
McGill University

Mechanics of Composite Materials

MECH 530

# Assignment 3

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**Orientation list :**

```
Orientation [degrees] :
[10, -10, 90, 0, 0, 50, -50, -50, 50, 0, 0, 90, -10, 10]
```

**Number of plies :**

```
14
```

**Material properties :**

```
'          ID :              1  [-]'
'fiber/matrix :     T300/N5208  [-]'
'        name : Graphite/Epoxy  [-]'
'          ex :       181.0000  [GPA]'
'          ey :        10.3000  [GPA]'
'          es :         7.1700  [GPA]'
'         nux :         0.2800  [-]'
'          xt :      1500.0000  [MPA]'
'          xc :      1500.0000  [MPA]'
'          yt :        40.0000  [MPA]'
'          yc :       246.0000  [MPA]'
'          sc :        68.0000  [MPA]'
'          h0 :         0.1250  [mm]'
'         nuy :         0.0159  [-]'
```

**Total thickness**

```
0.001750 [m]
```

**Modulus and Compliance on-axis matrices :**

```
S_on [1/GPa] :
[[   0.0055   -0.0015    0.0000]
 [  -0.0015    0.0971    0.0000]
 [   0.0000    0.0000    0.1395]]
U's for S [1/GPa]
U1 :  0.0555
U2 : -0.0458
U3 : -0.0042
U4 : -0.0058
U5 :  0.1226

Q_on [GPa] :
[[ 181.8111    2.8969    0.0000]
 [   2.8969   10.3462    0.0000]
 [   0.0000    0.0000    7.1700]]
U's for Q [GPa]
U1 : 76.3682
U2 : 85.7325
U3 : 19.7104
U4 : 22.6074
U5 : 26.8804
```

**Overall in-plane modulus and compliance matrices :**

```
A [GN/m] :
[[   0.2010    0.0265    0.0000]
 [   0.0265    0.0924    0.0000]
 [   0.0000    0.0000    0.0340]]
a [m/GN] :
[[   5.1708   -1.4817    0.0000]
 [  -1.4817   11.2418   -0.0000]
 [   0.0000   -0.0000   29.4384]]
```

**Applied resultant stress:**

```
Load [MN/m] :
[[   0.4500]
 [  -0.1100]
 [  -0.1300]]
```

**Off-axis strain using overall in-plane compliance matrix :**

```
Off-axis strain [-] :
[[   0.0025]
 [  -0.0019]
 [  -0.0038]]
```

**On-axis strain and on-axis stress [GPa] for each layer using transformation.**

On-axis strain is found by transforming the off-axis strain.

On-axis stress is found with the on-axis modulus matrix.

```
Layer number : 1
Orientation  : 10 [degrees]
On-axis Strain :
[   0.0017   -0.0011   -0.0051]
On-axis Stress
[   0.3064   -0.0066   -0.0366]


Layer number : 2
Orientation  : -10 [degrees]
On-axis Strain :
[   0.0030   -0.0024   -0.0021]
On-axis Stress
[   0.5406   -0.0164   -0.0150]


Layer number : 3
Orientation  : 90 [degrees]
On-axis Strain :
[  -0.0019    0.0025    0.0038]
On-axis Stress
[  -0.3388    0.0202    0.0274]


Layer number : 4
Orientation  : 0 [degrees]
On-axis Strain :
[   0.0025   -0.0019   -0.0038]
On-axis Stress
[   0.4472   -0.0125   -0.0274]


Layer number : 5
Orientation  : 0 [degrees]
On-axis Strain :
[   0.0025   -0.0019   -0.0038]
On-axis Stress
[   0.4472   -0.0125   -0.0274]


Layer number : 6
Orientation  : 50 [degrees]
On-axis Strain :
[  -0.0020    0.0026   -0.0037]
On-axis Stress
[  -0.3512    0.0208   -0.0263]


Layer number : 7
Orientation  : -50 [degrees]
On-axis Strain :
[   0.0018   -0.0012    0.0050]
On-axis Stress
[   0.3231   -0.0073    0.0358]


Layer number : 8
```

```
Orientation  : -50 [degrees]
On-axis Strain :
[   0.0018   -0.0012    0.0050]
On-axis Stress
[   0.3231   -0.0073    0.0358]


Layer number : 9
Orientation  : 50 [degrees]
On-axis Strain :
[  -0.0020    0.0026   -0.0037]
On-axis Stress
[  -0.3512    0.0208   -0.0263]


Layer number : 10
Orientation  : 0 [degrees]
On-axis Strain :
[   0.0025   -0.0019   -0.0038]
On-axis Stress
[   0.4472   -0.0125   -0.0274]


Layer number : 11
Orientation  : 0 [degrees]
On-axis Strain :
[   0.0025   -0.0019   -0.0038]
On-axis Stress
[   0.4472   -0.0125   -0.0274]


Layer number : 12
Orientation  : 90 [degrees]
On-axis Strain :
[  -0.0019    0.0025    0.0038]
On-axis Stress
[  -0.3388    0.0202    0.0274]


Layer number : 13
Orientation  : -10 [degrees]
On-axis Strain :
[   0.0030   -0.0024   -0.0021]
On-axis Stress
[   0.5406   -0.0164   -0.0150]


Layer number : 14
Orientation  : 10 [degrees]
On-axis Strain :
[   0.0017   -0.0011   -0.0051]
On-axis Stress
[   0.3064   -0.0066   -0.0366]
```