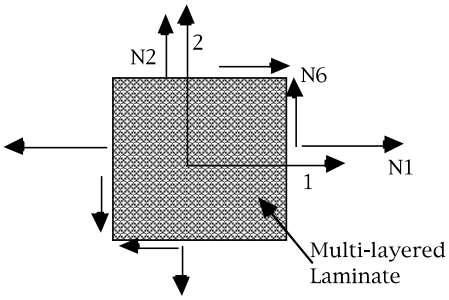
**Mechanics of Composite Materials** **September 30, 2014**
Mechanical Engineering MECH 530 Due **:** **October 7, 2014**

# Project, Assignment #3
# Laminate Properties [A], [a]

Review of Project so Far

The first part of the project was to write an input and output interface for your program. You have input a material, geometry parameters, total number of layers, n, individual ply thickness, $t_i$, ply orientation, $\theta_i$, core thickness, $2z_c$. All input parameters were output in SI units as well as the "on-axis" [S] and [Q] matrices, modulus U's and compliance U's. There should also be subroutines to perform stress & strain transformations, and to calculate "off-axis" modulus $[Q_{ij}]$,i,j=1,2,6 and compliance $[S_{ij}]$,i,j=1,2,6.




**Assignment #3**

Add the capability of calculating the overall in-plane modulus and in-plane compliance for a given laminate, i.e., the [A] and [a] matrix. The [A] matrix can be calculated using the formulation of Table 4.4. From this table, the V* quantities are given by Eq. 4.36 or 4.38. (Note that Table 4.4 is given in terms of $A_{ij}/h$). For the [a] matrix, you must invert the 3x3 [A] matrix. Be careful of the units of [A] and [a].

• Add to the input parameters, an applied stress vector ($N_1$, $N_2$, $N_6$)

• For the given example layup, $[\pm 10/90/0_2/\pm 50]s$, and material properties for graphite/epoxy (T300/N5208) material, print out non-normalized [A] and [a] matrices, in SI units.

• For the same $[\pm 10/90/0_2/\pm 50]s$ , layup and an off-axis stress resultant vector of ($N_1$, $N_2$, $N_6$)= (450,000, -110,000, -130,000), units=N/m or Pa·m, find the resulting off-axis strain ($\varepsilon_1^o$, $\varepsilon_2^o$, $\varepsilon_6^o$) using the off-axis compliance matrix [a].

• From off axis strain, for each layer, calculate on-axis strains and then on axis stresses, following the procedure shown in Fig. 4.3.

• **Print all appropriate results with appropriate units**.

**** Note **** off-axis [Q] and [S] matrices for each layer need **not** be printed at this time (there would be too much output), but keep it in your program as an optional calculation.

**** Note **** other output data (as in previous assignments) should be kept as we build the program, i.e., keep printing out the material properties, ply orientation, etc. The output should begin to look more and more like a report with each additional assignment.