Fracture and mode mixity analysis of shear deformable composite beams

Balázs Kiss* **and András Szekrényes**

* Budapest University of Technology and Economics
Department of Applied Mechanics
Műegyetem rkp. 5., Building MM, 1111 Budapest, Hungary
e-mail: kissb8@gmail.com

Summary

To analyse delaminated composite beams with high accuracy under mixed-mode I/II fracture conditions first-, second-, third- and Reddy third-order shear defromable theories are discussed in this paper. The developed models are based on the concept of two equivalent single layers and the system of exact kinematic conditions. To deduce the equilibrium equations of the linearly elastic system the principle of virtual work is utilized. As an example a built-in configuration with different delamination position and external loads are investigated. The mechanical fields at the delamination tip are provided and compared to finite element results. To carry out the fracture mechanical investigation the J-integral with zero-area path is introduced. Moreover, by taking the advantage of the J-integral, a partitioning method is proposed to determine the ratio of mode-I and mode-II in-plane fracture modes. Finally, in terms of the mode mixity, the results of the presented evaluation techniques are compared to numerical solutions and previously published models in the literature.

Figure about the developed mechanical model

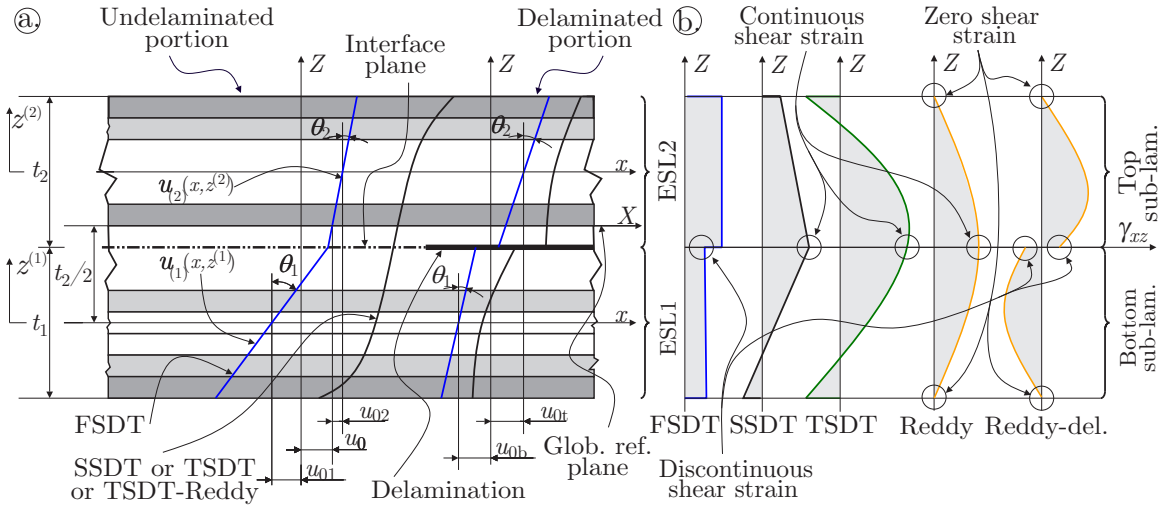

Figure 1: Cross section and the assumed deformation of the undelaminated portion in the $X-Z$ plane (a) and distributions of the transverse shear strain by different theories (b) using 2ESLs.

REFERENCES

[1] J.N.Reddy: Mechanics of Laminated Composite Plates and Shells - Theory and Analysis, Second edition, *Boca Raton, London, New York, Washington D.C.*, CRC Press, 2004.

[2] A.Szekrényes: Nonsingular crack modelling in orthotropic plates by four equivalent single layers, *Europen Journal of Mechanics A/Solids 55 73-99*, 2015.

[3] Meinhard Kuna: Finite elements in Fracture Mechanics Theory-Numerics-Applications, Springer, *Dordrecht Heidelberg New York London*, 2010.