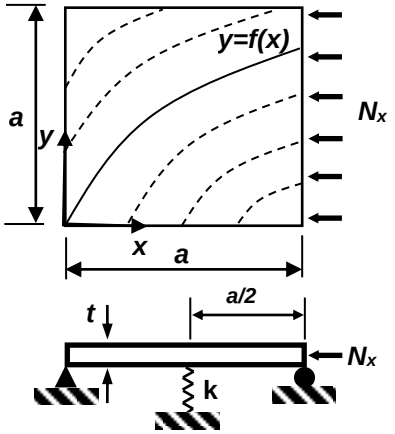
MP-206 ANALYSIS AND DESIGN OF COMPOSITE STRUCTURES

1S/2017

PLY PROPERTIES:

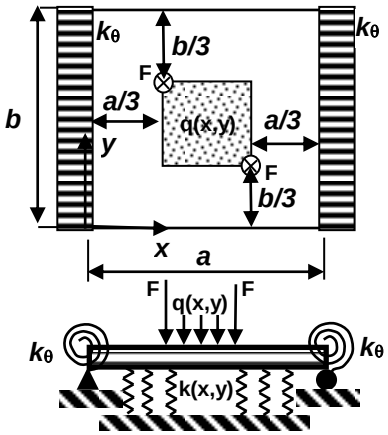
E_1=129500, E_2=9370,v_{12}=0.38, G_{12}=5240
X_t=1500 MPa, X_c=1000 MPa, Y_t=70 MPa, Y_c=200 MPa, S_{12}=90 MPa
Ply thickness: 0.19 mm

PROBLEM 1



Consider a simply supported square plate with ***a=300mm*****,** composed by a single ply with thickness ***t=0.19mm***, elastically restrained by a translational spring of ***k=10 N/mm***, placed in the central point of the plate. The plate is made of a single composite layer which was manufactured by automated fiber placement (ATL) process where the fiber deposition trajectory of the fiber tow indicated in the figure is defined by $\mathbf{y(x)=c_1x^3+ c_2x^2+ c_3x+c_4}$ ($\mathbf{c_1=-3.113e-6,\ c_2=-0.0003631,\ c_3=1.026\ c_4=-0.3196}$). Assuming the given ply properties, find the buckling load of the plate.

PROBLEM 2



Consider a simply supported rectangular plate with ***a=300mm*****,** ***b=250mm*****,** with layup $[0/90/45/90]_s$, transversely supported by springs with $\boldsymbol{k=100\ N/mm^3}$ and rotationally restrained along the edges (x=0,y=[0,b]) and (x=a,y=[0,b]) with $\boldsymbol{k_\theta = 2000\ rad.mm/mm^2}$. The central portion of the laminate is subjected to an uniform pressure ***q*****(x,y)** = **100 MPa** and two diagonally opposed concentrated loads in the positions indicated in the figure, with magnitudes **F=10 kN**. Assuming the given ply properties, compute the transverse displacement field and the stresses distribution acting on each layer of the laminate. By using the Maximum stress failure criteria, combined with the first-ply failure criterion check if the laminate resists without failure to the given loading combination.

PROBLEM 3

For the same plate and laminate given in the **Problem 2**, assuming ***q*****(x,y)**=**F=*k=0*** determine:

a) The variation of the first natural frequency of the plate with the pre-stress N_x varying the pre-stress up to the buckling pre-stress level N_{cx}. What happens when the pre-stress reaches the buckling pre-stress level?
b) The critical flutter pressure assuming: (i) the airflow aligned with the plate x direction, (ii) Pre-stress levels $N_x=0$, $N_x=N_{cx}/2$. Discuss the results.