A nonlinear analytical model for symmetric laminated beams in three-point bending

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The use of composite materials with continuous fibers in the aircraft and aerospace industries requires a thorough knowledge of behaviors of these laminate composites under various loading conditions. Indeed, the aim of this work is to simulate linear and nonlinear behavior of a symmetric laminated composite under three-point bending tests. The modelization used is based on an analytical approximation that has been recently developed for isotropic materials. This approximation is still valid for the studied quasi-isotropic laminated composite because it is symmetric with a specific layer sequence. The overall response of laminate composite is determined from the behavior of each ply outside of their orthotropic axis. Two methods are used to calculate the equivalent longitudinal Young-modulus of the laminate. The result shows that when the deflection of the specimens is less than 2.5 times the thickness, the difference between the experimental and analytical curves is about 1% for the average global stresses method, and about 7.5% for the apparent bending modulus method. For large deflections, the difference relative to the first method remains less than 11% and the second method is about 20%.