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REFINED 1D MODELS FOR THE ANALYSIS OF REINFORCED-SHELL AERONAUTICAL STRUCTURES INCLUDING LOAD FACTORS EFFECT

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The present work presents an innovative approach to the analysis of reinforced-shell structures for aeronautical engineering applications. This approach is based on the Carrera Unified Formulation (CUF) [1], which was originally devoted to the development of refined plate and shell theories. In this work, one-dimensional (1D) CUF models are exploited. In the framework of 1D CUF, refined theories are hierarchically obtained by considering arbitrary expansions of the problem unknowns above the beam cross-section. Depending on the choice of the expansion, different classes of models can be developed. In this paper, the attention is focussed on the use of Lagrange polynomials as expanding cross-sectional functions [2]. The use of Lagrange expansions leads to the so-called Component-Wise (CW) approach, which some recent papers [3, 4] demonstrated to have excellent performances in both static and dynamic analyses of simple as well as complex wing structures. Some results about the mechanical response of aeronautical structures by CW models are presented in the present work. Effects due to complex inertial field distributions are particularly discussed. The results from the CW models are compared to those from classical beam theories, refined 1D CUF models obtained using N-order Taylor-like expansions to define the displacement field on the cross-section, and solid models by a commercial software. The results justify the need to adopt refined models because of the inability of classical beam theories to foresee cross-sectional deformations, shear effects, and bending-torsion couplings caused by non-symmetric inertial fields.

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