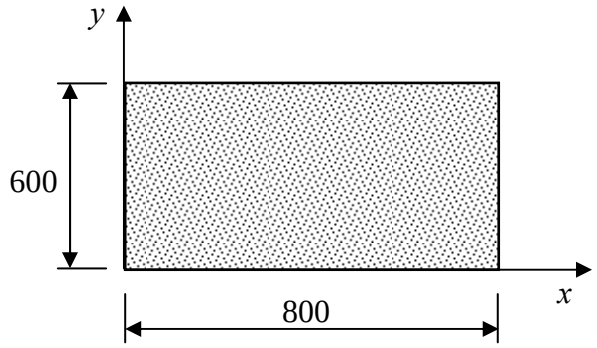
MEK 4540 – Autumn 2009: Compulsory Assignment no. 2

Deadline 09.15 Friday 30.10.2009 (see below)



A rectangular, flat plate 800 mm x 600 mm is built up from 8 unidirectional plies of fibre reinforced composite material. Each ply has thickness h = 1.0 mm and the following elastic properties:

E-modulus parallel to fibres:	E_1 = 181 GPa
E-modulus transverse to fibres:	E_2 = 10.3 GPa
Shear modulus:	G_{12} = 7.17 GPa
Poisson's ratio:	ν_{12} = 0.28

The panel is simply supported at all four edges and is subjected to a uniformly distributed pressure of 40 kPa.

Six differing lay-ups shall be considered, where the angles are measured in degrees from the x-axis:

$$[0_8],\ [90_8],\ [0/90]_{2s},\ [90/0]_{2s},\ [+45/-45]_{2s},\ [90/45/-45/0]_s.$$

a) Calculate the ABD-matrix for each laminate by means of Matlab (or other analysis tools).

b) Calculate the following response parameters:
- The deflection w_{max} at the middle of the plate
- The maximum bending moment per unit length about an axis parallel to the x-direction, $M_{y,max}$
- The maximum bending moment per unit length about an axis parallel to the y-direction, $M_{x,max}$
- The maximum twisting moment per unit length, $M_{xy,max}$

Explain how you have decided on the number of terms to use in the series solutions. (Equation 5.11 in Z&B is used to calculate the moments, with $D_{16} = D_{26} = 0$. Note that the maximum moments do not necessarily occur at the centre of the plate.)

c) Present the results in a table and comment on the differences between them.

d) The same plates are subjected to a loading in the xy-plane such that the edges x = 0, x = 800 mm experience equal, uniformly distributed compressive forces. Calculate the lowest critical value of this compressive loading that will cause buckling.

It is recommended that the problem is solved using Matlab or a similar software tool and that the method is tested for one or more cases from Z&B example 5.1 or 5.2 and also 5.6. Note that Z&B in fact tabulate M_x and M_y at the centre of the plate (not the true $M_{x,max}$ and $M_{y,max}$) and that the values given for $M_{xy,max}$ are one-half of the correct values.

The assignment shall be handed in by Friday 30 October 2009 at 09.15:
- by email (preferably in pdf-format) to Brian.Hayman at dnv.com, or
- on paper to Brian's mailbox on the 7th floor or directly at the start of the lecture.

Matlab files are to be handed in with the assignment and also sent by email. *BH/15.10.2009*