CHAPTER 4

AUTO EVALUATION EXERCISE

A catamaran is being designed using composite materials. The union between the two hulls is done via a 3 meters long beam with a double T section. The beam is manufactured by a symmetrical laminate composed by the same number of plies at 0 °, 45 ° and -45 °.

Modelling the structure as a single-span beam supported at its ends and subjected to a uniformly distributed load:
1. Determine the maximum stresses and the beam sections in which they appear.
2. Assuming that the bending moment would be supported solely by the flanges, propose a model to express this moment as a pair of axial forces acting on each flange.
3. Calculate the strain distribution in the upper flange.
4. Estimate the stresses that appear on the plies at 0 °of the laminate.
5. Considering exclusively the plies at 0 °, determine the load that produces the failure.

DATA:

Material: Kevlar/epoxy

Density: 1350 kg/m^3

X = 1410 MPa

X'=280 MPa

Y = 28 MPa

S = 45 MPa

E_1 = 85 MPa

E_2 = 5,6 GPa

ν_{21} = 0,34

G_{12} = 2,1 GPa

Y' = 141 MPa

Stiffness matrix of the lamina $\qquad [Q] = \begin{bmatrix} 85,65 & 1,92 & 0 \\ 1,92 & 5,64 & 0 \\ 0 & 0 & 2,10 \end{bmatrix}$ GPa