

Laminated strip under three-point bending

REFERENCE	NAFEMS, <i>Composite Benchmarks</i> , Ref . R0031, Issue 2, NAFEMS, Glasgow, 2001
MODEL FILENAME	Laminated Strip.nfx

Figure 1 shows a laminated strip with $[0/90/0/90/0/90/0]$ layup subjected to bending at three points. Layered shell and layered solid elements are used to obtain the linear static response of the laminate. For the model with layered solid elements, the entire laminate is modeled using either a single element layer in the thickness direction or using multiple layered solid elements stacked with each element representing an individual ply. The vertical displacement and the in-plane bending stress are computed at the point E, and the inter-laminar shear stress is computed at the point D. Comparisons are made with the reference solution given in the NAFEMS publication for composite benchmarks.

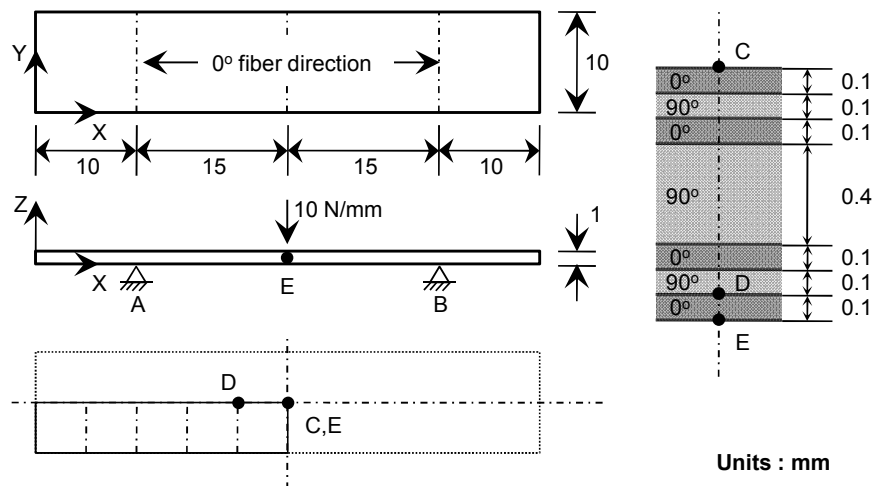


Figure 1. Laminated strip model

Material data	Young's modulus	$E_1 = 100 \text{ GPa}, E_2 = E_3 = 5 \text{ GPa}$
	Shear modulus	$G_{12} = 3 \text{ GPa}, G_{13} = G_{23} = 2 \text{ GPa}$
	Poisson's ratios	$\nu_{12} = \nu_{13} = 0.4, \nu_{23} = 0.3$

Table 2.19.2 Bending stress σ_{11} and Z deflection u_z at point E obtained using layered solid elements with a single element in the thickness direction

		σ_{11}^E [MPa]	u_z^E [mm]
Reference		683.9	-1.06
Element type	Number of elements		
PENTAL-15	40×1	682.3	-1.05