ME500/AA535 Homework Set 7

Due Weds 3 June

Preliminary discussion: Several output files are created when program SYMM is executed:

Type.txt: This file contains a single integer number:

(a) If the file contains the number "1", then SYMM has been used to calculate transverse displacements caused by a transverse load.

(b) If the file contains the number "2", then SYMM has been used to calculate the first four buckling loads and corresponding buckling modes

Dim.txt: This file contains the in-plane dimensions of the plate. The first number listed is dimensuion "*a*", and the second number listed is dimension "*b*"

M.txt: This file contains a single integer number that indicates the number of terms used to describe the in-plane displacement field, in accordance with eq 12.3:

$$w(x,y) = \sum_{m=1}^{M_3}\sum_{n=1}^{N_3} c_{mn} \sin\left(\frac{m\pi x}{a}\right)\sin\left(\frac{n\pi y}{b}\right) \qquad (12.3)$$

As has been discussed, we have used the same number of terms in the *x*- and *y*- directions. That is, let $M_3 = N_3$. The integer number contained in file M.txt equals M_3. For example, if the number contained in file M.txt is "4", then $M_3 = N_3 = 4$. This indicates that $4^2 = 16$ terms have been used to describe $w(x,y)$, using equation (12.3).

Coeff.txt: This file contains the coefficients c_{mn}. For example, if $M_3 = N_3 = 4$, then $4^2 = 16$ coefficients will be contained in file Coeff.txt, and will appear in ascending order:

c_{11}
c_{12}
c_{13}
c_{14}
c_{21}
c_{22}
c_{23}
.
.
.
c_{43}
c_{44}

Assume the properties listed for graphite-epoxy in Table 3.1 for all of the following problems.

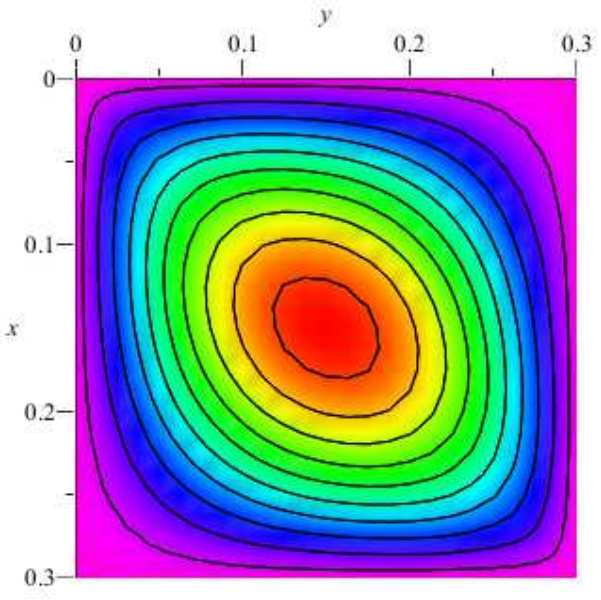
1. A $[25]_{12}$ graphite-epoxy laminate is trimmed to in-plane dimensions 300 x 300 mm and mounted in an assembly that provides type S4 simple supports along all four edges. The laminate is then subjected to a uniform transverse load $q(x,y)$ = 5 kPa and $N_{xx} = N_{yy} = N_{xy} = 0$. Calculate the maximum transverse deflection using program *SYMM* based on 100 terms (i.e., for $M_3 = N_3 = 10$), and create a contour map of out-of-plane displacements. You should calculate a maximum deflection of 9.79 mm, and your contour plot should be equivalent to that shown below.

Note: Several programs can be used to create the contour map; for example, MATLAB or Mathematica , and both of these are available using the remote ME desktop server:

http://www.me.washington.edu/computing.html

If you wish the contour map can also be created using program PLOT, which involves the use of the software package MAPLE. MAPLE is not available on the remote ME desktop server, but is available in many on-campus computer labs, including the pre-Engineering computer lab in Wilcox Hall: http://www.engr.washington.edu/mycoe/computing/labs/index.html

w_{max} = 9.79 mm



2. A $[25]_{12}$ graphite-epoxy laminate is trimmed to in-plane dimensions 300 x 300 mm and mounted in an assembly that provides type S4 simple supports along all four edges. The laminate is then subjected to a transverse point load P = 100 N, applied at x = 200mm, y = 200mm. In-plane loads are $N_{xx} = N_{yy} = N_{xy} = 0$.

a) Calculate the maximum transverse displacement and create a contour map of out-of-plane displacements based on the use of one term, i.e., based on $M_3 = N_3 = 1$.
b) Calculate the maximum transverse displacement and create a contour map of out-of-plane displacements based on the use of four terms, i.e., based on $M_3 = N_3 = 2$.

c) Calculate the maximum transverse displacement and create a contour map of out-of-plane displacements based on the use of sixteen terms, i.e., based on $M_3 = N_3 = 4$.

d) Calculate the maximum transverse displacement and create a contour map of out-of-plane displacements based on the use of 64 terms, i.e., based on $M_3 = N_3 = 8$.

e) Calculate the maximum transverse displacement and create a contour map of out-of-plane displacements based on the use of 100 terms, i.e., based on $M_3 = N_3 = 10$.

3. A $[25]_{12}$ graphite-epoxy laminate is trimmed to in-plane dimensions 300 x 300 mm and mounted in an assembly that provides type S4 simple supports along all four edges. A compressive load N_{xx} is applied and causes buckling ($N_{yy} = N_{xy} = 0$.).

Create a contour map of the first four buckling modes, and determine the buckling load associated with each mode.