Analysis of sound transmission loss through thick-walled cylindrical shell using three-dimensional Elasticity theory

K. Daneshjou, R. Talebitooti, A. Tarkashvand

www.elsevier.com/locate/ijmecsci

PII: S0020-7403(15)00446-4
DOI: http://dx.doi.org/10.1016/j.ijmecsci.2015.12.019
Reference: MS3183

To appear in: *International Journal of Mechanical Sciences*

Received date: 23 June 2015
Revised date: 23 November 2015
Accepted date: 18 December 2015

Cite this article as: K. Daneshjou, R. Talebitooti and A. Tarkashvand, Analysis of sound transmission loss through thick-walled cylindrical shell using three dimensional Elasticity theory, *International Journal of Mechanical Sciences* http://dx.doi.org/10.1016/j.ijmecsci.2015.12.019

Analysis of sound transmission loss through thick-walled cylindrical shell using three-dimensional Elasticity theory

K. Daneshjou[a], R. Talebitooti[a,*], A. Tarkashvand[b]

[a] *School of Mechanical Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran*

[b] *School of New Technologies, Iran University of Science and Technology, Narmak, Tehran, Iran*

Abstract

In this paper, the transmission loss (TL) of a thick-walled shell under obliquely plane incident wave is investigated considering three dimensional (3-D) theory of elasticity. Governing equations of the thick shell have been derived in radial, axial, and circumferential directions. Then, Helmholtz decomposition is used to solve the equations. Therefore, the displacement field is considered in terms of Lame potential functions. A comparison of the present method results with those obtained from classical shell theory (CST), first and third-order shear deformation theories (FSDT, TSDT) for this special case of the thin shell indicates an excellent agreement. Moreover, the comparison of present method with these theories for a thick shell having R/h=20 reveals good conformity at low frequencies. However, at the high frequencies these classical and higher order shell theories encounter insufficient accuracies as a result of increasing of the rotational terms as well as shear wave effects. The results of the present method show that with thickening the shell, the critical frequency is getting closer to the ring frequency. Consequently, the mass-low controlled region is going to be completely removed which leads to significant enhancement of the TLs. Finally, the obtained numerical results demonstrate that the transmission loss is considerably decreased at the frequencies greater than the resonance frequency by increasing Mach number of the external mean flow.

Keywords*:* Transmission loss, thick-walled cylindrical shell, three-dimensional Elasticity, Helmholtz decomposition

∗ Corresponding author. Tel.: + 98 21 77 240 360; Fax: + 98 21 7724 0488.
E-mail addresses: rtalebi@iust.ac.ir, (R. Talebitooti).