ASSESSMENT OF MIXED AND DISPLACEMENT-BASED MODELS FOR STATIC ANALYSIS OF COMPOSITE BEAMS OF DIFFERENT CROSS-SECTIONS

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Summary. A numerical assessment of different finite element models (FEMs) for the static analysis of laminated composite beams of various cross-sections, considering equivalent single theories (Classical Lamination Theory-CLT, First-order Shear Deformation Theory-FSDT and Higher-order Shear Deformation Theories-HSDTs), is presented. Mixed least-squares FEMs are derived and presented for all theories as well as confronted with displacement-based weak form, mixed weak form and weighted residual mixed form FEMs developed for comparison purposes. The governing equations consistent with the mixed formulations, derived from the Hellinger-Reissner variation principle, are also presented. A method of transforming the actual geometrical beam cross-section into an equivalent single layer, through transformation matrices and the parallel axis theorem, existing in literature for the CLT is implemented and extended to the FSDT and HSDTs. Validation and assessment of the different FEMs involved the implementation of analytical solutions and comparison with experimental/numerical/analytical results available in literature, from which conclusions in terms of accuracy and computational effort are drawn.