In [1]:
```
run 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
-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 =
[[   0.0075   -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]
 [      0.0       0.0    5.1000]] [GPa]
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-The linear combinations of the modulus, independent of ply angle are the follo
wing:
Us_1 =    0.0689 [1/GPa]
Us_2 =   -0.0524 [1/GPa]
Us_3 =   -0.0090 [1/GPa]
Us_4 =   -0.0111 [1/GPa]
Us_5 =    0.1600 [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
NO
Would you like to input a resultant applied moment? ON/OFF/NO
OFF
Enter the applied moment resultant vector [M1, M2, M6] [N].
M1 = -2869.245
M2 = 0
M6 = 0

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Curvature K =
[[  -0.5748    0.4467    0.0128]] [m]

OFF-AXIS APPLIED RESULTANTS:
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(INPUT) Off-axis Applied stress resultant N =
[[      0.0       0.0       0.0]] [GN/m]

(INPUT) Off-axis Applied moment resultant M =
[[-2869.2450       0.0       0.0]] [N]

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STRESSES AND STRAINS PER PLY:
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PLY: 13
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[  -0.0033    0.0026    0.0001]] [unitless]

On-axis strain =
[[  -0.0033    0.0026    0.0001]] [unitless]

On-axis stress =
[[  -0.4387    0.0147    0.0004]] [GPa]

BOTTOM

Off-axis strain =
[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis strain =
[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis stress =
[[  -0.4292    0.0144    0.0004]] [GPa]

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PLY: 12
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis strain =
[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis stress =
[[  -0.4292    0.0144    0.0004]] [GPa]

BOTTOM

Off-axis strain =
[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis strain =
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[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis stress =
[[  -0.4197    0.0141    0.0004]] [GPa]

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PLY: 11
ORIENTATION: 25 degrees

TOP

Off-axis strain =
[[  -0.0032    0.0025    0.0001]] [unitless]

On-axis strain =
[[  -0.0021    0.0014    0.0043]] [unitless]

On-axis stress =
[[  -0.2834    0.0074    0.0222]] [GPa]

BOTTOM

Off-axis strain =
[[  -0.0031    0.0024    0.0001]] [unitless]

On-axis strain =
[[  -0.0021    0.0014    0.0043]] [unitless]

On-axis stress =
[[  -0.2770    0.0073    0.0217]] [GPa]

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PLY: 10
ORIENTATION: -25 degrees

TOP

Off-axis strain =
[[  -0.0031    0.0024    0.0001]] [unitless]

On-axis strain =
[[  -0.0021    0.0014   -0.0042]] [unitless]

On-axis stress =
[[  -0.2840    0.0076   -0.0212]] [GPa]

BOTTOM

Off-axis strain =
[[  -0.0030    0.0023    0.0001]] [unitless]

On-axis strain =
[[  -0.0021    0.0014   -0.0041]] [unitless]

On-axis stress =
[[  -0.2774    0.0074   -0.0207]] [GPa]
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PLY: 9
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[  -0.0030    0.0023    0.0001]] [unitless]

On-axis strain =
[[  -0.0030    0.0023    0.0001]] [unitless]

On-axis stress =
[[  -0.4006    0.0134    0.0003]] [GPa]

BOTTOM

Off-axis strain =
[[  -0.0029    0.0023    0.0001]] [unitless]

On-axis strain =
[[  -0.0029    0.0023    0.0001]] [unitless]

On-axis stress =
[[  -0.3910    0.0131    0.0003]] [GPa]

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PLY: 8
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[  -0.0029    0.0023    0.0001]] [unitless]

On-axis strain =
[[  -0.0029    0.0023    0.0001]] [unitless]

On-axis stress =
[[  -0.3910    0.0131    0.0003]] [GPa]

BOTTOM

Off-axis strain =
[[  -0.0029    0.0022    0.0001]] [unitless]

On-axis strain =
[[  -0.0029    0.0022    0.0001]] [unitless]

On-axis stress =
[[  -0.3815    0.0128    0.0003]] [GPa]

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PLY: 7, CORE!
ORIENTATION: N/A
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PLY: 6
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[   0.0029   -0.0022   -0.0001]] [unitless]

On-axis strain =
[[   0.0029   -0.0022   -0.0001]] [unitless]

On-axis stress =
[[   0.3815   -0.0128   -0.0003]] [GPa]

BOTTOM

Off-axis strain =
[[   0.0029   -0.0023   -0.0001]] [unitless]

On-axis strain =
[[   0.0029   -0.0023   -0.0001]] [unitless]

On-axis stress =
[[   0.3910   -0.0131   -0.0003]] [GPa]

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PLY: 5
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[   0.0029   -0.0023   -0.0001]] [unitless]

On-axis strain =
[[   0.0029   -0.0023   -0.0001]] [unitless]

On-axis stress =
[[   0.3910   -0.0131   -0.0003]] [GPa]

BOTTOM

Off-axis strain =
[[   0.0030   -0.0023   -0.0001]] [unitless]

On-axis strain =
[[   0.0030   -0.0023   -0.0001]] [unitless]

On-axis stress =
[[   0.4006   -0.0134   -0.0003]] [GPa]

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PLY: 4
ORIENTATION: -25 degrees
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TOP

Off-axis strain =
[[   0.0030   -0.0023   -0.0001]] [unitless]

On-axis strain =
[[   0.0021   -0.0014    0.0041]] [unitless]

On-axis stress =
[[   0.2774   -0.0074    0.0207]] [GPa]

BOTTOM

Off-axis strain =
[[   0.0031   -0.0024   -0.0001]] [unitless]

On-axis strain =
[[   0.0021   -0.0014    0.0042]] [unitless]

On-axis stress =
[[   0.2840   -0.0076    0.0212]] [GPa]

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PLY: 3
ORIENTATION: 25 degrees

TOP

Off-axis strain =
[[   0.0031   -0.0024   -0.0001]] [unitless]

On-axis strain =
[[   0.0021   -0.0014   -0.0043]] [unitless]

On-axis stress =
[[   0.2770   -0.0073   -0.0217]] [GPa]

BOTTOM

Off-axis strain =
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis strain =
[[   0.0021   -0.0014   -0.0043]] [unitless]

On-axis stress =
[[   0.2834   -0.0074   -0.0222]] [GPa]

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PLY: 2
ORIENTATION: 0 degrees

TOP

Off-axis strain =
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```
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis strain =
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis stress =
[[   0.4197   -0.0141   -0.0004]] [GPa]

BOTTOM

Off-axis strain =
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis strain =
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis stress =
[[   0.4292   -0.0144   -0.0004]] [GPa]

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PLY: 1
ORIENTATION: 0 degrees

TOP

Off-axis strain =
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis strain =
[[   0.0032   -0.0025   -0.0001]] [unitless]

On-axis stress =
[[   0.4292   -0.0144   -0.0004]] [GPa]

BOTTOM

Off-axis strain =
[[   0.0033   -0.0026   -0.0001]] [unitless]

On-axis strain =
[[   0.0033   -0.0026   -0.0001]] [unitless]

On-axis stress =
[[   0.4387   -0.0147   -0.0004]] [GPa]

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CHECK DESIGN CRITERION:

The deflection at the midpoint is: -12.9519 mm
The maximum strain along the fibers is: 0.0033

Therefore the design will NOT meet the requirements!

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