



Analysis of Influence of Cylinder Shell Thickness on Distribution Character of Dynamic Characteristics of Free Vibrations



Published: 05 May 2026
(2026) [Cite this article](#)

[Save article](#)

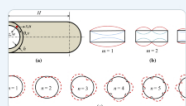
O. Ya. Grigorenko  M. Yu. Borysenko, O. V. Boychuk & S. O. Sperkach

 2 Accesses [Explore all metrics](#) →

The free vibrations of circular cylindrical shells with various thickness-to-midsurface radius ratios and different combinations of clamped and hinged edges of the shell are studied using the finite element method. The dependence of the natural frequency vibrations on the increase in the shell thickness is analyzed. The symmetric and asymmetric modes of free vibrations, frequencies, and modes of the vibrations corresponding to bending, torsion, tension-compression, and shear deformations are considered. Significant attention is paid to validation of the reliability of the numerical results.

 This is a preview of subscription content, [log in via an institution](#)  to check access.

Similar content being viewed by others



Free Vibration Analysis of Thin Circular Cylindrical Shell with Closure Using Finite Element Method

Article | 20 September 2019



Analysis of Natural Vibration of Circular Cylindrical Shells with Varying Thickness

Chapter | © 2026



Free Vibrations of a Corrugated Closed Cylindrical Shell

Article | 01 January 2022

References

1. V. D. Budak, Yu. G. Zolotoi, and A. V. Ovcharenko, "Vibrations of a circular cylindrical shell filled with liquid," *Collections Sci. Papers of UDMTU*, No. 4, 96–101 (1998).
2. M. Amabili and M. P. Paidoussis, "Review of studies on geometrically nonlinear vibrations and dynamics of circular cylindrical shells and panels, with and without fluid-structure interaction," *Appl. Mech. Rev.*, 56, No. 4, 349–381 (2003).
[Article](#) [Google Scholar](#)
3. E. I. Bespalova and N. P. Boreiko, "Determination of the natural frequencies of compound anisotropic shell systems using various deformation models," *Int. Appl. Mech.*, 55, No. 1, 41–54 (2019).
[Article](#) [Google Scholar](#)
4. Y. Dong, H. Hu, and L. Wang, "A comprehensive study on the coupled multi-mode vibrations of cylindrical shells," *Mech. Syst. Signal Process.*, 169, 108730 (2022).
[Article](#) [Google Scholar](#)
5. T. L. Efimova, "Solution of problems of free torsional vibrations of thick-walled orthotropic inhomogeneous cylinders," *J. Math. Sci.*, 168, No. 4, 613–623 (2010).
[Article](#) [Google Scholar](#)
6. A. Farshidianfar and P. Oliazadeh, "Free vibration analysis of circular cylindrical shells: comparison of different shell theories," *Int. J. Mech. Appl.*, 2, No. 5, 74–80 (2012).
[Google Scholar](#)
7. G. R. Ghulghazaryan, L. G. Ghulghazaryan, and I. I. Kudish, "Free Vibrations of a thin elastic orthotropic cylindrical panel with free edges," *Mech. Compos. Mater.*, 55, No. 5, 557–574 (2019).
[Article](#) [Google Scholar](#)
8. A. Grigorenko, Yu. Zolotoi, A. Prigoda, I. Zhuk, V. Khorishko, and A. Ovcharenko, "Experimental investigation of natural vibrations of a thick-walled cylindrical shell by

Access this article

Log in

Log in via an institution →



Subscribe and save

from €37.37 /Month

from 10 chapters or articles per

- Access and download chapters and articles from more than 300k books and 2,500 journals
- Cancel anytime

[View plans](#) →

Buy Now

[Buy article PDF 39,95 €](#)

Price includes VAT (Ukraine)

Instant access to the full article PDF.

[Institutional subscriptions](#) →

Sections

References

[References](#)

[Author information](#)

[Additional information](#)

[Rights and permissions](#)

[About this article](#)

Advertisement

[Article](#) [Google Scholar](#)

9. A. Y. Grigorenko, M. Y. Borysenko, O. V. Boychuk, and L. Y. Vasil'eva, "Free vibrations of an open non-circular cylindrical shell of variable thickness," in: *Analysis of Shells, Plates, and Beams. Advanced Structured Materials*, **134**, Springer, Cham (2020), pp. 141–154.
10. A. Ya. Grigorenko, M. Yu. Borisenko, E. V. Boichuk, and A. P. Prigoda, "Numerical determination of natural frequencies and modes of the vibrations of a thick-walled cylindrical shell," *Int. Appl. Mech.*, **54**, No. 1, 75–84 (2018).
[Article](#) [Google Scholar](#)
11. A. Ya. Grigorenko and T. L. Efimova, "Using spline-approximation to solve problems of axisymmetric free vibration of thick-walled orthotropic cylinders," *Int. Appl. Mech.*, **44**, No. 10, 1137–1147 (2008).
12. O. Ya. Grigorenko, M. Yu. Borisenko, and O. V. Boichuk, "Free vibrations of a corrugated closed cylindrical shell," *Int. Appl. Mech.*, **58**, No. 1, 43–52 (2022).
[Article](#) [Google Scholar](#)
13. A. S. Kairov, "An experimental study of the natural vibrations of supported shells," *J. Math. Sci.*, **77**, No. 6, 3533–3536 (1995).
[Article](#) [Google Scholar](#)
14. A. S. Kairov, "An experimental study of the vibrations of cylindrical shells with holes," *J. Math. Sci.*, **90**, No. 1, 1879–1882 (1998).
[Article](#) [Google Scholar](#)
15. Y. Kumar, "The Rayleigh–Ritz method for linear dynamic, static and buckling behavior of beams, shells and plates: A literature review," *J. Vibr. Control*, **24**, No. 7, 1205–1227 (2018).
[Article](#) [Google Scholar](#)
16. S. Mahmoudkhani, H. M. Navazi, and H. Haddadpour, "An analytical study of the non-linear vibrations of cylindrical shells," *Int. J. Non-Linear Mech.*, **46**, No. 10, 1361–1372 (2011).
[Article](#) [Google Scholar](#)
17. T. P. Nguyen, T. Nguyen-Thoi, D. K. Tran, D. T. Ho, and H. N. Vu, "Nonlinear vibration of full-filled fluid corrugated sandwich functionally graded cylindrical shells," *J. Vibr. Contr.*, **27**, Nos. 9–10, 1020–1035 (2021).
18. F. Pellicano, "Vibrations of circular cylindrical shells: Theory and experiments," *J. Sound Vibr.*, **303**, Nos. 1–2, 154–170 (2007).
[Article](#) [Google Scholar](#)
19. F. Pellicano, M. Amabili, and M. P. Paidoussis, "Effect of the geometry on the non-linear vibration of circular cylindrical shells," *Int. J. Non-Linear Mech.*, **37**, No. 7, 1181–1198 (2002).
[Article](#) [Google Scholar](#)
20. N. P. Semenyuk, I. Yu. Babich, and N. B. Zhukova, "Natural vibrations of corrugated cylindrical shells," *Int. Appl. Mech.*, **41**, No. 5, 512–519 (2005).
[Article](#) [Google Scholar](#)
21. S. Sun, S. Chu., and D. Cao, "Vibration characteristics of thin rotating cylindrical shells with various boundary conditions," *J. Sound Vibr.*, **331**, No. 18, 4170–4186 (2012).
22. Y. Xiang, Y. F. Ma, S. Kitipornchai, C. W. Lim, and C. W. H. Lau, "Exact solutions for vibration of cylindrical shells with intermediate ring supports," *Int. J. Mech. Sci.*, **44**, No. 9, 1907–1924 (2002).
[Article](#) [Google Scholar](#)
23. L. Xuebin, "Study on free vibration analysis of circular cylindrical shells using wave propagation," *J. Sound Vibr.*, **311**, Nos. 3–5, 667–682 (2008).
[Article](#) [Google Scholar](#)
24. H. Yuan and Rh. Liu, "Nonlinear vibration of corrugated shallow shells under uniform load," *Appl. Math. Mech.*, **28**, 573–580 (2007).
[Article](#) [Google Scholar](#)

25. H. Zhou, W. Li, B. Lv, and W. L. Li, "Free vibrations of cylindrical shells with elastic-support boundary conditions," *Appl. Acoust.*, **73**, No. 8, 751–756 (2012).

[Article](#) [Google Scholar](#)

[Download references](#) 

Author information

Authors and Affiliations

S. P. Timoshenko Institute of Mechanics, National Academy of Sciences of Ukraine, 3 Nesterova St., Kyiv, 03057, Ukraine

O. Ya. Grigorenko & M. Yu. Borysenko

Mykolaiv National Agrarian University, 9 Georgy Gongadze St., Mykolaiv, 54020, Ukraine

O. V. Boychuk

Technical Center of National Academy of Sciences of Ukraine, 13 Pokrovska St., Kyiv, 04070, Ukraine

S. O. Sperkach

Corresponding author

Correspondence to [O. Ya. Grigorenko](#).

Additional information

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Translated from *Prykladna Mekhanika*, Vol. 61, No. 6, pp. 15–29, November–December 2025.

Rights and permissions

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

[Reprints and permissions](#)

About this article



Check for updates

Cite this article

Grigorenko, O.Y., Borysenko, M.Y., Boychuk, O.V. *et al.* Analysis of Influence of Cylinder Shell Thickness on Distribution Character of Dynamic Characteristics of Free Vibrations. *Int Appl Mech* (2026). <https://doi.org/10.1007/s10778-026-01389-2>

[Download citation](#) 

Received	Accepted	Published
05 March 2024	10 June 2025	05 May 2026

Version of record
05 May 2026

DOI
<https://doi.org/10.1007/s10778-026-01389-2>

Keywords

[free vibrations](#) [circular cylindrical shell](#) [different boundary conditions](#)

[ratio of the shell thickness to the radius](#) [finite element method](#)

Discover content

[Journals A–Z](#)

[Books A–Z](#)

Publish with us

[Journal finder](#)

[Publish your research](#)

[Language editing](#)

[Open access publishing](#)

Products and services

[Our products](#)

[Librarians](#)

[Societies](#)

[Partners and advertisers](#)

Our brands

[Springer](#)

[Nature Portfolio](#)

[BMC](#)

[Palgrave Macmillan](#)

[Apress](#)

[Discover](#)

217.77.211.118

Not affiliated

SPRINGER NATURE
© 2026 Springer Nature