AE4509 Advanced design and optimization of composites

Assignments

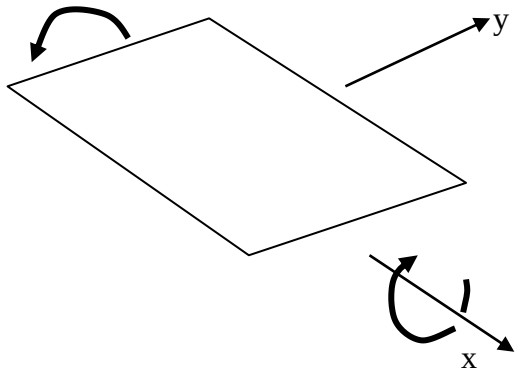
Delft
University of
Technology

Advanced Design and Optimization of Composite Structures – Part 1

Problem Set 1

1. A rectangular laminate with layup [45/-45/0]s is under pure torsion. The applied twisting moment is M_{xy}=44.48 Nmm/mm.

(a) Given that the out-of-plane deflection w is zero at x=y=0 and that the first derivatives $\partial w/\partial x$ and $\partial w/\partial y$ are zero at the same location, determine the out-of-plane shape of w and plot it. For the plot, assume length of laminate =10 cm (along x) and width =5 cm. If you cannot do a 3-D plot, it suffices to plot w as a function of y at x=-2, x=0, x=+2 and x=+4 cm.
(b) Determine the value of M_{xy} at which the laminate fails and the type of failure (tension, compression, shear, fiber, matrix, etc.) Determine the exact location where failure starts and the corresponding maximum strain (give only the highest of the three strains, two axial strains parallel or perpendicular to the fibers, or shear strain).



Material properties (mean Room Temperature Ambient RTA values):

Ex	1.23E+11	Pa
Ey	8.48E+09	Pa
nuxy	0.29	
Gxy	5.24E+09	Pa
tply	0.13970	mm
Xt	1693855800	Pa
Xc	1276079400	Pa
Yt	25507800	Pa
Yc	115819200	Pa
S	100652400	Pa

(2) During an actual test at Elevated Temperature Wet conditions, the specimen failed at half the load predicted in part (1). Assuming there was no damage in the specimen but that it was an A-Basis specimen (i.e. its strength was at 1 percentile of the population), estimate the coefficient of variation and the B-Basis of the critical strength property at RTA. You may use any material in the course so far.