

Accepted Manuscript

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PII: S0997-7538(17)30242-5

DOI: [10.1016/j.euromechsol.2017.08.008](https://doi.org/10.1016/j.euromechsol.2017.08.008)

Reference: EJMSOL 3476

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

Received Date: 21 March 2017

Revised Date: 6 August 2017

Accepted Date: 14 August 2017

Please cite this article as: Liu, S., Yu, T., Bui, T.Q., Size effects of functionally graded moderately thick microplates: A novel non-classical simple-FSDT isogeometric analysis, *European Journal of Mechanics / A Solids* (2017), doi: 10.1016/j.euromechsol.2017.08.008.

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Size effects of functionally graded moderately thick microplates: A novel non-classical simple-FSDT isogeometric analysis

Shuo Liu^a, Tiantang Yu^{a,*}, Tinh Quoc Bui^{b,c,*}

^a*Department of Engineering Mechanics, Hohai University, Nanjing 211100, PR China.*

^b*Institute for Research and Development, Duy Tan University, Da Nang City, Vietnam*

^c*Department of Civil and Environmental Engineering, Tokyo Institute of Technology, 2-12-1-W8-22, Ookayama, Meguro-ku, Tokyo 152-8552, Japan.*

Abstract

This paper presents an effective plate formulation coupling the merits of isogeometric analysis (IGA) and a new non-classical simple first-order shear deformation theory (SFSDT) for static bending, free vibration, and buckling of functionally graded (FG) moderately thick microplates. In contrast to the conventional first-order shear deformation theory (FSDT), the new SFSDT adopted here inherently owns several advantages such as free from shear-locking, capturing the shear-deformation effect, and fewer unknowns. In order to capture the small scale effects, we thus introduce a non-classical SFSDT based on a modified couple stress theory. The requirement for C^2 -continuity in terms of the non-classical SFSDT is straightforwardly treated with the aid of inherent high-order continuity of non-uniform rational B-spline (NURBS), which serves as basis functions in our IGA framework. Numerical examples are presented and the obtained numerical results reveal that the deflection decreases while the frequency and buckling load increase with decreasing the plate thickness. Results also show that the small size effect can lead to an increase of microplate stiffness.

Keywords: *FG microplates; size effect; couple stress theory; simple first order shear deformation*

* Corresponding authors

Emails: tiantangyu@hhu.edu.cn (T.T. Yu); buiquoctinh@duytan.edu.vn; bui.t.aa@m.titech.ac.jp (T.Q. Bui)

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