MECÂNICA ESTRUTURAL – 10371/10391/10411

2014/2015

Assignment 1

OBJECTIVES

To learn how to implement a computer code to solve a structural problem, using the finite element method.

1. PROBLEM

A wing spar of an ultralight aircraft is to be sized for minimum weight using the finite element method. In the finite element formulation of the Euler-Bernoulli beam, assume that the cross-section properties are constant within the element. Determine the width, b, and thickness, t = t0+t1*x, of the wing's cross-section for minimum weight subject to a maximum tip deflection of 10% of the semi-span, L; a safety factor of FS = 1.5 and a minimum safety margin in any position along the spar of MS = 0.2. Assume that $b \leq h$.

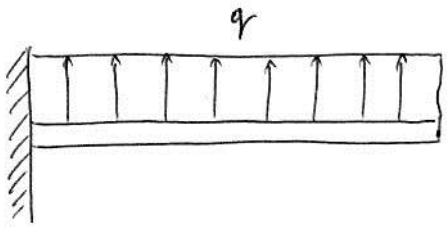
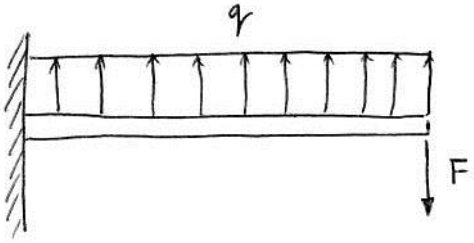
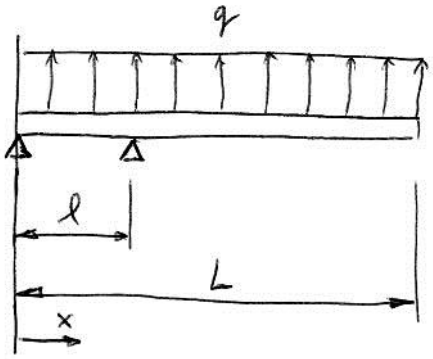
Plot the transverse deflection, w, the rotation, θ, the thickness, t, the maximum stress, σ, and the safety margin, MS, as functions of the position, x, along the spar.

2. DATA

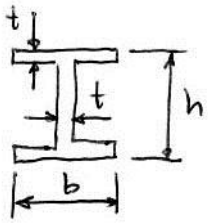
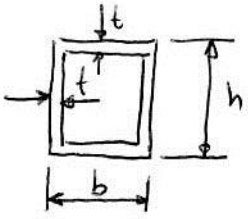
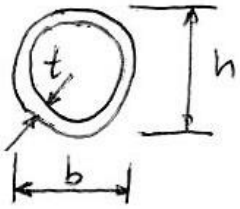
Each group should select a different combination of loading, cross-section and material from the options below.

	Material	
i	Young's modulus Ultimate direct stress	E = 70 GPa σmax =600MPa
ii	Young's modulus Ultimate direct stress	E = 100 GPa σmax = 1000 MPa

Loading

1		L = 5 m q = 1800 N/m
2		L = 5 m q = 1800 N/m F = 250 N
3		L = 5vm l = 2 m q = 1800 N/m

Cross-section

A		h = 0.1 m b = ? t = t0+t1*x t0 = ? t1 = ?
B		h = 0.1 m b = ? t = t0+t1*x t0 = ? t1 = ?
C		h = 0.1m b = ? t = t0+t1*x t0 = ? t1 = ?