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Numerical Study of Elastic Performances of Sandwich Beam with Carbon-Fibre Reinforced Skins

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Abstract : Sandwich materials with composite reinforced skins are mostly required in advanced construction applications with a view to ensure resistant structures. Their lightweight, their high flexural stiffness and their optimal thermal insulation make them a suitable solution to obtain efficient structures with performing rigidity and optimal energy safety. In this paper, the mechanical behavior of a sandwich beam with composite skins reinforced by unidirectional carbon fibers is investigated numerically through analyzing the impact of reinforcements specifications on the longitudinal elastic modulus in order to select the adequate sandwich configuration that has an interesting rigidity and an accurate convergence to the analytical approach which is proposed to verify performed numerical simulations. Therefore, concerned study starts by testing flexion performances of skins with various fibers orientations and volume fractions to determine those to use in sandwich beam. For that, the combination of a reinforcement inclination of 30° and a volume ratio of 60% is selected with the one with 60° of fibers orientation and 40% of volume fraction, this last guarantees to chosen skins an important rigidity with an optimal fibers concentration and a great enhance in convergence to analytical results in the sandwich model for the reason of the crucial core role as transverse shear absorber. Thus, a resistant sandwich beam is elaborated from a face-sheet constituted from two layers of previous skins with fibers oriented in 60° and an epoxy core; concerned beam has a longitudinal elastic modulus of 54 Gpa (gigapascal) that equals to the analytical value by a negligible error of 2%.

Keywords : fibers orientation, fibers volume ratio, longitudinal elastic modulus, sandwich beam
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