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REFINED 1D FINITE ELEMENTS FOR THIN-WALLED CURVED STRUCTURES

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Abstract. *This paper presents numerical results on the static and dynamic analysis of thin-walled, composite structures. The results are obtained via 1D finite elements based on refined beam theories. The Carrera Unified Formulation (CUF) is employed to build the refined theories. In the CUF framework, structural models can be obtained using expansions of the unknown variables along the cross-section of the beam. Any expansion type can be employed; for instance, polynomial, exponential, harmonic, etc.. Moreover, the order of the expansion can be set as an input, and chosen via a convergence analysis. Such features stem from the use of a few fundamental nuclei to obtain the governing equations and the finite element matrices. The formal expressions of the nuclei are independent of the order and the type of the expansion. 1D CUF models can provide 3D-like accuracies with low computational cost. Moreover, non-classical effects, such as warping, can be dealt with straightforwardly. This paper shows the latest extension of 1D CUF models. Legendre polynomials are employed as expansion functions of the displacement variables. The use of Legendre polynomials allows the parametrization of the cross-section geometry to tackle complex geometries, such as curved boundaries. The Principle of Virtual Displacements (PVD) is employed to obtain the finite element matrices. Various structural configurations are considered, including composite, thin-walled, curved structures. The results are compared with those from literature and 3D finite element models.*