

Author's Accepted Manuscript

The post-buckling behavior of a beam constrained by springy walls

Shmuel Katz, Sefi Givli



www.elsevier.com/locate/jmps

PII: S0022-5096(15)00035-6
DOI: <http://dx.doi.org/10.1016/j.jmps.2015.02.004>
Reference: MPS2598

To appear in: *Journal of the Mechanics and Physics of Solids*

Received date: 29 October 2014
Revised date: 2 February 2015
Accepted date: 9 February 2015

Cite this article as: Shmuel Katz and Sefi Givli, The post-buckling behavior of a beam constrained by springy walls, *Journal of the Mechanics and Physics of Solids*, <http://dx.doi.org/10.1016/j.jmps.2015.02.004>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

The post-buckling behavior of a beam constrained by springy walls

Shmuel Katz[†], Sefi Givli^{†*}

[†]Faculty of Mechanical Engineering, Technion – Israel Institute of Technology, Haifa 32000, Israel

*Corresponding author, email: givli@technion.ac.il

Abstract

The post-buckling behavior of a beam subjected to lateral constraints is of practical importance in a variety of applications, such as stent procedures, filopodia growth in living cells, endoscopic examination of internal organs, and deep drilling. Even though in reality the constraining surfaces are often deformable, the literature has focused mainly on rigid and fixed constraints. In this paper, we make a first step to bridge this gap through a theoretical and experimental examination of the post-buckling behavior of a beam constrained by a fixed wall and a springy wall, i.e. one that moves laterally against a spring. The response exhibited by the proposed system is much richer compared to that of the fixed-wall system, and can be tuned by choosing the spring stiffness. Based on small-deformation analysis, we obtained closed-form analytical solutions and quantitative insights. The accuracy of these results was examined by comparison to large-deformation analysis. We concluded that the closed-form solution of the small-deformation analysis provides an excellent approximation, except in the highest attainable mode. There, the system exhibits non-intuitive behavior and non-monotonous force-displacement relations that can only be captured by large-deformation theories. Although closed-form solutions cannot be derived for the large-deformation analysis, we were able to reveal general properties of the solution. In the last part of the paper, we present experimental results that demonstrate various features obtained from the theoretical analysis.

Keywords: buckling; large deformations; contact; constrained elastica; guidewire; mathematical modeling; experiment

Download English Version:

<https://daneshyari.com/en/article/7178083>

Download Persian Version:

<https://daneshyari.com/article/7178083>

[Daneshyari.com](https://daneshyari.com)