## Accepted Manuscript

Large displacement static and transient analysis of functionally graded deep curved beams with generalized differential quadrature method

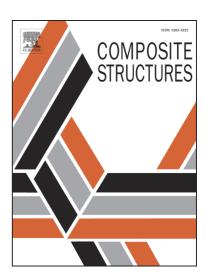
## Hasan Kurtaran

PII: S0263-8223(15)00488-2

DOI: http://dx.doi.org/10.1016/j.compstruct.2015.06.024

Reference: COST 6523

To appear in: Composite Structures



Please cite this article as: Kurtaran, H., Large displacement static and transient analysis of functionally graded deep curved beams with generalized differential quadrature method, *Composite Structures* (2015), doi: http://dx.doi.org/10.1016/j.compstruct.2015.06.024

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 proof before it is published in its final 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.

CCEPTED MANUSCRIPT

Large displacement static and transient analysis of functionally graded

deep curved beams with generalized differential quadrature method

Hasan Kurtaran

Department of Mechanical Engineering, Gebze Technical University, Gebze, Kocaeli, Turkey

Abstract

In this article, large displacement static and transient behavior of moderately thick deep

functionally graded curved beams with constant curvature are investigated using generalized

differential quadrature method. Equilibrium equations for static and dynamic responses are

obtained using the virtual work principle. Spatial derivatives in the equilibrium equations are

expressed with the generalized differential quadrature method. Large displacements are taken

into account using Green-Lagrange nonlinear strain-displacement relations that are derived from

elasticity theory equations. Transverse shear effect is considered through the first-order shear

deformation theory. Static and dynamic equilibrium equations are solved using Newton and

Newmark methods respectively. Several curved beam problems with different level of deepness

is solved with the proposed method. Effect of functionally graded material properties on the

behavior of curved beam is investigated using various ceramic and metal combinations such as

Zirconia/Aluminum, Alumina/Aluminum, Zirconia/Monel, Silicon Nitride/Steel and

Alumina/Steel materials in analyses.

Keywords: Generalized differential quadrature, Large displacement, Functionally graded,

Curved beam

1. Introduction

Functionally graded materials (FGMs) were invented by Japanese scientists in 1984 to

overcome problems such as high thermal residual stresses and stress concentrations at the

interface of conventional composite materials. FGMs are formed by combining different sets of

materials commonly metal with ceramic. In FGMs desired mechanical properties are achieved

by changing volume fraction gradually through the thickness. FGMs have important

applications in aerospace, biomedical, defense, energy, and optoelectronics areas. If

manufacturing technique can be improved, FGMs are promising and can be used in wider areas.

## Download English Version:

## https://daneshyari.com/en/article/6706784

Download Persian Version:

https://daneshyari.com/article/6706784

<u>Daneshyari.com</u>