16th International Conference on Composite Structures
ICCS 16
A. J. M. Ferreira (Editor)

BUCKLING OF COMPOSITE THIN WALLED BEAMS BY REFINED THEORY

E. Carrera*, S. M. Ibrahim ‡ , M. Petrolo † and E. Zappino**

* Dipartimento di Ingegneria Aeronautica e Spaziale (DIASP)
Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129, Torino, Italy
e-mail: erasmo.carrera@polito.it, web page: www.mul2.com

‡ Dipartimento di Ingegneria Aeronautica e Spaziale (DIASP)
Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129, Torino, Italy
e-mail: muhammad.syed@polito.it, web page: www.mul2.com

† Dipartimento di Ingegneria Aeronautica e Spaziale (DIASP)
Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129, Torino, Italy
e-mail: marco.petrolo@polito.it, web page: www.mul2.com

** Dipartimento di Ingegneria Aeronautica e Spaziale (DIASP)
Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129, Torino, Italy
e-mail: enrico@cometacom.it, web page: www.mul2.com

Key words: Buckling, Composite structures, Carrera Unified Formulation (CUF).

ABSTRACT

Accurate analysis using the refined theories, incorporating the non-classical effects which can not be obtained with the Euler-Bernoulli and Timoshenko beam theories, is of paramount importance for thin walled composite structures frequently used in modern engineering applications like aerospace, marine and civil structural components. Literature on the buckling analysis of thin walled composite structures using refined beams theories is limited as compared to that on the static analysis [1-3]. Further, the literature on the buckling analyses highlights the fact that features like the torsional buckling modes are scarcely reported, in spite of their fundamental significance.

In the present paper, the hierarchical refined beam theories, based on the Carrera Unified Formulation (CUF) are used. CUF permits us to deal with any-order theories in a hierarchical manner with no need of *ad hoc* implementations since the order of the model is set as an input parameter. Moreover, these thin walled structures with arbitrary cross-section geometries are accurately idealized by the beam models using the CUF and an insight of the shell-type features can be obtained efficiently [4, 5].

The main objective of the study is to illustrate the application of CUF and to present and discuss some numerical results concerning the local and global buckling behaviour of thin-walled columns. Comparisons are carried out with the classical approaches to highlight the efficacy of the present formulation. Various numerical examples are investigated and new results are presented for the columns with different geometries.

REFERENCES

[1] K. Kapania and S. Raciti, "Recent advances in analysis of laminated beams and plates, part I: Shear effect and buckling", *AIAA Journal*, 27, 923-935 (1989).

[2] K. Kapania and S. Raciti, "Recent advances in analysis of laminated beams and plates, part II: Vibrations and wave propagation", *AIAA Journal*, 27, 935-946 (1989).

[3] G. Simitses, "Buckling of moderately thick laminated cylindrical shells: a review", *Composites Part B: Engineering*, 27, 581-587 (1996).

[4] E. Carrera and G. Giunta, "Refined beam theories based on Carrera's unified formulation", *International Journal of Applied Mechanics*, 2, 117-143 (2010).

[5] E. Carrera, G. Giunta, P. Nali, and M. Petrolo, "Refined beam elements with arbitrary cross-section geometries", *Computers and Structures*, 88, 283-293 (2010).