SESG6039 – Composites Engineering Design and Mechanics

Individual Assignment 1

Introduction

Assignment 1 is primarily a validation case study for your CLPT calculations. Using the information provided in the lectures, you will develop a CLPT code (or spreadsheet) that will take constituent material properties, lamina orientations and physical dimensions and return the engineering constants for the described laminate.

You should submit:

- A formal report of no more than 6 sides of A4 which includes:
  - A flow chart explaining how your code works as a support for the submitted code
  - Answers to the questions 1-5 below.
- A copy of your CLPT calculator

The CLPT calculator can be written in the code of your choice Python, Matlab etc. If you do not have a programming language then the calculations can be done in Microsoft Excel.

Questions

Use your CLPT calculator and its output to answer the following questions

Question 1:

Show that your CLPT code produces the same answers as the worked example of the $[0, 90]_s$ laminate provided on the blackboard site. At each stage of your flow chart show that it correctly provides the interim answers from the micromechanics to the final laminate properties.

Question 2:

Using the engineering elastic constants given in Table 1 for E-glass/epoxy use your CLPT programme to calculate the [A] and [D] matrices for the laminate configuration of:

[-45, +45, 0, 90, 90, 0, 0, 90, 90, 0, +45, -45]

assuming a ply thickness of 0.2 mm.

Table 1 Lamina engineering elastic constants

Property	**Symbol (Units)**	**Value**
Young's modulus in the 1-direction	E_1 (GPa)	54
Young's modulus in the 2-direction	E_2 (GPa)	18
Major Poisson's ratio	ν_{12}	0.28
Shear Modulus	G_{12} (GPa)	6

Question 3:

Explain why the [B] matrix for this laminate should be zero? When we do the calculations we do not get exactly zero for every term in the [B], why does this occur?

Question 4:

Using the procedure outlined in the lecture material, calculate the equivalent laminate elastic engineering properties (E_{xlam}, E_{ylam},ν_{xylam} and G_{xylam}) for the laminate as described in Question 2. Comment on the values obtained, with respect to the laminate.

Question 5:

Take a 4 ply laminate (ply thickness 0.125 mm) with stacking sequence [90, 45,-45, 0], using the engineering elastic constants from Table 2 and your CLPT-code to calculate the [A], [B] and [D] matrices. Calculate the laminate stiffness's E_{xlam} and E_{ylam}. Discuss the results obtained with respect to the laminate stacking sequence and the ABD matrix.

Conclusions

Marks are given for both the code and the flow chart, the predictions of the CLPT code/script, and the discussion and interpretation of the results.

The Report and associated code/spreadsheet are to be uploaded to the Blackboard site under Assignments>Individual Assignment 1.

Feedback on this part of the assignment will be provided to students via Blackboard before the submission of Individual Assignment 2.

It is important to note that it will be impossible to complete the Individual Assignments 2 and 3 without having a working CLPT calculator.