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The analysis of tapered structures using a component-wise approach based on refined one-dimensional models

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Abstract

This paper presents the results of a static analysis on reinforced thin-walled tapered structures using refined one-dimensional models. The structural model is based on a one-dimensional formulation derived from the Carrera Unified Formulation. This formulation provides a quasi three-dimensional solution, thanks to the use of polynomial expansions to describe the displacement field over the cross-section. According to which type of expansion is used, various classes of refined one-dimensional elements are obtained. Lagrange expansions were used in this work. The use of these models allows each structural component to be considered separately; this methodology is called the component-wise approach. After an initial assessment of the structural model, different kinds of aeronautical structures, which gradually become more complex, have been studied. The stress and displacement fields have been obtained. The results have been compared with those obtained using commercial tools. Three- and two-dimensional models have been used for comparison purposes. The results show the capability of the present advanced one-dimensional models to achieve accurate results while avoiding high computational costs.

Key words: CUF, One-dimensional model, tapered beam.

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