An asymptotic and numerical analysis of the vibration spectrum of two Timoshenko beams coupled by general linear dissipative joints

Matthew P. Coleman, Laura A. McSweeney

PII: S0997-7538(17)30086-4

DOI: 10.1016/j.euromechsol.2017.02.001

Reference: EJMSOL 3406

To appear in: *European Journal of Mechanics / A Solids*

Received Date: 10 March 2016

Revised Date: 2 February 2017

Accepted Date: 3 February 2017

Please cite this article as: Coleman, M.P., McSweeney, L.A., An asymptotic and numerical analysis of the vibration spectrum of two Timoshenko beams coupled by general linear dissipative joints, *European Journal of Mechanics / A Solids* (2017), doi: 10.1016/j.euromechsol.2017.02.001.

An asymptotic and numerical analysis of the vibration spectrum of two Timoshenko beams coupled by general linear dissipative joints

Matthew P. Coleman and Laura A. McSweeney

Department of Mathematics, Fairfield University,
Fairfield, Connecticut 06824-5195, USA,
Email: mcoleman@fairfield.edu, lmcsweeney@fairfield.edu

Abstract

An asymptotic analysis, using the Wave Propagation Method of Keller and Rubinow, was performed on the problem of two identical Timoshenko beams coupled end to end via a so called Type I energy-dissipative joint in 2010. This paper generalizes those results by employing the same method to treat the problem involving any of the four standard types of dissipative joint. A numerical analysis also is performed, and a comparison of the results shows a good match, once one is far enough along the spectrum. In addition, it is found that numerical results for increasing values of the aspect ratio approach the corresponding Euler-Bernoulli beam results, and the asymptotically undamped Timoshenko modes are found to play a lesser role as the aspect ratio increases.

Keywords: Timoshenko, beam, joint, vibration, spectrum

1. Introduction

Complex flexible structures generally are composed of simpler components, that often can be modeled as beams, plates or shells, coupled together via joints that include active or passive damping mechanisms. Successful design requires a knowledge of the system's natural frequencies of vibration - its vibration spectrum. The problem of two identical Euler-Bernoulli beams coupled end to end via an energy-dissipating joint was treated in [1], where the authors derived asymptotic expressions for the clamped-free problem subject to a so called Type I energy dissipative joint, and also introduced Types