C7 - Compute ABD matrix for Example 2 1
C8 - Compute ABD matrix for Example 3 1
C9 - Calculate strains in Example 4 2

```
%Derrik Adams
%Homework 4 - Composites 7-10
%2/7/18
clear all
```

C7 - Compute ABD matrix for Example 2

```
%Create properties for graphite-reinforced composite (Pa)
E1 = 155e9; E2 = 12.1e9; E3 = E2;
v23 = .458; v12 = .248; v21 = E2*v12/E1;
G12 = 4.4e9; G13 = G12; G23 = 3.2e9;

num_plies = 6;
ply_angles_7 = [30, -30, 0, 0, -30, 30]; %deg
z_7 = [-.45, -.3, -.15, 0, .15, .3, .45]; %in mm

%Call function to create ABD matrix (Pa-mm)
ABD_mat_7 = buildABD_mat(E1, E2, v12, v21, G12, z_7, ply_angles_7, num_plies)
```

```
ABD_mat_7 =

   1.0e+11 *

    1.0240    0.1894    0.0000    0.0000         0         0
    0.1894    0.1625    0.0000         0         0         0
    0.0000    0.0000    0.2019         0         0    0.0000
    0.0000         0         0    0.0578    0.0177    0.0126
         0         0         0    0.0177    0.0126    0.0042
         0         0    0.0000    0.0126    0.0042    0.0185
```

C8 - Compute ABD matrix for Example 3

```
num_plies = 6;
ply_angles_8 = [30, -30, 0, 30, -30, 0]; %deg
z_8 = [-.45, -.3, -.15, 0, .15, .3, .45]; %in mm

%Call function to create ABD matrix (Pa-mm)
ABD_mat_8 = buildABD_mat(E1, E2, v12, v21, G12, z_8, ply_angles_8, num_plies)
```

```
ABD_mat_8 =

   1.0e+11 *

    1.0240    0.1894    0.0000    0.0283   -0.0122   -0.0210
    0.1894    0.1625    0.0000   -0.0122   -0.0040   -0.0070
    0.0000    0.0000    0.2019   -0.0210   -0.0070   -0.0122
    0.0283   -0.0122   -0.0210    0.0705    0.0122    0.0032
   -0.0122   -0.0040   -0.0070    0.0122    0.0108    0.0010
   -0.0210   -0.0070   -0.0122    0.0032    0.0010    0.0130
```

C9 - Calculate strains in Example 4

```
Stress_Res = [0; 0; 0; 12.84; 3.92; 2.8]; %Nm/m
num_plies = 6;
ply_angles_9 = [30, -30, 0, 0, -30, 30];
z_9 = [-.00045, -.0003, -.00015, 0, .00015, .0003, .00045]; %in mm

%Call function to create ABD matrix (Pa-mm)
ABD_mat_9 = buildABD_mat(E1, E2, v12, v21, G12, z_9, ply_angles_9, num_plies);

%Multiply given resultant stress vector by the inverse of the ABD to get
%strains
Strain_vec = inv(ABD_mat_9)*Stress_Res
```

```
Strain_vec =

   -0.0000
    0.0000
    0.0000
    2.2233
   -0.0041
   -0.0011
```

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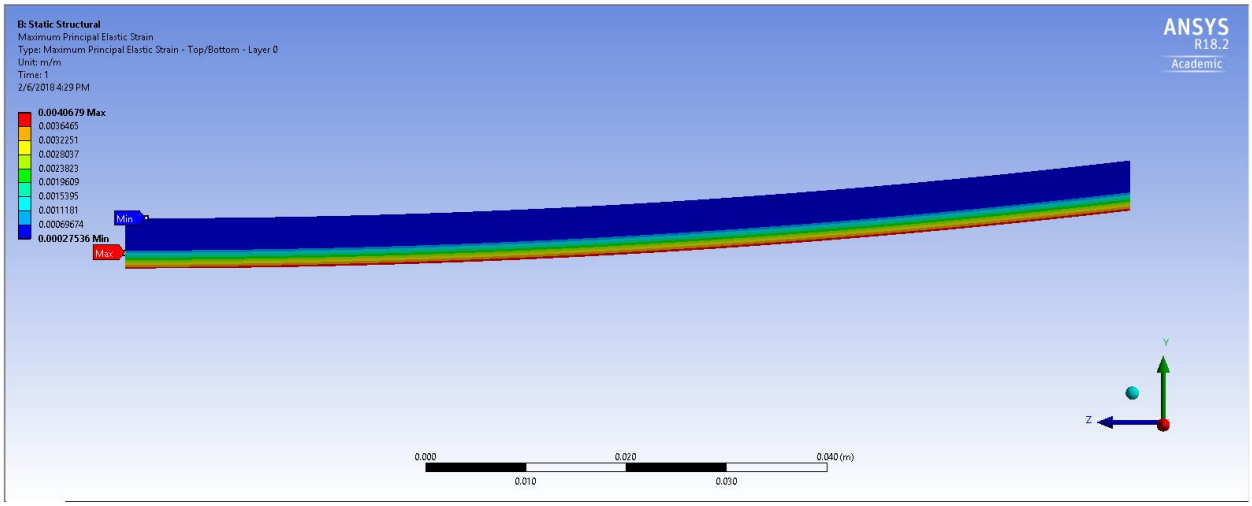
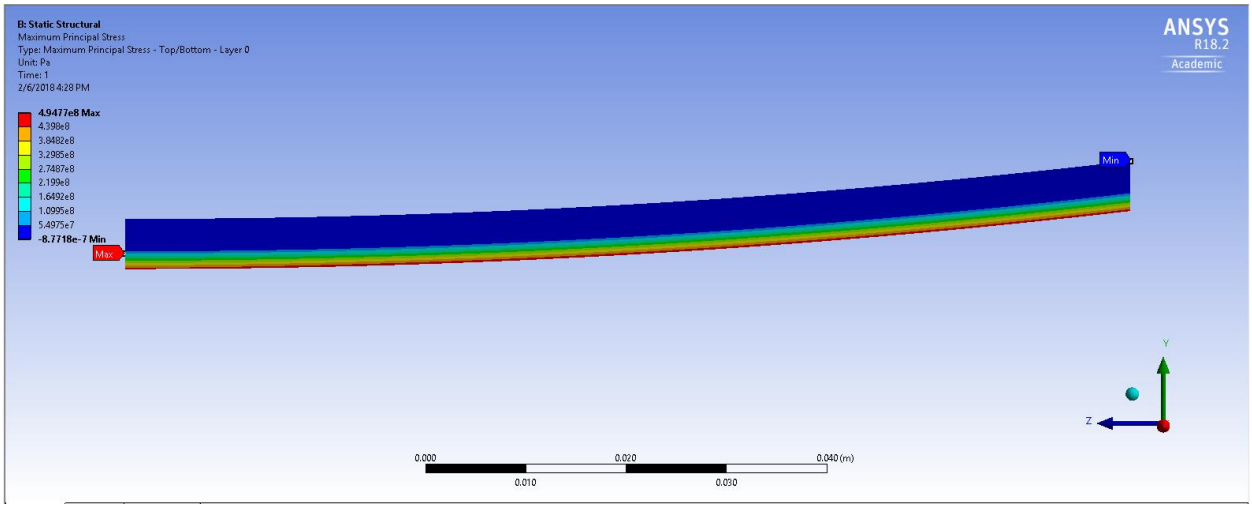
C 10) Confirm C6 in ANSYS

Max Strain - .00407



Stress - 494.7 MPa



It shouldn't be bending, but I assume the force is being applied to just one ply since I can't apply the force to a face but just an edge. The strain is pretty close though.

Custom ANSYS Tutorial

TABLE 7
Model (B2) > Imported Plies > ACP (Pre) > ModelingGroup.1(ACP (Pre)) > ModelingPly.1(ACP (Pre)) > P1__ModelingPly.1(ACP (Pre)) > P1L1__ModelingPly.1(ACP (Pre))

Object Name	*P1L1__ModelingPly.1(ACP (Pre))*	*P1L2__ModelingPly.1(ACP (Pre))*	*P1L3__ModelingPly.1(ACP (Pre))*	*P1L4__ModelingPly.1(ACP (Pre))*	*P1L5__ModelingPly.1(ACP (Pre))*	*P1L6__ModelingPly.1(ACP (Pre))*
State	No State					
Definition						
Name in Source	P1L1__ModelingPly.1	P1L2__ModelingPly.1	P1L3__ModelingPly.1	P1L4__ModelingPly.1	P1L5__ModelingPly.1	P1L6__ModelingPly.1
ID in Source	P1L1__ModelingPly.1	P1L2__ModelingPly.1	P1L3__ModelingPly.1	P1L4__ModelingPly.1	P1L5__ModelingPly.1	P1L6__ModelingPly.1
Material	Epoxy Carbon Woven (230 GPa) Prepreg					
Thickness	2.86e-004 m					
Angle	0. °	30. °	60. °	90. °	45. °	0. °
Number of Elements	1363.					
Transfer Properties						
Source	A5::ACP (Pre)					

Equivalent Stress

Subject: ME 501 Homework 4 - ANSYS Tutorial with Custom Ply Angles
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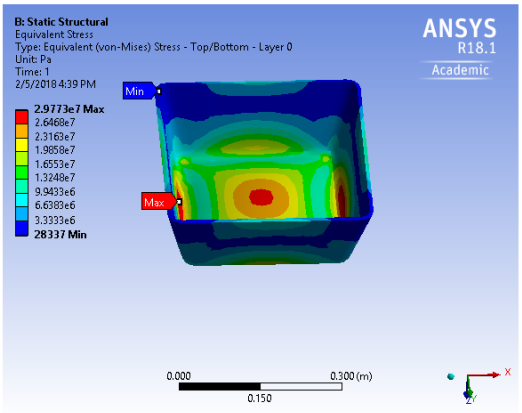
Date Monday, February 5, 2018
Comments:



Total Deformation

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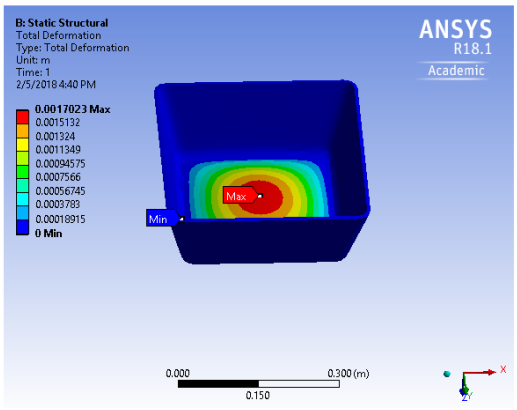

Safety Factor

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