# Linearised buckling analysis of thin-walled structures using detailed three-dimensional stress fields

S. Minera,[*] M. Patni, P.M. Weaver, and A. Pirrera

Bristol Composites Institute (ACCIS), University of Bristol, Queen's Building, University Walk, Bristol BS8 1TR, UK

## Abstract

The buckling and post-buckling behaviour of thin-walled structures can be sensitive to imperfections. Trying to strike a good compromise between accuracy and computational efficiency, critical buckling loads are usually calculated with approximated stress fields derived from plate- or shell-like models. It is hypothesised that these simplifications, and the errors that they introduce, may lead to inaccuracies in the assessment of a structures imperfection sensitivity. In this work, utilising accurate three-dimensional stress fields, we perform linearised buckling analyses of beam-like structures with generic cross section. Our objective is to assess whether common simplifications influence the prediction and mechanisms underlying a structures buckling loads and modes. To this end, finite elements are the traditional method of choice. However, the estimation of accurate, three-dimensional stress fields in thin-walled structures is impractical, because it requires fine meshes, a large number of degrees of freedom, and, consequently, long, computationally expensive calculations. To overcome this disadvantage, a new methodology, based on the Unified Formulation [1], is introduced. Our approach allows for speedy analyses, employing only a fraction of the degrees of freedom required in traditional finite elements for converged results. Numerical examples are presented with different structures, boundary conditions and loads.

# References

[1] Carrera E, Cinefra M, Petrolo M, and Zappino E. *Finite Element Analysis of Structures through Unified Formulation*. Wiley, Politecnico di Torino, Italy, 2014.

---

[*]Speaker