The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

PURE BENDING IN NON-LINEAR ELASTICITY – ANALYTICAL SOLUTION FOR A FAMILY OF ELASTIC MATERIALS IN 2D CONTINUUM MECHANICS

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Keywords: *Pure bending, Non-linear analysis, Semi-linear material, Saint Venant–Kirchhoff material, Hencky material, Seth–Hill family*

Bending of a plate into a cylindrical shape in a geometrically non-linear regime has an analytical solution as shown e.g. by Lurie, Ogden and Bruhns et al. among others, for a variety of elastic constitutive laws.

In the process, a semi-inverse method is utilised, whereby a deformed geometry in the shape of a circular strip of unknown thickness and curvature is assumed and tested against the governing equations of the problem. In contrast to linear elasticity, the through-the-thickness stress component now develops, while the longitudinal and lateral stress components cease to be linearly varying functions of the cross-section co-ordinates.

In the present contribution, an attempt will be made to re-cast some of the known solutions in a more general form applicable to a wider class of elastic materials belonging to the Seth-Hill family of material models.

Essentially, for a material capable of undergoing large elastic deformations, this leaves room for an extra material parameter to be defined assuming a linear relationship between an arbitrary pair of energy-conjugate strain and stress tensors.

Acknowledgement — The present work has been financially supported by the Croatian Science Foundation project *Fixed-pole Concept in Numerical Modelling of Cosserats' Continuum* (HRZZ-IP-2018-01-1732).

REFERENCES

[1] A. Lurie, *Nonlinear theory of elasticity*. North-Holland, 1990.

[2] R.W. Ogden, *Non-linear elastic deformations*. Dover, 1984.

[3] O.T. Bruhns, H. Xiao and A. Meyers, Finite bending of a rectangular block of an elastic Hencky material. *Journal of Elasticity*, Vol. **66**, pp. 237–256, 2002.