TAPERED COMPOSITE BEAMS ANALYSIS USING REFINED 1-D MODELS

Enrico Zappino*, Andrea Viglietti†, Erasmo Carrera#

Politecnico di Torino
Department of Mechanical and Aerospace Engineering
Corso Duca degli Abruzzi, 24
10129, Torino, Italy

*e-mail: enrico.zappino@polito.it, web page: http://www.mul2.com

†e-mail: andrea.viglietti@polito.it, web page: http://www.mul2.com

#e-mail: erasmo.carrera@polito.it, web page: http://www.mul2.com

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The design of structures, made of composite materials, requires the use of advanced structural models such as 3D finite elements. This approach provides accurate results regarding displacements, strains and stresses but, on the other hand, requires a huge computational cost.
The research of new structural models able to provide reliable analyses reducing the computational cost is an challenging task.
The present work proposes the use of an advanced one-dimensional FE model based on the Carrera Unified Formulation (CUF) that allows increasing the accuracy of the results maintaining a lower number of DOFs. These beam models concern the use of several expansions to describe the displacement field over the cross-section. In this particular case, the Lagrange Expansions are used [1]. This feature allows to maintain the geometric characteristics of the studied structure and, therefore, provide 3D-like results. Through the formulation presented, different structures can be arbitrary oriented in a global reference system and joined via the assembly procedure. In this way, this approach can deal with the analysis of complex structures made of several components.
This work focuses on the analyses of tapered beams with different cross-sections. Composite materials have been mostly used in this work but, during the assessment, isotropic metallic materials are also used. Both static and dynamic analyses have been performed to evaluate the modal frequencies and the stress fields under simple load cases. The results have been compared with solid FEM solutions from commercial FE codes. Where possible, the results have also been compared with literature results. The research demonstrates that the advanced FE model used can provide accurate analyses and 3-D-like results in spite of the use of 1-D finite elements. Tapered structures can be easily studied considering an high-fidelity geometrical description.

REFERENCES

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