on the vibration analysis of cylindrical shell (Mercan and Civalek 2019, Civalek *et al.* 2021, Arefi and Civalek 2020), however there is no comprehensive work on the stress, strain and deformation analysis using the analytical methods.

Li *et al.* (2008) studied elastic responses of a pressure vessel subjected to internal blast loading. The bending and membrane configurations of vibration responses have been discussed analytically. The nonlinear in plane results of the shell was analyzed using the FEM. Shah *et al.* (2010) developed a theoretical work on the vibration responses of a functionally graded cylindrical shell resting on elastic foundation based on wave propagation method. Ma *et al.* (2008) developed an experimental analysis for elastic buckling analysis of bionic cylindrical shells using three-point bending test for computation of elastic moduli. The results of the bionics were compared with the finite element responses. As a results, 124% increase in load capacity was obtained. Huang *et al.* (2021) investigated effect of several dispersions of graphene nanoplatelets on the thermomechanical responses of the closed cylindrical shells subjected to various thermal boundary conditions. Effect of both hemispherical shell at the end of cylindrical shell was included in the analysis. Jin *et al.* (2013) studied free vibration responses of a laminated composite cylindrical shell subjected to general elastic boundaries and various laminations. Significance of the Fourier series was developed in the solution procedure. The problem was solved using Rayleigh–Ritz procedure. The results have been extended with changes of boundaries stiffness and various laminations. Karam and Gibson (1995) developed an experimental work on the elastic buckling responses of the cylindrical shells on the rubber made of silicone considering cores made of compliant foam using four-point bending test and uniaxial compression. Some applications of nanomaterials in fluid dynamics and heat transfer may be observed in the (Abbas *et al.* 2020, Maouedj *et al.* 2021, Hu *et al.* 2021, Liaquat *et al.* 2021, Ramesh *et al.* 2020, Nazeer *et al.* 2021, Ha *et al.* 2020, Chu *et al.* 2020 a, b, Chung *et al.* 2021, Waqas *et al.* 2020, Ge-JiLe *et al.* 2021, Khan *et al.* 2022, Adnan *et al.* 2020, Ikram *et al.* 2022, Rasool *et al.* 2022, Nazeer *et al.* 2022, Ibrahim *et al.* 2021).

Loy and Lam (1999) used layerwise methodology for free vibration investigation of the circular shells based on 3D elasticity theory with SS and CC boundary conditions. Division method was used for solution of the problem in which trigonometric functions have been employed for description of deflection along the thickness direction.

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*Corresponding author, Master
E-mail: yangyuhao199696@163.com

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Akbari Alashti and Khorsand (2011) studied effect of thermal and mechanical loads on the thermoelastic responses of FG shells using differential quadrature method. The shell was integrated with piezoelectric layers. Arefi *et al.* (2021) used a theoretical two dimensional method for elastic analysis of graphene nanoplatelets reinforced cylindrical pressure vessel based on a shear deformable model. The results were presented for different dispersions of reinforcement. Sofiyev and Kuruoglu (2013) studied torsional vibration and stability analyses of the functionally graded cylindrical shell resting on an elastic foundation using the Galerkin's approach. Chen *et al.* (2013) used Fourier series method for dynamic responses of cylindrical shell with nonuniform boundary conditions. Rayleigh–Ritz technique was used to obtain unknown coefficients. Accuracy of the method was performed through comparison with FE results. Santos *et al.* (2009) studied free vibration responses of functionally graded cylindrical shell using a semi analytical finite element method and three dimensional linear elasticity theory. Karam and Gibson (1995) presented an elastic analysis on the elastic buckling analysis of cylindrical shell with elastic core. Ghannad *et al.* (2013) employed a shear deformable model for analytical elastic analysis of a CC cylindrical shell with variable thickness using matched asymptotic method and perturbation technique. The trueness of the results has been confirmed through comparison with finite element results. Xuyuan *et al.* (2020) employed an improved unified version of Rayleigh-Ritz method for damping/vibration characteristics of thin shell with short length composed of viscoelastic damping materials based on Donnell's shell theory. Soldatos (1994) summarized a review work on the three dimensional dynamic responses of circular cylindrical shell made of composite materials based on analytical methods and finite element approach. The buckling and stability analyses of the shell and plate structures of advanced materials was studied by Huang *et al.* (2021). Wave propagation characteristics of functionally graded materials was studied by Tahir *et al.* (2022) and Liu *et al.* (2022). There are some important works on the new material and structures applicable in advanced technologies reported by Bai *et al.* (2022, 2023), Shi *et al.* (2023), Luo *et al.* (2023), Sun *et al.* (2023a, b), Hao *et al.* (2022), Lu *et al.* (2022), Shi *et al.* (2023), Zhang *et al.* (2022), Li *et al.* (2022, 2023), Wu *et al.* (2023), Tian *et al.* (2023 a, b), Ren *et al.* (2022), Guo *et al.* (2022), Fu *et al.* (2020), Yang *et al.* (2022), Yu *et al.* (2023), Zhang *et al.* (2021). Effect of gradation of material properties and porosity was studied on the vibration and bending responses of advanced materials and structures by Kouider *et al.* (2021); Rachid *et al.* (2022).

Safarpour *et al.* (2020) developed elasticity theory for three dimensional static/dynamic analyses of graphene nanoplatelets reinforced truncated conical shell with various boundary conditions. Numerical solution of the governing equations was obtained using DQM and state-space technique. Ma *et al.* (2017) developed modified Fourier-Ritz approach for solution of cylindrical shell including annular plates at a definite length location with various boundary conditions. The results have been presented in terms of axial location of the annular plates. Haywood (1958) studied effect of a pressure pulse on the dynamic responses and model analysis of an elastic cylindrical shell. Brooks (1987) presented elastoplastic analysis of a pressurized cylindrical shell based on Tresca yield criteria. It was expressed that the plasticity is often occurred near the ends of segment where bending stresses are very important. Foroutan *et al.* (2019) developed an analytical approach for free vibration responses of cylindrical shell reinforced with spiral segments resting on linear and nonlinear foundation with damping force. The governing equations of motion were solved using Galerkin's technique. Von Karman nonlinearity was included in the governing equations. Kushnir *et al.* (2021) used refined theory of the shells for thermoelastic analysis of short length cylindrical shell with accounting out of plane shear strains using Laplace transformation technique and Fourier method. Mehditabar *et al.* (2018) employed coupled differential quadrature as well as finite difference method for transient thermoelastic analysis of a smart cylindrical shell subjected to centrifugal force.

Recent works on the analysis of cylindrical pressure vessels were studied with focus on the higher-order shear deformation theory. The main contribution of this paper is modeling the shear deformation and stress at the clamped boundaries using the two-variable sinusoidal shear deformation theory with accounting thickness stretching functions responsible for strain along the thickness direction. This paper investigates effect of clamped-clamped boundary conditions on the longitudinal variation of various stress and deformation components specially shear stress using Eigenvalue-Eigenvector method. The governing equations are derived using virtual work principle. The stress, strain and deformation results will be presented along the longitudinal and radial directions.

2. Thickness stretching included formulation

Eigenvalue-Eigenvector method is used in this section for mechanical stress, strain and deformation analyses of pressurized cylindrical shell based on a higher-order shear deformable modelling. Virtual work Principle is used for formulation of the problem. The strain energy for a shear deformable shell is define as

$$\delta U=\int_{r}\int_{\theta}\int_{z}\left[\sigma_{xx}\delta\varepsilon_{xx}+\sigma_{\theta\theta}\delta\varepsilon_{\theta\theta}+\sigma_{zz}\delta\varepsilon_{zz}+\tau_{xz}\delta\gamma_{xz}\right]dV \tag{1}$$

The constitutive relations are derived as

$$\begin{Bmatrix}\sigma_{xx}\\ \sigma_{\theta\theta}\\ \sigma_{zz}\\ \tau_{xz}\end{Bmatrix}=\frac{E}{(1-2\vartheta)(1+\vartheta)}\begin{bmatrix}1-\vartheta & \vartheta & \vartheta & 0\\ \vartheta & 1-\vartheta & \vartheta & 0\\ \vartheta & \vartheta & 1-\vartheta & 0\\ 0 & 0 & 0 & \frac{1-2\vartheta}{2}\end{bmatrix}\begin{Bmatrix}\varepsilon_{xx}\\ \varepsilon_{\theta\theta}\\ \varepsilon_{zz}\\ \gamma_{xz}\end{Bmatrix} \tag{2}$$

In which E,ϑ are modulus of elasticity and Poisson's ration, respectively. The strain components are defined using the kinematic relations. The two-variable sinusoidal shear deformation theory is used for description of kinematic relations with accounting thickness stretching functions. The kinematic relations for axial and radial displacements are developed as (Allam *et al.* 2020)

$$u_x = u_0 - z\frac{\partial w_b}{\partial x} - f(z)\frac{\partial w_s}{\partial x}, \quad w_z = w_b + w_s + g(z)\chi \tag{3}$$

In which, w_b, w_s are bending and shear parts of transverse displacements, χ as the thickness stretching function, $f(z) = z - h/\pi \sin(\pi z/h)$ and $g(z) = 1 - f'(z)$. Using the kinematic relations in cylindrical coordinate system, the strains are derived as

$$\begin{Bmatrix} \varepsilon_{xx} \\ \varepsilon_{\theta\theta} \\ \varepsilon_{zz} \\ \gamma_{xz} \end{Bmatrix} = \begin{bmatrix} \frac{\partial(..)}{\partial x} & -z\frac{\partial^2(..)}{\partial x^2} & -f(z)\frac{\partial^2(..)}{\partial x^2} & 0 \\ 0 & \frac{1}{r} & \frac{1}{r} & \frac{g(z)}{r} \\ 0 & 0 & 0 & g'(z) \\ 0 & 0 & g(z)\frac{\partial(..)}{\partial x} & g(z)\frac{\partial(..)}{\partial x} \end{bmatrix} \begin{Bmatrix} u_0 \\ w_b \\ w_s \\ \chi \end{Bmatrix} \tag{4}$$

Using the strain components, the variation of strain energy is formulated as (Arefi and Rahimi 2010, 2011, 2012a,b,c, 2014, Rahimi *et al.* 2011, 2012, Khoshgoftar *et al.* 2013, Arefi *et al.* 2011, 2018, 2019)

$$\begin{aligned} \delta U = 2\pi \int & [N_{xx}\frac{\partial \delta u_0}{\partial x} - M_{xx}\frac{\partial^2 \delta w_b}{\partial x^2} - S_{xx}\frac{\partial^2 \delta w_s}{\partial x^2} + N_{\theta\theta}\delta w_b \\ & + N_{\theta\theta}\delta w_s + S_{\theta\theta}\delta\chi + S_{zz}\delta\chi + N_{xz}\frac{\partial \delta w_s}{\partial x} \\ & + S_{xz}\frac{\partial \delta\chi}{\partial x}]dx \end{aligned} \tag{5}$$

Where the resultant components are defined in Appendix. Substitution of stress components yields the resultant components as follows

$$N_{xx} = \wp_1\frac{\partial u_0}{\partial x} - \wp_2\frac{\partial^2 w_b}{\partial x^2} - \wp_3\frac{\partial^2 w_s}{\partial x^2} + \wp_4 w_b + \wp_4 w_s + \wp_5\chi + \wp_6\chi$$

$$M_{xx} = \wp_7\frac{\partial u_0}{\partial x} - \wp_8\frac{\partial^2 w_b}{\partial x^2} - \wp_9\frac{\partial^2 w_s}{\partial x^2} + \wp_{10} w_b + \wp_{10} w_s + \wp_{11}\chi + \wp_{12}\chi$$

$$S_{xx} = \wp_{13}\frac{\partial u_0}{\partial x} - \wp_{14}\frac{\partial^2 w_b}{\partial x^2} - \wp_{15}\frac{\partial^2 w_s}{\partial x^2} + \wp_{16} w_b + \wp_{16} w_s + \wp_{17}\chi + \wp_{18}\chi$$

$$N_{\theta\theta} = \wp_{19} w_b + \wp_{19} w_s + \wp_{20}\chi + \wp_{21}\frac{\partial u_0}{\partial x} - \wp_{22}\frac{\partial^2 w_b}{\partial x^2} - \wp_{23}\frac{\partial^2 w_s}{\partial x^2} + \wp_{24}\chi$$

$$S_{\theta\theta} = \wp_{25} w_b + \wp_{25} w_s + \wp_{26}\chi + \wp_{27}\frac{\partial u_0}{\partial x} - \wp_{28}\frac{\partial^2 w_b}{\partial x^2} - \wp_{29}\frac{\partial^2 w_s}{\partial x^2} + \wp_{30}\chi$$

$$S_{zz} = \wp_{31}\chi + \wp_{32} w_b + \wp_{32} w_s + \wp_{33}\chi + \wp_{34}\frac{\partial u_0}{\partial x} - \wp_{35}\frac{\partial^2 w_b}{\partial x^2} - \wp_{36}\frac{\partial^2 w_s}{\partial x^2}$$

$$N_{xz} = \wp_{37}\frac{\partial w_s}{\partial x} + \wp_{38}\frac{\partial \chi}{\partial x}$$

$$S_{xz} = \wp_{39}\frac{\partial w_s}{\partial x} + \wp_{40}\frac{\partial \chi}{\partial x}$$

The external work is computed as follow

$$\delta W = 2\pi \int \int [(P_i - P_o - F_f)\delta w_b + (P_i - P_o - F_f)\delta w_s]dzdx \tag{7}$$

The governing equations are derived as

$$\begin{aligned} & \delta u_0: -\frac{\partial N_{xx}}{\partial x} = 0 \\ & \delta w_b: -\frac{\partial^2 M_{xx}}{\partial x^2} + N_{\theta\theta} = P_i - P_o - F_f \\ & \delta w_s: -\frac{\partial^2 S_{xx}}{\partial x^2} - \frac{\partial N_{xz}}{\partial x} + N_{\theta\theta} = P_i - P_o - F_f \\ & \delta\chi: S_{\theta\theta} + S_{zz} - \frac{\partial S_{xz}}{\partial x} = 0 \end{aligned} \tag{8}$$

Substitution of resultant components into governing equations leads governing equations as follows

$$\begin{aligned} \delta u_0: & -\wp_1\frac{\partial^2 u_0}{\partial x^2} + \wp_2\frac{\partial^3 w_b}{\partial x^3} - \wp_4\frac{\partial w_b}{\partial x} + \wp_3\frac{\partial^3 w_s}{\partial x^3} - \wp_4\frac{\partial w_s}{\partial x} \\ & - (\wp_5 + \wp_6)\frac{\partial \chi}{\partial x} = 0 \\ \delta w_b: & - \wp_7\frac{\partial^3 u_0}{\partial x^3} + \wp_{21}\frac{\partial u_0}{\partial x} + \wp_8\frac{\partial^4 w_b}{\partial x^4} - (\wp_{10} + \wp_{22} + K_p)\frac{\partial^2 w_b}{\partial x^2} \\ & + (\wp_{19} + K_w)w_b + \wp_9\frac{\partial^4 w_s}{\partial x^4} \\ & - (\wp_{10} + \wp_{23} + K_p)\frac{\partial^2 w_s}{\partial x^2} + (\wp_{19} + K_w)w_s \\ & - (\wp_{11} + \wp_{12})\frac{\partial^2 \chi}{\partial x^2} + (\wp_{20} + \wp_{24})\chi \\ & = P_i - P_o \\ \delta w_s: & -\wp_{13}\frac{\partial^3 u_0}{\partial x^3} + \wp_{21}\frac{\partial u_0}{\partial x} + \wp_{14}\frac{\partial^4 w_b}{\partial x^4} - (\wp_{16} + \wp_{22} + K_p)\frac{\partial^2 w_b}{\partial x^2} \\ & + (K_w + \wp_{19})w_b + \wp_{15}\frac{\partial^4 w_s}{\partial x^4} \\ & - (\wp_{16} + \wp_{23} + \wp_{37} + K_p)\frac{\partial^2 w_s}{\partial x^2} \\ & + (K_w + \wp_{19})w_s - (\wp_{17} + \wp_{18} + \wp_{38})\frac{\partial^2 \chi}{\partial x^2} \\ & + (\wp_{20} + \wp_{24})\chi = P_i - P_o \\ \delta\chi: & (\wp_{34} + \wp_{27})\frac{\partial u_0}{\partial x} - (\wp_{28} + \wp_{35})\frac{\partial^2 w_b}{\partial x^2} + (\wp_{25} + \wp_{32})w_b \\ & - (\wp_{29} + \wp_{36} + \wp_{39})\frac{\partial^2 w_s}{\partial x^2} + (\wp_{25} + \wp_{32})w_s \\ & - \wp_{40}\frac{\partial^2 \chi}{\partial x^2} + (\wp_{26} + \wp_{30} + \wp_{31} + \wp_{33})\chi = 0 \end{aligned} \tag{9}$$

3. Solution

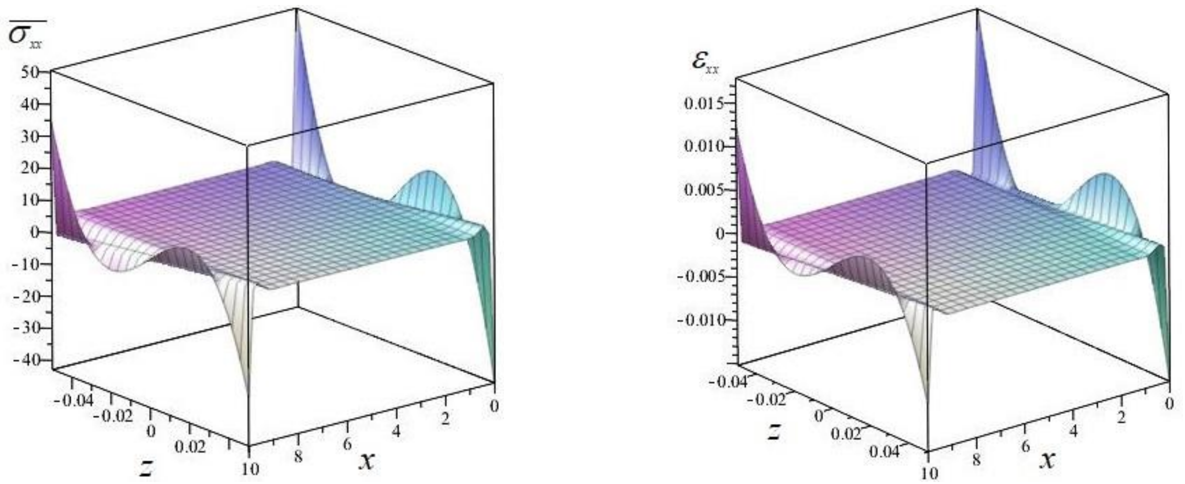
The solution is developed in this section for a clamped-clamped boundary conditions. The solution is performed using Eigenvalue-Eigenvector method. Based on this method, the results are assumed as exponential form as follows

$$[X] = \begin{Bmatrix} u_0 \\ w_b \\ w_s \\ \chi \end{Bmatrix}, X^j = e^{m_i x} C_i \in_i^j \tag{10}$$

in which X is unknown vector including four unknown functions, C_i are unknown integration constants, and $\in_i^j$ are eigenvectors. Two dimensional results including stresses, strains and displacements are explored along the radial and axial directions. The eigenvalues are obtained with substitution of the proposed solution into the governing equations and solution of the characteristics equations as follows: After finding the eigenvalues, the eigenvectors should be obtained using the normalization as follows

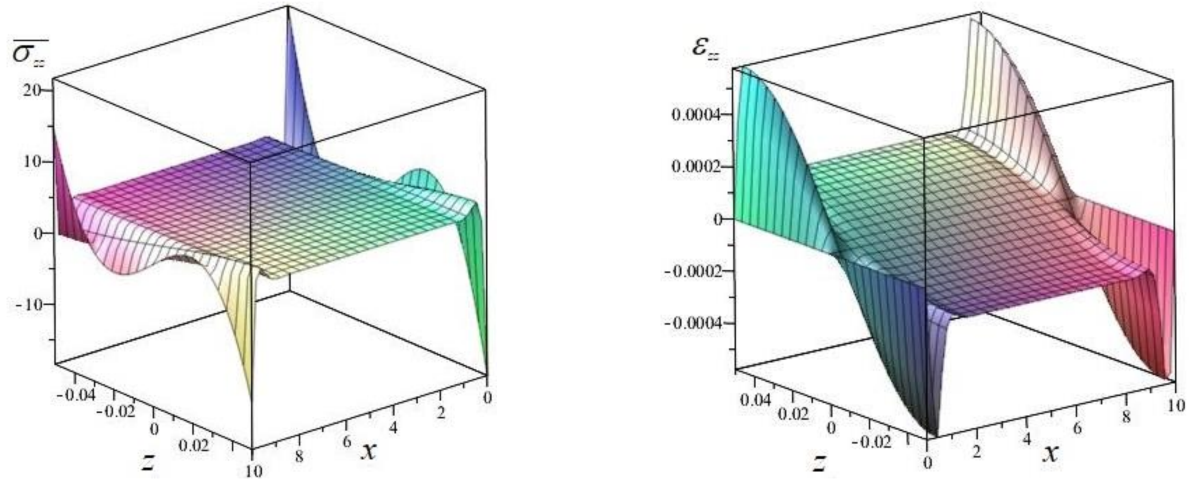
$$[G]_{m_i}\{\Xi_i^j\} = 0$$

The values of eigenvectors are obtained using solution of the above relation for every eigenvalue. The integration constants are obtained using applying the required boundary conditions.



(a) Stress (b) Strain

Fig. 1 Two dimensional variation of the axial stress $\overline{\sigma_{xx}}$ and strain ε_{xx} along the thickness and length directions



(a) Stress (b) Strain

Fig. 2 Two dimensional variation of the radial stress $\overline{\sigma_{zz}}$ and strain ε_{zz} along the thickness and length directions

4. Results and discussion

Numerical results including radial displacements, bending, shear and tensile deformations, radial, hoop and axial stresses and strains are given in this section along the thickness and axial directions.

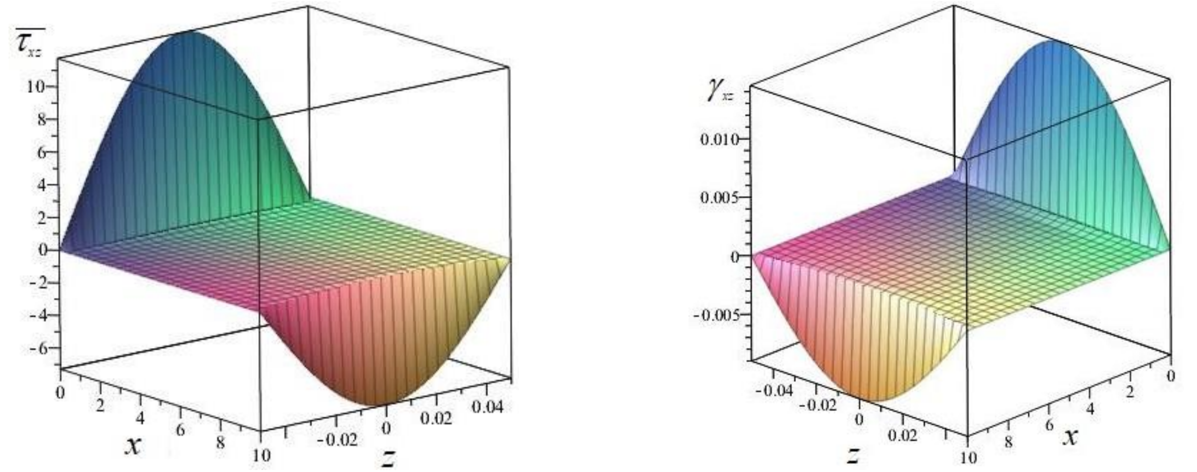
The numerical results including mechanical stress, strain and deformation are presented in this section along the thickness and length directions. Figs. 1(a) and 1(b) present two dimensional changes of mechanical axial stress $\overline{\sigma_{xx}}$ and strain ε_{xx} along the thickness and length directions for an internally pressurized cylindrical shell. It is concluded that the maximum stress and strain are occurred at both ends of the shell as well as inner and outer surfaces.

Shown in Figs. 2(a) and 2(b) present two dimensional changes of radial stress $\overline{\sigma_{zz}}$ and strain ε_{zz} along the thickness and length directions for an internally pressurized cylindrical shell. The maximum radial strain is observed at both ends of the shell as well as inner and outer surfaces. Investigating the changes of radial stress indicates that this stress is approximately constant at more location of the shell except both ends and inner and outer surfaces where the maximum ones are occurred.

Two dimensional changes of shear stress $\overline{\tau_{xz}}$ and strain γ_{xz} is observed in Figs. 3(a) and 3(b). It is concluded that the maximum shear stress is occurred at the location of the clamped constraints where the most shear deformations are occurred. Furthermore, based on elementary concepts in strength materials, the maximum shear stress is occurred at middle of the thickness in which is decreased to the inner and outer surfaces.

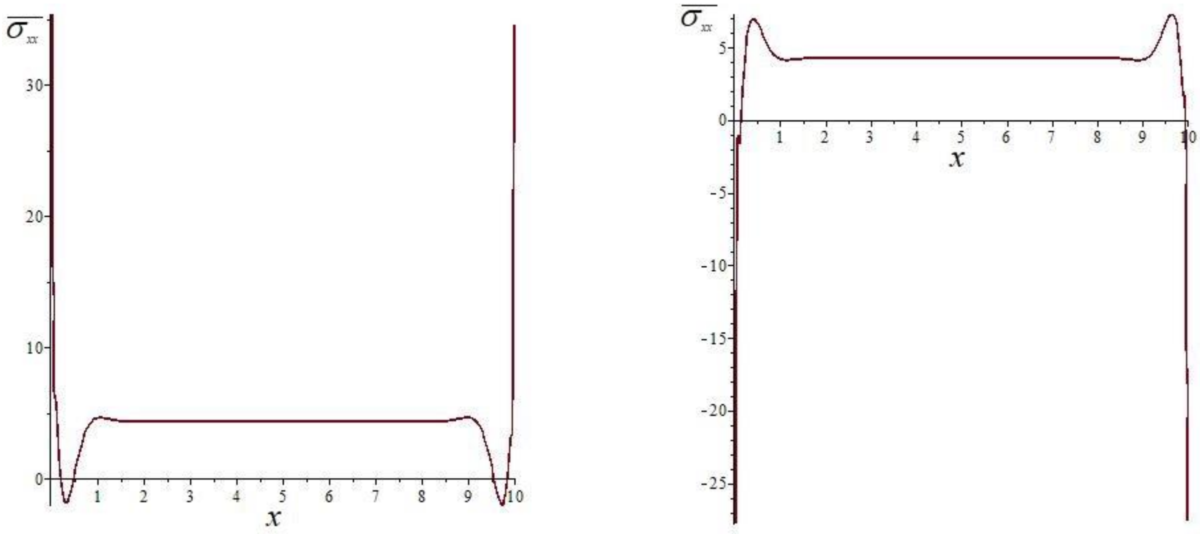
Longitudinal variations of circumferential and radial stresses are presented in Figs. 4 and 5(a) and 5(b), respectively. A uniform variation of circumferential and radial stress is observed at middle of the thickness while the maximum ones are observed at both ends of the shell where the clamped constraints are existed.

Fig. 8 shows longitudinally changes of shear stress $\overline{\tau_{xz}}$ at middle surface z=0 and a surface at z=t/4 along the length direction. It is observed that the shear stress is zero at most longitudinal locations of the shell except at both clamped ends where the main shear stress is observed.



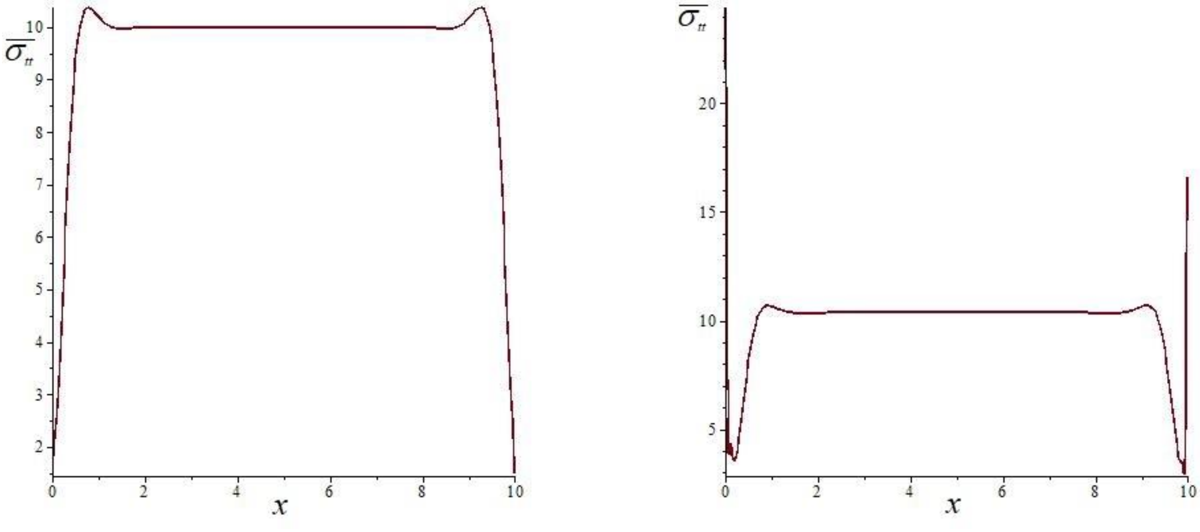
(a) Stress (b) Strain

Fig. 3 Two dimensional variation of the shear stress $\overline{\tau_{xz}}$ and strain γ_{xz}along the thickness and length directions



(a) z=0 (b) z=t/2

Fig. 4 Longitudinal changes of axial stress $\overline{\sigma_{xx}}$ at middle and outer surfaces



(a) z=0 (b) z=t/2

Fig. 5 Longitudinal changes of circumferential stress $\overline{\sigma_{tt}}$ at middle and outer surfaces

5. Conclusions

Stress, strain, and deflection analysis of a pressurized cylindrical shell using a high-order deformable model based on a bivariate sinusoidal shear strain theory. For more accurate modeling of shells, the thickness stretch function is used for transverse displacements and accounts for the sinusoidal variation of axial displacements through the thickness. Use the principle of virtual work to derive the relevant equations. The eigenvalue-eigenvector method is used for the general solution of the clamp-clamp boundary condition problem. Results including homogeneous and granular solutions were obtained using the proposed method. Determine the constants of integration using the desired boundary conditions. Results are determined along the longitudinal and thickness directions. The main outputs of this work are categorized as follows:

The two-dimensional variation of the normal stress and strain along the longitudinal and radial directions shows that the maximum values occur at both ends and the inner and outer surfaces of the shell. The changes in shear stress and strain show that the largest changes occur at the restraint locations where most shear deformation occurs.

Furthermore, zero shear stresses were observed at most of the longitudinal positions of the shell, except at the two clamped ends where major shear stresses were observed.

The longitudinal variation of the bending and shear parts of the transverse strain indicates that the bending deflection is much larger than the shear deflection. Uniform bending and shear strain values are observed in the middle of the shell.

References

Abbas, S.Z., Waqas, M., Thaljaoui, A., Zubair, M., Riahi, A., Chu, Y.M. and Khan, W.A. (2022), “Modeling and analysis of unsteady second-grade nanofluid flow subject to mixed convection and thermal radiation”, *Soft Comput.*, **26**(3), 1033-1042. https://doi.org/10.1007/s00500-021-06575-7.

Adnan, U.K., Ahmed, N. and Mohyud-Din, S.T. (2020), “γ-nanofluid thermal transport between parallel plates suspended by micro-cantilever sensor by incorporating the effective Prandtl model: applications to biological and medical sciences”, *Molecules*, **25**(8), 1777. https://doi.org/10.3390/molecules25081777.

Akbari Alashti, R. and Khorsand, M. (2011), “Three-dimensional thermo-elastic analysis of a functionally graded cylindrical shell with piezoelectric layers by differential quadrature method”, *Int. J. Pres. Ves. Piping,* **88**(5-7), 167-180. https://doi.org/10.1016/j.ijpvp.2011.06.001.

Arefi, M. and Civalek, O. (2020), “Static analysis of functionally graded composite shells on elastic foundations with nonlocal elasticity theory”, *Arch. Civil. Mech. Eng.*, **20**(1), 1-17. https://doi.org/10.1007/s43452-020-00032-2.

Arefi, M. and Rahimi, G.H. (2010), “Thermo elastic analysis of a functionally graded cylinder under internal pressure using first order shear deformation theory”, *Sci. Res. Essays.*, **5**(12), 1442-1454. https://doi.org/10.5897/SRE.9000953.

Arefi, M. and Rahimi, G.H. (2011), “Non linear analysis of a functionally graded square plate with two smart layers as sensor and actuator under normal pressure”, *Smart. Struct. Syst.*, **8**(5), 433-447. https://doi.org/10.12989/sss.2011.8.5.433.

Arefi, M. and Rahimi, G.H. (2012a), “Studying the nonlinear behavior of the functionally graded annular plates with piezoelectric layers as a sensor and actuator under normal pressure”, *Smart. Struct. Syst.*, **9**(2), 127-143. https://doi.org/10.12989/sss.2012.9.2.127.

Arefi, M. and Rahimi, G.H. (2012b), “Three-dimensional multi-field equations of a functionally graded piezoelectric thick shell with variable thickness, curvature and arbitrary nonhomogeneity”, *Acta. Mech.*, **223**(1), 63-79. https://doi.org/10.1007/s00707-011-0536-5

Arefi, M. and Rahimi, G.H. (2014), “Application of shear deformation theory for two dimensional electro-elastic analysis of a FGP cylinder”, *Smart. Struct. Syst.*, **13**(1), 1-24. https://doi.org/10.12989/sss.2014.13.1.001.

Arefi, M., Kiani Moghaddam, S., Mohammad-Rezaei Bidgoli, E., Kiani, M. and Civalek, O. (2021), ”Analysis of graphene nanoplatelet reinforced cylindrical shell subjected to thermo-mechanical loads”, *Compos. Struct.*, **255**, 12924. https://doi.org/10.1016/j.compstruct.2020.112924

Arefi, M. and Rahimi, G.H. (2012c), “Comprehensive thermoelastic analysis of a functionally graded cylinder with different boundary conditions under internal pressure using first order shear deformation theory”, *Mechanika*, **18**(1), 5-13. https://doi.org/10.5755/j01.mech.18.1.1273.

Bai, X., Shi, H., Zhang, K., Zhang, X. and Wu, Y. (2022), “Effect of the fit clearance between ceramic outer ring and steel pedestal on the sound radiation of full ceramic ball bearing system”, *J. Sound. Vib.*, **529**, 116967. https://doi.org/10.1016/j.jsv.2022.116967

Bai, X., Zhang, Z., Shi, H., Luo, Z. and Li, T. (2023). “Identification of subsurface mesoscale crack in full ceramic ball bearings based on strain energy theory”, *Appl. Sci*., **13**(13), 7783. doi: 10.3390/app13137783.

Brooks, G.N. (1987), “Elastic-plastic analysis of pressurized cylindrical shells”, *J. Appl. Mech.*, **54**(3), 597-603. https://doi.org/10.1115/1.3173075.

Chen, Y. Jin, G. and Liu, Z. (2013), “Free vibration analysis of circular cylindrical shell with non-uniform elastic boundary constraints”, *Int. J. Mech. Sci.*, **74**, 120-132. https://doi.org/10.1016/j.ijmecsci.2013.05.006.

Chu, Y.M., Hashmi, M.S., Khan, N. and Khan, S.U. (2020b), “Thermophoretic particles deposition features in thermally developed flow of Maxwell fluid between two infinite stretched disks”, *J. Mater. Res. Tech.-JMR&T,* **9**(6), 12889-12898. https://doi.org/10.1016/j.jmrt.2020.09.011

Chu, Y.M., Shah, F., Khan, M.I. and Kadry, S. (2020a), “Cattaneo-Christov double diffusions (CCDD) in entropy optimized magnetized second grade nanofluid with variable thermal conductivity and mass diffusivity”, *J. Mater. Res. Tech.-JMR&T*, **9**(6), 13977-13987. https://doi.org/10.1016/j.jmrt.2020.09.101.

Chung, J.D., Ramzan, M. and Gul, H. (2021), “Partially ionized hybrid nanofluid flow with thermal stratification”, *J. Mater. Res. Tech.-JMR&T*, **11**, 1457-1468. https://doi.org/10.1016/j.jmrt.2021.01.095.

Civalek, Ö., Dastjerdi, S., Akbaş, Ş.D. and Akgöz, B. (2021), “Vibration analysis of carbon nanotube-reinforced composite microbeams”, *Math. Meth. Appl. Sci.*, https://doi.org/10.1002/mma.7069.

Elsamak, G. and Fayed, S. (2021), “Flexural strengthening of RC beams using externally bonded aluminum plates: An experimental and numerical study”, *Adv. Conc. Construct.*, **11**(6), 481-492. https://doi.org/10.12989/acc.2021.11.6.481.

Foroutan, K., Shaterzadeh, A. and Ahmadi, H. (2019), “Nonlinear dynamic analysis of spiral stiffened cylindrical shells rested on elastic foundation”, *Steel. Compos. Struct.*, **32**(4), 509-519. https://doi.org/10.12989/scs.2019.32.4.509.

Fu, Z.H., Yang, B.J., Shan, M.L., Li, T., Zhu, Z.Y., Ma, C.P. and Gao, W. (2020), “Hydrogen embrittlement behavior of SUS301L-MT stainless steel laser-arc hybrid welded joint localized zones”, *Corros. Sci.*, **164**, 108337.

https://doi.org/10.1016/j.corsci.2019.108337.

Ge-JiLe, H., Waqas, H., Khan, S.U., Khan, M.I., Farooq, S. and Hussain, S. (2021), "Three-dimensional radiative bioconvective flow of a Sisko nanofluid with motile microorganisms", *Coatings*, **11**(3), 335. https://doi.org/10.3390/coatings11030335

Ghannad, M., Rahimi, G.H. and Nejad, M.Z. (2013), "Elastic analysis of pressurized thick cylindrical shells with variable thickness made of functionally graded materials", *Compos. Part B: Eng.*, **45**(1), 388-396. https://doi.org/10.1016/j.compositesb.2012.09.043.

Guo, K., Gou, G., Lv, H. and Shan, M. (2022), "Jointing of CFRP/5083 Aluminum Alloy by Induction Brazing: Processing, Connecting Mechanism, and Fatigue Performance", *Coatings*, **12**(10), 1559. https://doi.org/10.3390/coatings12101559.

Ha, F., Kadry, S., Chu, Y.M., Khan, M. and Kha, M.I. (2020), "Modeling and theoretical analysis of gyrotactic microorganisms in radiated nanomaterial Williamson fluid with ac tivation energy", *J. Mater. Res. Tech.-JMR&T,* **9**(5), 10468-10477. https://doi.org/10.1016/j.jmrt.2020.07.025.

Hao, R., Lu, Z., Ding, H. and Chen, L. (2022), "Orthogonal six-DOFs vibration isolation with tunable high-static-low-dynamic stiffness: Experiment and analysis", *Int. J. Mech. Sci.*, **222**, 107237. https://doi.org/10.1016/j.ijmecsci.2022.107237.

Haywood, J.H. (1958), "Response of an elastic cylindrical shell to a pressure pulse", *Quart. J. Mech. Appl. Math.*, **11**(2), 129-141. https://doi.org/10.1093/qjmam/11.2.129

Hu, G.J., Khurram, J., Sami, U.K., Khan, S.U., Raza, M., Ijaz Khan, M. and Qayyum, S. (2021), "Double diffusive convection and Hall effect in creeping flow of viscous nanofluid through a convergent microchannel: A biotechnological applications", *Comput. Meth. Biomech. Biomed. Eng.*, **24**(12), 1326-1343. https://doi.org/10.1080/10255842.2021.1888373.

Huang, X., Yang, J. and Yang, Z. (2021), "Thermo-elastic analysis of functionally graded graphene nanoplatelets (GPLs) reinforced closed cylindrical shells", *Appl. Math. Model.*, **97**, 754-770. https://doi.org/10.1016/j.apm.2021.04.027.

Huang, Y., Karami, B., Shahsavari, D. and Tounsi, A. (2021), "Static stability analysis of carbon nanotube reinforced polymeric composite doubly curved micro-shell panels", *Archiv. Civ. Mech. Eng.*, **21**, 139. https://doi.org/10.1007/s43452-021-00291-7.

Ibrahim, M., Saeed, T. and Riahi Bani, F. (2021), "Two-phase analysis of heat transfer and entropy generation of water-based magnetite nanofluid flow in a circular microtube with twisted porous blocks under a uniform magnetic field", *Powder Tech.*, **384**, 522-541. https://doi.org/10.1016/j.powtec.2021.01.077.

Ikram, M.D., Imran, M.A., Chu, YM. and Akgül, A. (2022), "MHD flow of a Newtonian fluid in symmetric channel with ABC fractional model containing hybrid nanoparticles", *Comb. Chem. & High Through. Scr.*, **25**(7), 2087-1102. https://doi.org/10.2174/1386207324666210412122544.

Jin, G., Ye, T., Chen, Y., Su, Z. and Yan, Y. (2013), "An exact solution for the free vibration analysis of laminated composite cylindrical shells with general elastic boundary conditions", *Compos. Struct.*, **106**, 114-127. https://doi.org/10.1016/j.compstruct.2013.06.002.

Karam, G.N. and Gibson, L.J. (1995), "Elastic buckling of cylindrical shells with elastic cores—II. Experiments", *Int. J. Solids. Struct.*, **32**(8–9), 1285-1306. https://doi.org/10.1016/0020-7683(94)00148-P.

Karam, G.N. and Gibson, L.J. (1995), "Elastic buckling of cylindrical shells with elastic cores—I. Analysis", *Int. J. Solids. Struct.*, **32**(8-9), 1259-1283. https://doi.org/10.1016/0020-7683(94)00147-O

Khan, U., Zaib, A., Waini, I., Ishak, A., Sherif, E.S.M., Xia, W.F. and Muhammad, N. (2022), "Impact of Smoluchowski temperature and Maxwell velocity slip conditions on axisymmetric rotated flow of hybrid nanofluid past a porous moving rotating disk", *Nanomaterials*, **12**(2), 276. https://doi.org/10.3390/nano12020276.

Khdeir, A.A., Reddy, J.N. and Frederick, D. (1989), "A study of bending, vibration and buckling of cross-ply circular cylindrical shells with various shell theories". *Int. J. Eng. Sci.*, **27**(11), 1337-1351. https://doi.org/10.1016/0020-7225(89)90058-X.

Khoshgoftar, M., Rahimi, M.J. and Arefi, G.H. (2013), "Exact solution of functionally graded thick cylinder with finite length under longitudinally non-uniform pressure", *Mech. Res. Com.,* **51**, 61-66. https://doi.org/10.1016/j.mechrescom.2013.05.001.

Kouider, D., Kaci, A., Selim, M.M., Bousahla, A.A., Bourada, F., Tounsi, A., Tounsi, A. and Hussain, M. (2021), "An original four-variable quasi-3D shear deformation theory for the static and free vibration analysis of new type of sandwich plates with both FG face sheets and FGM hard core", *Steel. Compos. Struct.*, **41**(2), 167-191. https://doi.org/10.12989/scs.2021.41.2.167.

Kushnir, R.M., Zhydyk, U.V. and Flyachok, V.M. (2021), "Thermoelastic analysis of functionally graded cylindrical shells", *J. Math. Sci.*, **254**, 46-58. https://doi.org/10.1007/s10958-021-05287-5,

Li, J., Chen, M. and Li, Z. (2022), "Improved soil–structure interaction model considering time-lag effect", *Comput. Geotech.*, **148**, 104835. https://doi.org/10.1016/j.compgeo.2022.104835.

Li, L.Y., Zhang, Y.B., Cui, X., Said, Z., Sharma, S., Liu, M.Z., Gao, T., Zhou, Z.M., Wang, X.M. and Li, C.H. (2023), "Mechanical behavior and modeling of grinding force: A comparative analysis", *J. Manuf. Proc.*, **102**, 921-954. https://doi.org/10.1016/j.jmapro.2023.07.074.

Li, Q.M., Dong, Q. and Zheng, J.Y. (2008), "Strain growth of the in-plane response in an elastic cylindrical shell", *Int. J. Impact. Eng.,* **35**(10), 1130-1153. https://doi.org/10.1016/j.ijimpeng.2008.01.007.

Liu, G., Wu, S., Shahsavari, D., Karami, B. and Tounsi, A. (2022), "Dynamics of imperfect inhomogeneous nanoplate with exponentially-varying properties resting on viscoelastic foundation", *Eur. J. Mech. A/Solids*, **95**, 104649. https://doi.org/10.1016/j.euromechsol.2022.104649.

Loy, C.T. and Lam, K.Y. (1999), "Vibration of thick cylindrical shells on the basis of three-dimensional theory of elasticity", *J. Sound. Vib.*, **226**(4), 719-737. https://doi.org/10.1006/jsvi.1999.2310.

Lu, H., Zhu, Y., Yin, M., Yin, G. and Xie, L. (2022), "Multimodal fusion convolutional neural network with cross-attention mechanism for internal defect detection of magnetic tile", *IEEE. Access.,* **10**, 60876-60886. https://doi.org/10.1109/ACCESS.2022.3180725.

Lund, L.A., Omar, Z., Dero, S., Chu, Y. and Khan, I. (2021), "Temporal stability analysis of magnetized hybrid nanofluid propagating through an unsteady shrinking sheet: partial slip conditions", *Comput., Mater. Continua.*, **66**(2), 1963-1975. https://doi.org/10.32604/cmc.2020.011976.

Luo, C., Wang, L., Xie, Y. and Chen, B. (2022), "A New conjugate gradient method for moving force identification of vehicle–bridge system", *J. Vib. Eng. Tech.*, https://doi.org/10.1007/s42417-022-00824-1.

Ma, J.F., Chen, W.Y., Zhao, L. and Zhao, D.H. (2008), "Elastic buckling of bionic cylindrical shells based on bamboo", *J. Bion. Eng.,* **5**(3), 231-238. https://doi.org/10.1016/S1672-6529(08)60029-3

Ma, X., Jin, G., Shi, S., Ye, T. and Liu, Z. (2017), "An analytical method for vibration analysis of cylindrical shells coupled with annular plate under general elastic boundary and coupling conditions", *J. Vib. Control*, **23**(2), 305-328. https://doi.org/10.1177/1077546315576301.

Maouedj, R., Menni, Y., Inc, M., Chu, Y.M., Ameur, H. and Lorenzini, G. (2021), "Simulating the turbulent hydrothermal behavior of oil/MWCNT nanofluid in a solar channel heat exchanger equipped with vortex generators", *Comput. Model. . Eng. Sci.*, **126**(3), 855-889. https://doi.org/10.32604/cmes.2021.014524.

Mehditabar, A., Rahimi, G.H. and Tarahhomi, M.H. (2018), "Thermo-elastic analysis of a functionally graded piezoelectric rotating hollow cylindrical shell subjected to dynamic loads", *Mech. Adv. Mater. Struct.*, **25**(12), 1068-1079. https://doi.org/10.1080/15376494.2017.1329466.

Mercan, K. and Civalek, Ö. (2019), "Geometric mapping for non-rectangular plates with micro/nano or macro scaled under different effects", *Int. J. Eng. Appl. Sci.*, **11**(3), 445-454. https://doi.org/10.24107/ijeas.641211.

Nazeer, M., Hussain, F., Ahmad, M.O., Saeed, S., Ijaz Khan, M., Kadry, S. and Chu, Y.M. (2021), "Multi-phase flow of Jeffrey Fluid bounded within magnetized horizontal surface", *Surf. Interf.*, **22**, 100846. https://doi.org/10.1016/j.surfin.2020.100846.

Nazeer, M., Ijaz Khan, M. and Chu, Y.M. (2022), "Mathematical modeling of multiphase flows of third-grade fluid with lubrication effects through an inclined channel: analytical treatment", *J. Disp. Sci. Tech.*, **43**(10), 1555-1567. https://doi.org/10.1080/01932691.2021.1877557.

Nazeer, M., Khan, M.I., Chu, Y.M., Kadry, S. and Eid, M.R. (2022), "Mathematical modeling of multiphase flows of third-grade fluid with lubrication effects through an inclined channel: analytical treatment", *J. Disp. Sci. Tech.*, **43**(10), 1555-1567. https://doi.org/10.1080/01932691.2021.1877557.

Nwojia, C.U. and Ani, D.G. (2022), "Second–order models for the bending analysis of thin and moderately thick circular cylindrical shells", *Lat. Am. J. Solids. Struct.*, **19**(3).

Qiao, W., Fu, Z., Du, M., Wei, N. and Liu, E. (2023), "Seasonal peak load prediction of underground gas storage using a novel two-stage model combining improved complete ensemble empirical mode decomposition and long short-term memory with a sparrow search algorithm", *Energy*, **274**, 127376. https://doi.org/10.1016/j.energy.2023.127376.

Rachid, A., Ouinas, D., Lousdad, A., Zaoui, F.Z., Achour, B., Gasmi, H., Butt, T.A. and Tounsi, A. (2022), "Mechanical behavior and free vibration analysis of FG doubly curved shells on elastic foundation via a new modified displacements field model of 2D and quasi-3D HSDTs", *Thin. Walled. Struct.*, **172**, 108783. https://doi.org/10.1016/j.tws.2021.108783.

Rahimi, G.H., Arefi, M. and Khoshgoftar, M.J. (2011), "Application and analysis of functionally graded piezoelectrical rotating cylinder as mechanical sensor subjected to pressure and thermal loads", *Appl. Math. Mech. (Eng. Ed.)*, **32**(8), 997-1008. https://doi.org/10.1007/s10483-011-1475-6.

Rahimi, G.H., Arefi, M. and Khoshgoftar, M.J. (2012), "Electro elastic analysis of a pressurized thick-walled functionally graded piezoelectric cylinder using the first order shear deformation theory and energy method", *Mechanika*, **18**(3), 292-300. https://doi.org/10.5755/j01.mech.18.3.1875.

Ramesh, K., Khan, S.U., Jameel, M., Khan, M.I., Chu, Y.M. and Kadry, S. (2020), "Bioconvection assessment in Maxwell nanofluid configured by a Riga surface with nonlinear thermal radiation and activation energy", *Surf. Interf.*, **21**, 100749. https://doi.org/10.1016/j.surfin.2020.100749.

Rasool, G., Shafiq, A., Chu, Y.M., Bhutta, M.S. and Ali, A. (2022), "Optimal homotopic exploration of features of Cattaneo-Christov model in second grade nanofluid flow via Darcy-Forchheimer medium subject to viscous dissipation and thermal radiation", *Comb. Chem. & High Through. Scr.*, **25**(14), 2485-2497. https://doi.org/10.2174/1386207324666210903144447.

Ren, C., Yu, J., Liu, S., Yao, W., Zhu, Y. and Liu, X. (2022), "A plastic strain-induced damage model of porous rock suitable for different stress paths", *Rock. Mech. Rock. Eng.*, **55**(4), 1887-1906. https://doi.org/10.1007/s00603-022-02775-1.

Safarpour, M., Rahimi, A.R. and Alibeigloo, A. (2020), "Static and free vibration analysis of graphene platelets reinforced composite truncated conical shell, cylindrical shell, and annular plate using theory of elasticity and DQM", *Mech. Based. Des. Struc.*, **48**(4), 496-524. https://doi.org/10.1080/15397734.2019.1646137.

Santos, H., Soares, C.M.M., Soares, C.A.M. and Reddy, J.N. (2009), "A semi-analytical finite element model for the analysis of cylindrical shells made of functionally graded materials", *Compos. Struct.,* **91**(4), 427-432. https://doi.org/10.1016/j.compstruct.2008.03.004.

Shah, A.G., Mahmood, T., Naeem, M.N., Iqbal, Z. and Arshad, S.H. (2010), "Vibrations of functionally graded cylindrical shells based on elastic foundations", *Acta. Mech.*, **211**, 293-307. https://doi.org/10.1007/s00707-009-0225-9.

Shi, H., Song, Z., Bai, X., Hu, Y., Li, T. and Zhang, K. (2023), "A novel digital twin model for dynamical updating and real-time mapping of local defect extension in rolling bearings", *Mech. Syst. Signal. Proc.*, **193**, 110255. https://doi.org/10.1016/j.ymssp.2023.110255

Shi, J., Zhao, B., He, T., Tu, L., Lu, X. and Xu, H. (2023), "Tribology and dynamic characteristics of textured journal-thrust coupled bearing considering thermal and pressure coupled effects", *Trib. Int.*, **180**, 108292. https://doi.org/10.1016/j.triboint.2023.108292.

Sidhoum, I.A., Boutchicha, D., Benyoucef, S. and Tounsi, A. (2018), "A novel quasi-3D hyperbolic shear deformation theory for vibration analysis of simply supported functionally graded plates", *Smart. Struct. Syst.*, **22**(3), 303-314. https://doi.org/10.12989/sss.2018.22.3.303.

Soedel, W. (2004), "Vibrations of shells and plates. Marcel Dekker", Inc (New York).

Sofiyev, A.H. and Kuruoglu, N. (2013), "Torsional vibration and buckling of the cylindrical shell with functionally graded coatings surrounded by an elastic medium", *Compos. Part B: Eng.*, **45**(1), 1133-1142. https://doi.org/10.1016/j.compositesb.2012.09.046

Soldatos, K.P. (1994), "Review of three dimensional dynamic analyses of circular cylinders and cylindrical shells", *Appl. Mech. Rev.*, **47**(10), 501-516. https://doi.org/10.1115/1.3111064.

Sun, T., Peng, L., Ji, X., Li, X. and Rodellar, J. (2023a), "A half-cycle negative-stiffness damping model and device development", *Struct. Control. Health. Monit.*, **2023**, 4680105. https://doi.org/10.1155/2023/4680105.

Sun, W., Wang, H. and Qu, R. (2023b), "A novel data generation and quantitative characterization method of motor static eccentricity with adversarial network", *IEEE Trans. Power Elect.*, **38**(7), 8027-8032. https://doi.org/10.1109/TPEL.2023.3267883.

Tahir, S.I., Tounsi, A., Chikh, A., Al-Osta, M.A., Al-Dulaijan S.U. and Al-Zahrani, M.M. (2022), "The effect of three-variable viscoelastic foundation on the wave propagation in functionally graded sandwich plates via a simple quasi-3D HSDT", *Steel. Compos. Struct.*, **42**(4), 501-511. https://doi.org/10.12989/scs.2022.42.4.501.

Tian, L., Jin, B. and Li, L. (2023b), "Axial compressive mechanical behaviors of a double-layer member", *J. Struct. Eng.*, **149**(8), 4023110. https://doi.org/10.1061/JSENDH.STENG-12175.

Tian, L., Li, M., Li, L., Li, D. and Bai, C. (2023a), "Novel joint for improving the collapse resistance of steel frame structures in column-loss scenarios", *Thin. Walled. Struct.*, **182**, 110219. https://doi.org/10.1016/j.tws.2022.110219.

Waqas, M., Ijaz Khan, M., Asghar, Z., Kadry, S., Chu, Y.M. and Khan, W.A. (2020), "Interaction of heat generation in nonlinear mixed/forced convective flow of Williamson fluid flow subject to generalized Fourier's and Fick's concept", *J. Mater. Res. Tech.-JMR&T*, **9**(5), 11080-11086. https://doi.org/10.1016/j.jmrt.2020.07.068.

Wu, Z., Huang, B., Fan, J. and Chen, H. (2023). "Homotopy based stochastic finite element model updating with correlated static measurement data", *Measurement*, **210**, 112512. https://doi.org/10.1016/j.measurement.2023.112512

Xuyuan, S., Tienan, C., Peixin, G. and Qingkai, H. (2020), "Vibration and damping analysis of cylindrical shell treated with viscoelastic damping materials under elastic boundary conditions via a unified Rayleigh-Ritz method", *Int. J. Mech. Sci.*, **165**, 105158. https://doi.org/10.1016/j.ijmecsci.2019.105158.

Yang, K., Qin, N., Yu, H., Zhou, C., Deng, H., Tian, W. and Guan, J. (2022), "Correlating multi-scale structure characteristics to mechanical behavior of Caprinae horn sheaths", *J. Mater. Res. Tech.*, **21**, 2191-2202. https://doi.org/10.1016/j.jmrt.2022.10.044.

Yu, H., Zhang, J., Fang, M., Ma, T., Wang, B., Zhang, Z. and Yang, K. (2023), "Bio-inspired strip-shaped composite composed of glass fabric and waste selvedge from A. pernyi silk for lightweight and high-impact applications", *Compos. Part A: Appl. Sci. Manufact.*, **174**, 107715. https://doi.org/10.1016/j.compositesa.2023.107715.

Zhang, L., Xiong, D., Su, Z., Li, J., Yin, L., Yao, Z. and Zhang, H. (2022), "Molecular dynamics simulation and experimental study of tin growth in SAC lead-free microsolder joints under thermo-mechanical-electrical coupling", *Mater. Today. Com.*, **33**, 104301. https://doi.org/10.1016/j.mtcomm.2022.104301.

Zhang, Z., Sui, M., Li, C., Zhou, Z., Liu, B., Chen, Y., Said, Z., Debnath, S. and Sharma, S. (2021), "Residual stress of MoS2 nano-lubricant grinding cemented carbide", *Int. J. Adv. Manuf. Tech.*, https://doi.org/10.1007/s00170-022-08660-z.

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