In [1]:
```
run -i MECH530_main.py
```

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PLYBOOK (READ FROM EXCEL FILE AND SUMMARIZED HERE)

The laminate is given by the following plybook where the highest ply number '13
' indicates the top layer, while the first ply number '1' indicates the bottom
layer.

Unique Ply #, Fiber/Matrix, Orientation, Thickness
                              (degrees)      (mm)
    13            AS4/PEEK          0          0.125
    12            AS4/PEEK          0          0.125
    11            AS4/PEEK         25          0.125
    10            AS4/PEEK        -25          0.125
     9            AS4/PEEK          0          0.125
     8            AS4/PEEK          0          0.125
     7                CORE          0         10.000
     6            AS4/PEEK          0          0.125
     5            AS4/PEEK          0          0.125
     4            AS4/PEEK        -25          0.125
     3            AS4/PEEK         25          0.125
     2            AS4/PEEK          0          0.125
     1            AS4/PEEK          0          0.125

PLIES AND THICKNESSES
-Total number of plies in the laminate: 13
-Total thickness of laminate is: 11.500 mm
-The core thickness is 2 Zc = 10.000 mm
-Note that the CORE will be ommitted in the following stress and safety factor
tables
-Laminate contains 1 Fiber/Matrix combination. The material properties for this
 combination shall be listed below.

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MATERIALS AND MATERIAL PROPERTIES

RESIN/MATRIX 1 of 1: For AS4/PEEK, the given material properties are:

-Stiffness and Strength:

Ex = 134.0000 GPa, Ey =   8.9000 GPa, Es =   5.1000 GPa and nu_x =   0.2800

Xt = 2130.0000 MPa, Xc = 1100.0000 MPa, Yt =  80.0000f MPa, Yc = 200.0000 MPa a
nd Sc = 160.0000 MPa.

-The 'on-axis' matrices are given by the following:
S_on =
[[      0.0   -0.0021       0.0]
 [  -0.0021    0.1124       0.0]
 [      0.0       0.0    0.1961]] [1/GPa]

Q_on =
[[ 134.7014    2.5050       0.0]
 [   2.5050    8.9466       0.0]
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 [      0.0       0.0    5.1000]] [GPa]

-The linear combinations of the modulus, independent of ply angle are the follo
wing:
Us_1 =    0.0661 [1/GPa]
Us_2 =   -0.0562 [1/GPa]
Us_3 =   -0.0099 [1/GPa]
Us_4 =   -0.0120 [1/GPa]
Us_5 =    0.1563 [1/GPa]

-The linear combinations of the modulus, dependent on ply angle are the followi
ng:
Uq_1 =   57.0443 GPa
Uq_2 =   62.8774 GPa
Uq_3 =   14.7797 GPa
Uq_4 =   17.2848 GPa
Uq_5 =   19.8797 GPa

-The 'Stiffness' [A] and 'Compliance' [a] matrices are given by the following:
A =
[[   0.1821    0.0124       0.0]
 [   0.0124    0.0160       0.0]
 [      0.0       0.0    0.0163]] [GN/m]

a =
[[   5.7979   -4.5109      -0.0]
 [  -4.5109   66.0994      -0.0]
 [      0.0       0.0   61.2628]] [m/GN]

-The 'In-Plane Flexural Modulus' [D] and 'In-Plane Flexural Compliance' [d] mat
rices are given by the following:
D =
[[   5.2718    0.3594    0.0130]
 [   0.3594    0.4622    0.0032]
 [   0.0130    0.0032    0.4720]] [kNm]

d =
[[ 200.3143 -155.6995   -4.4529]
 [-155.6995 2284.5488  -11.2113]
 [  -4.4529  -11.2113 2118.8941]] [1/MNm]

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INPUTS:

Would you like to input a resultant applied stress? ON/OFF/NO
OFF
Enter the applied stress resultant vector [N1, N2, N6] [N/m].
N1 = 4545.4545
N2 = 0
N6 = 0
Would you like to input a resultant applied moment? ON/OFF/NO
OFF
Enter the applied moment resultant vector [M1, M2, M6] [N].
M1 = -1159.0909
M2 = 0
M6 = 0
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Curvature K =
[[  -0.2322    0.1805    0.0052]] [1/m]

OFF-AXIS APPLIED RESULTANTS:

(INPUT) Off-axis Applied stress resultant N =
[[4545.4545       0.0       0.0]] [N/m]

(INPUT) Off-axis Applied moment resultant M =
[[-1159.0909       0.0       0.0]] [N]

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FAILURE CRITERION AND ANALYSIS

MAXIMUM STRESS:
-Minimum R = 6.331 and laminate fails in Fiber Compression at TOP of ply 13
-The load vectors which cause the failure are:
R*N =
[[  28.7795       0.0       0.0]] [kN/m]
R*M =
[[  -7.3388       0.0       0.0]] [kN]

QUADRATIC POLYNOMIAL:
-Minimum R = 4.664 and laminate fails at TOP of ply 13
-The load vectors which cause the failure are:
R*N =
[[  21.2022       0.0       0.0]] [kN/m]
R*M =
[[  -5.4066       0.0       0.0]] [kN]

HASHIN CRITERION:
-Minimum R = 6.331 and laminate fails in Fiber Compression at TOP of ply 13
-The load vectors which cause the failure are:
R*N =
[[  28.7795       0.0       0.0]] [kN/m]
R*M =
[[  -7.3388       0.0       0.0]] [kN]
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In [2]:
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# stress_df
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In [3]:
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# failure_df
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In [11]:
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# print stress_df.to_latex()
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In [12]:
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# print failure_df.to_latex(float_format=lambda x:"%.3f" % x)
```