UNIVERSIDADE BEIRA INTERIOR

DEPARTAMENTO DE CIÊNCIAS AEROESPACIAIS

MECÂNICA ESTRUTURAL – 10371/10391/10411

2016/2017

Assignment 2

OBJECTIVES

To learn how to use a commercial computer program to determine the modal shapes and natural frequencies of vibration of an aircraft structure and gain experience in solving such problems.

1. PROBLEM

It is required to analyse the wing spar of a light aircraft in terms of its bending modes of vibration in the vertical plane. This spar is the one obtained in assignment 1 in its minimum weight configuration.

The code previously developed to analyse an Euler-Bernoulli beam under static loading conditions, using the finite element method, must be extended to allow the natural frequencies of vibration and the corresponding mode shapes to be computed. The solution obtained from the developed code should be compared with a solution obtained from a commercial software package. The first six modes should be obtained.

A report should be written explaining the construction of the FE model and showing the mode shapes in graphical form. The results should be discussed taking into account the following: spar mass, spar stiffness, differences between the developed code's solution and the commercial software's solution.

2. DATA

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

Table 1: Material properties

	material	density ρ, kg/m^3	Young's modulus E, GPa	tensile strength σ_{tu}, MPa	compressive strength σ_{cu}, MPa
1	aluminium alloy	2700	70	600	480
2	pultruded carbon	1600	140	1500	1200

Table 2: Load cases

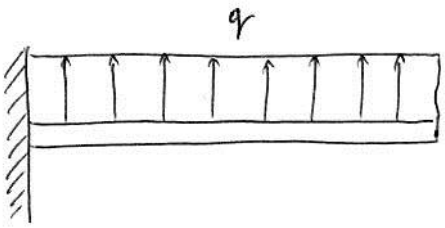
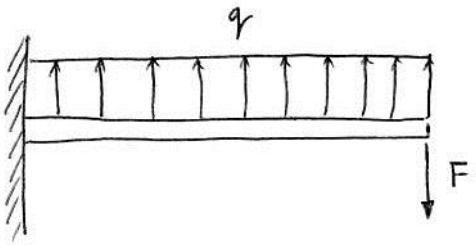
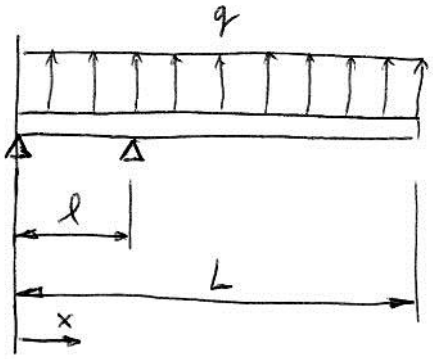
	Loading	
i		L = 5 m q = 1800 N/m
ii		L = 5 m q = 1800 N/m F = 250 N
iii		L = 5 m l = 2 m q = 1800 N/m

Table 3: Cross-section shapes.

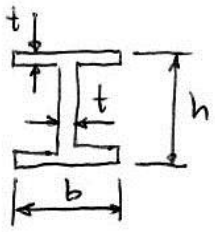
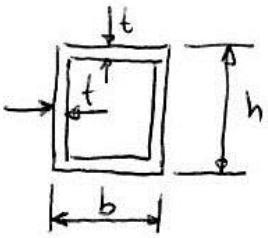
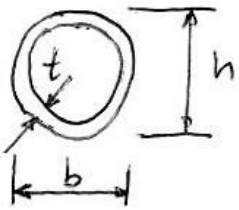
cross-section	dimensions
A  B  C 	h = 0.12 m b = ? $t = t_0 + t_1 * x$ t_0 = ? t_1 = ?

Table 4: Problem combinations and students' names.

Mat.	Load	C.-sec.	Name 1	Name 2
1	i	A	Patrick Figiel	Michal Celek
1	i	B	Gonçalo Fernandes	Nuno Santos
1	i	C	Henrique Almeida	Gustavo Garcia
1	ii	A	Eryk Giefert	Michal Dudkiewicz
1	ii	B	Hugo Lopes	
1	ii	C	Francesco Rossi	
1	iii	A	Nuno Cunha	Pedro Barros
1	iii	B	Joanna Cuprys	Ewa Kruczek
1	iii	C	Pawel Gadomski	Lukasz Zakrzowski
2	i	A	Joanna Kulczycka	Dominik Cisek
2	i	B	Pedro Carneiro	Nuno Rafael
2	i	C	Pedro Paiva	Diogo Marinho
2	ii	A		
2	ii	B	Jorge Monteiro	Paulo Antunes
2	ii	C	Eduardo Gonçalves	André Branco
2	iii	A		
2	iii	B	Luís Correia	João Perdigão
2	iii	C	Alexandre Nunes	Miguel Santos