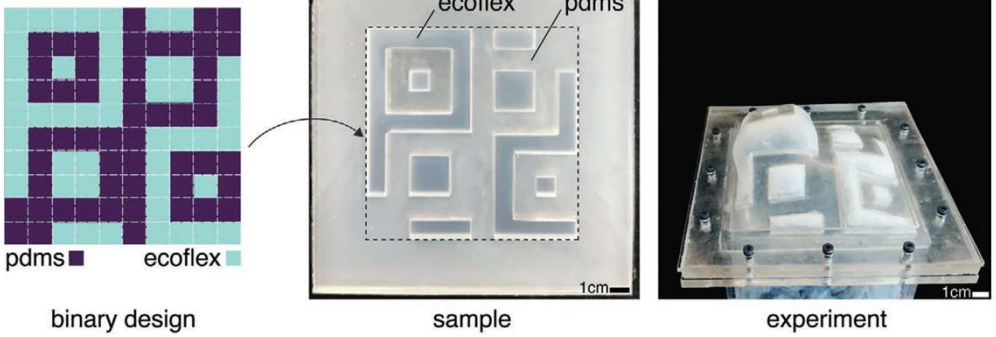
Abaqus Tutorial:
PDMS + Ecoflex 0030 binary material membrane design, modeling, simulation

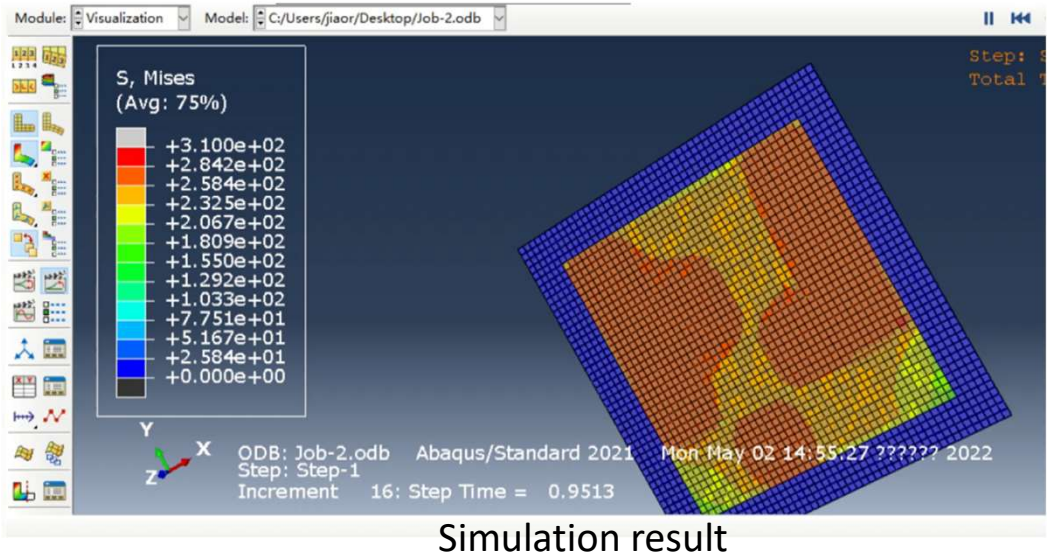
JRW

2022/05/02

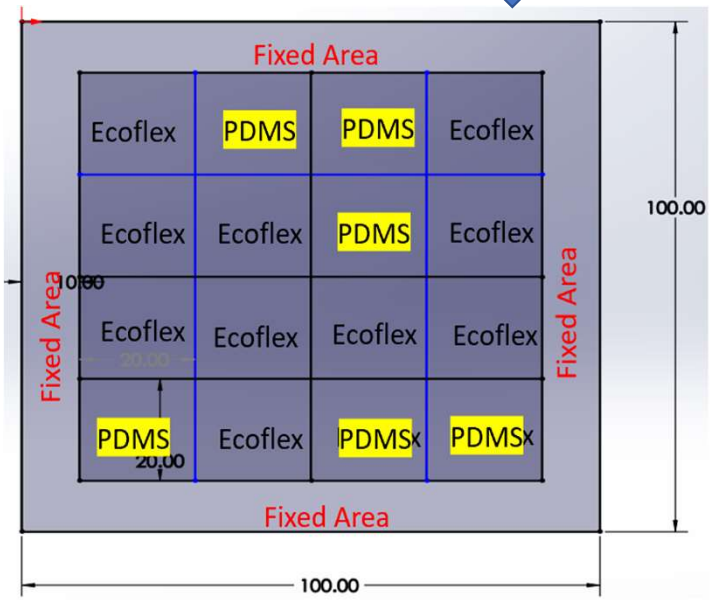


binary design sample experiment

Paper refer to: bi-material pixel membrane design
Antonio Elia Forte, 2022

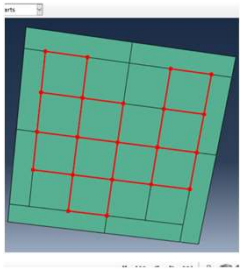


Simulation result

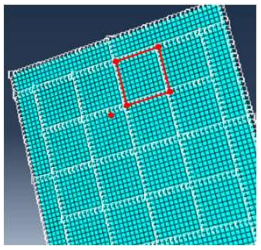


Modeling

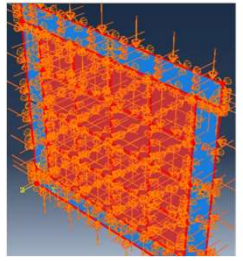
Abaqus Setting	
Material	PDMS: 500 kPa/0.4 Ecoflex 0030: 29.5 kPa and 0.45
Load Parameter	Pressure: 500 Pa (Centered Area); Boundary condition: brim fixed
Modeling:	Shell Thickness: 0.2 (Unit: mm)
Mesh Size:	2mm



Material Assignment

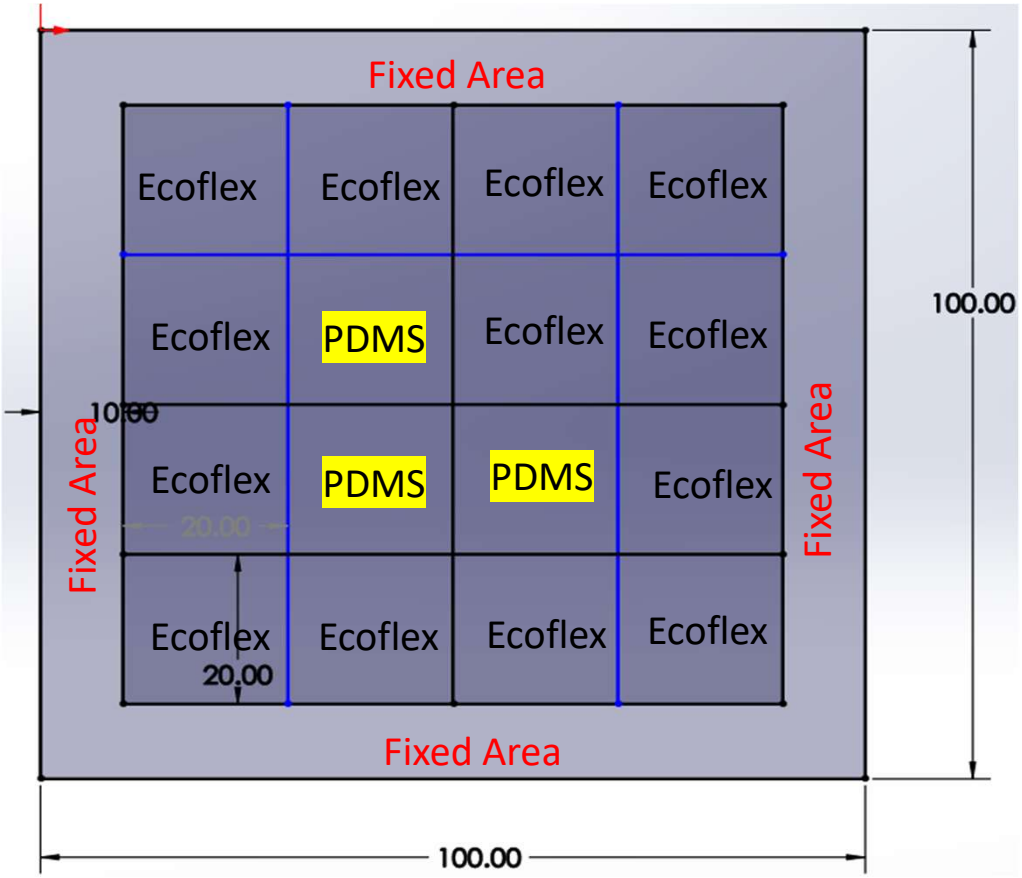


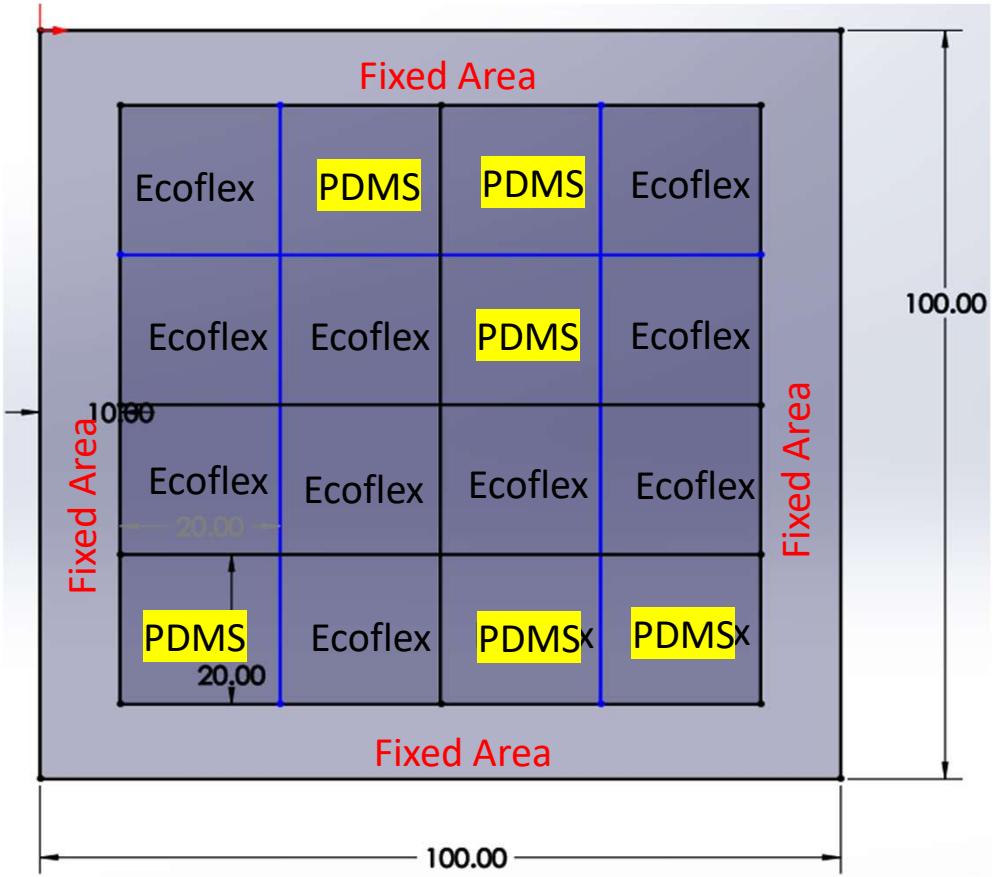
Mesh



Load/BC

Design 2D model





Abaqus simulation setting

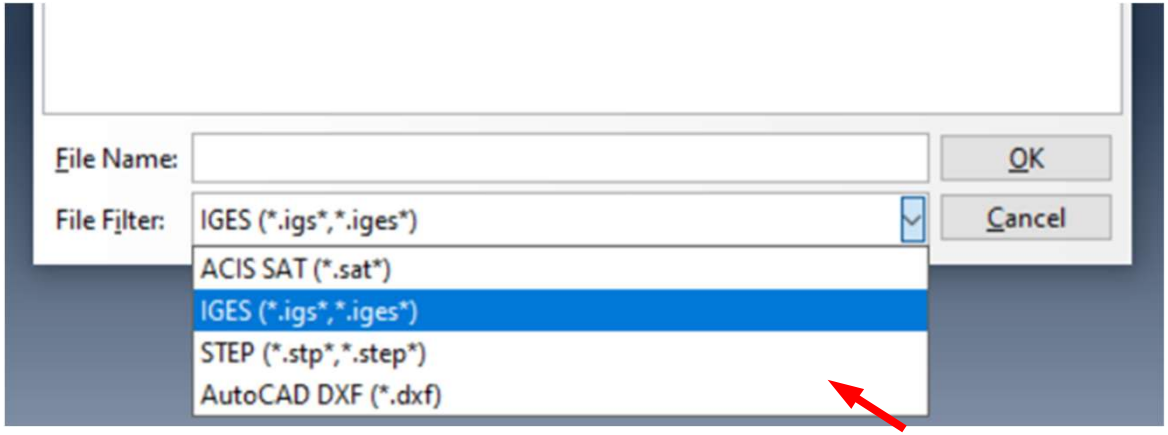
- Modeling: Shell Thickness: 0.2 (Unit: mm)
- Load Parameter setting: Pressure-500 Pa (Centered Area); Boundary condition-brim fixed
- Material:

PDMS: Young's modulus of 500 kPa + Poisson's ratio of 0.4

Ecoflex 0030: for the 1:1:0 mixture proportions 29.5 kPa and 0.45,

Import 2D patterns

- Click File > Import > Sketch
- Choose the directory, then select “IGES” in File Filter
- Select the .iges file that you want to import, click “OK”
- Click “OK” in the pop-up window



Create part from sketch

- Click Module > Part > create part > Shape > Shell > Type > Planar > Continue (Fig.1)
- Click Add Sketch (Fig.2), select the sketch you just added, click “OK”
- Click “Done” (Fig.3), or click mouse wheel
- Click “Done” again (Fig.4), or click mouse wheel

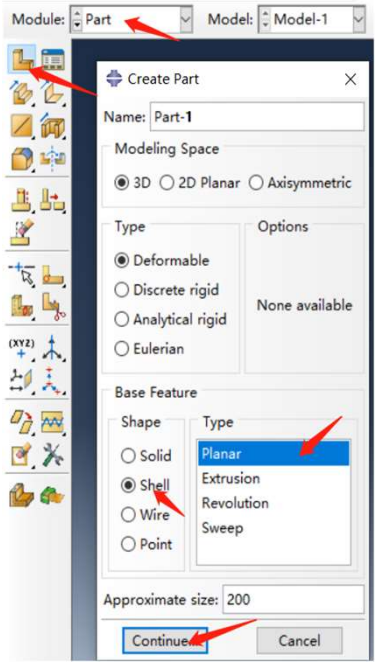


Figure 1

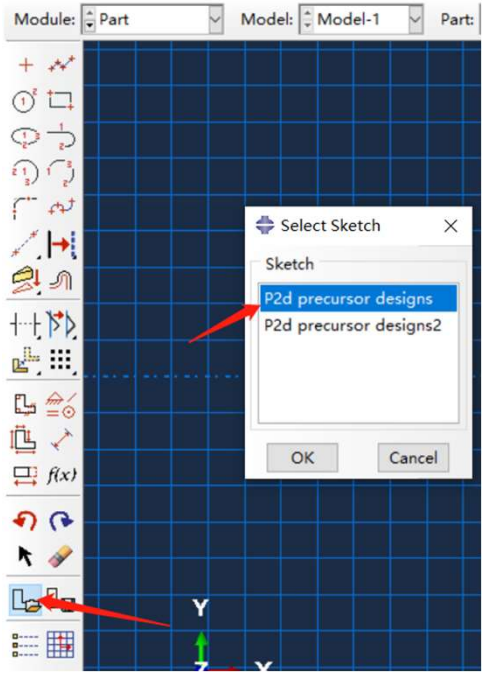
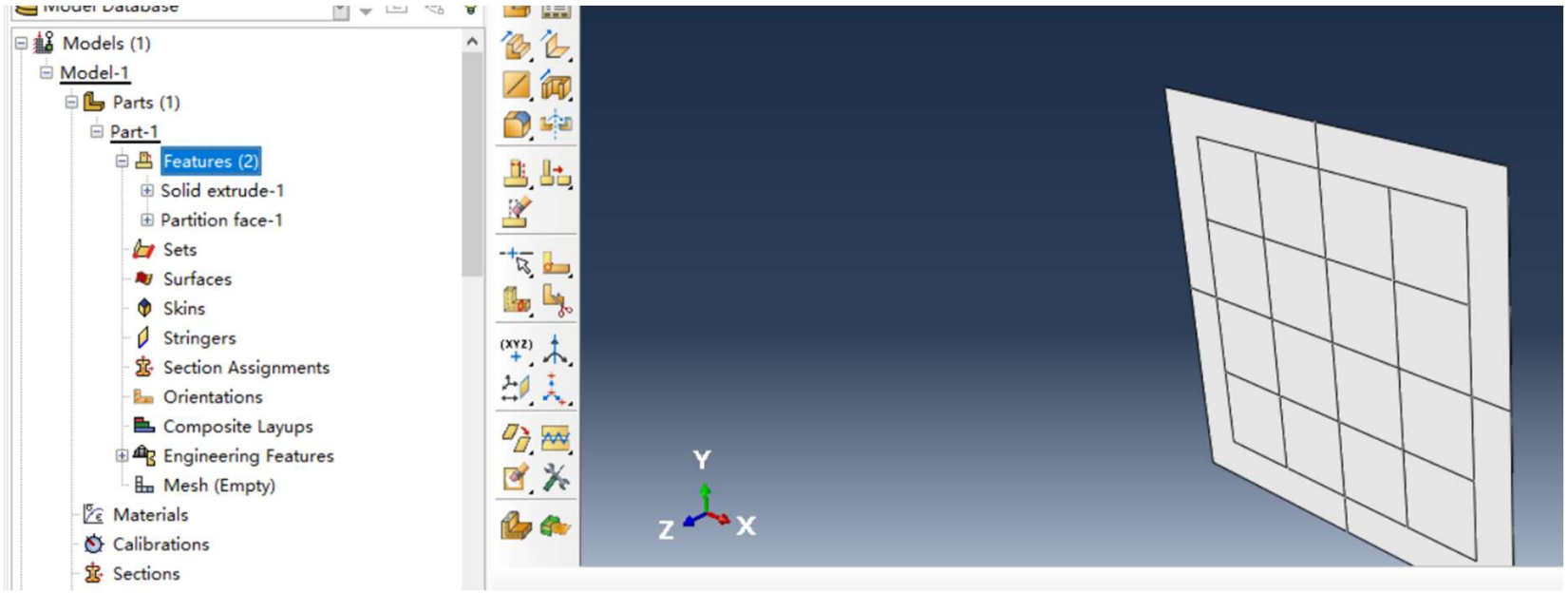


Figure 2

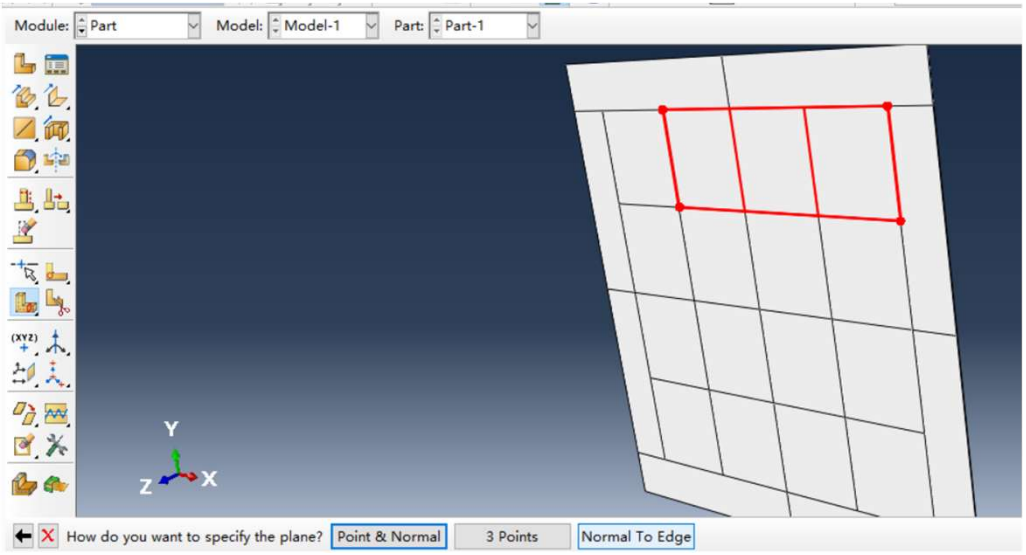
Figure 3

Figure 4

Partition Part



- Click “Partition Face: Sketch”
- Click an edge of the part, shows up the sketch window
- Then cut it into partition cell



Create Material

- Click Module > Property > Create Material (Fig.1)
- In the Edit Material window, create a name for this material (Fig.2)
- Click Mechanical > Elasticity > Elastic (Fig.2)
- Input the Young's Modulus and Poisson's Ratio (500000 Pa and 0.5 for PDMS)(Fig.3)

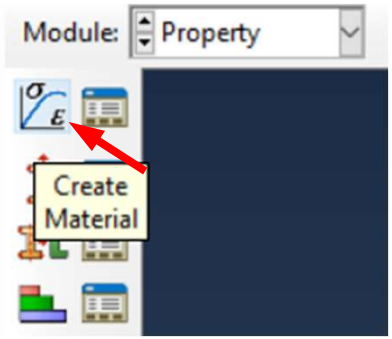


Figure 1

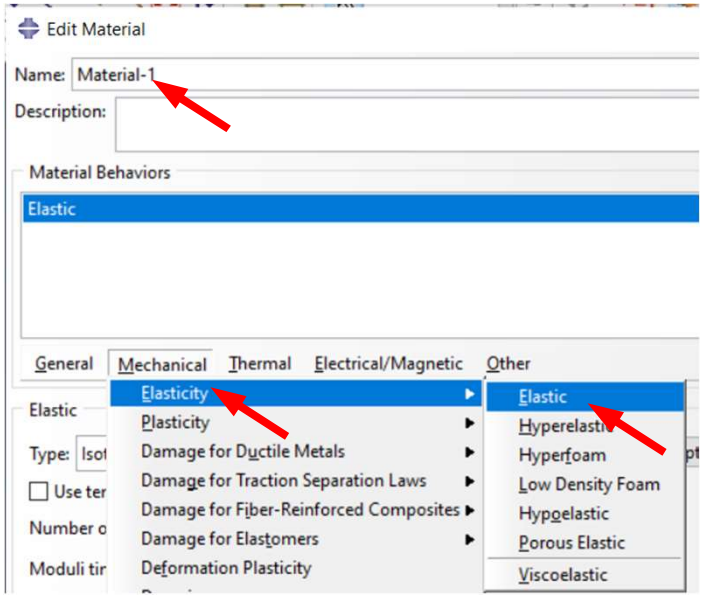


Figure 2

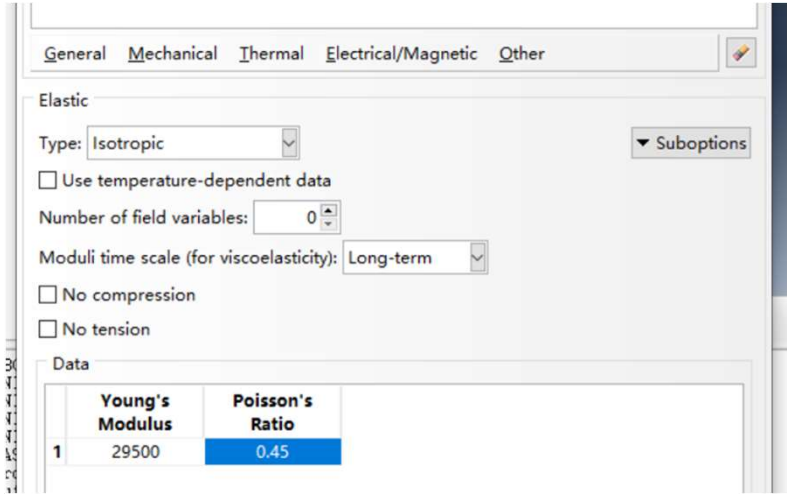


Figure 3

Create Section

- In Property Module, click Create Section (Fig.1)
- In Create Section window, create a name for this section (Fig.1)
- Click Shell > Homogeneous > Continue (Fig.1)
- In Edit Section window, set the shell thickness as ~~0.003~~, select the material you just created (Fig.2)
- Click “OK” (Fig.2)

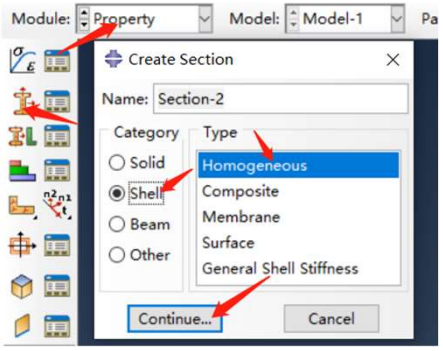


Figure 1

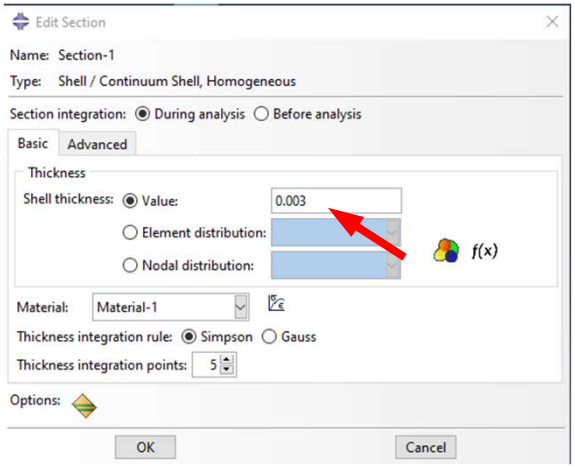
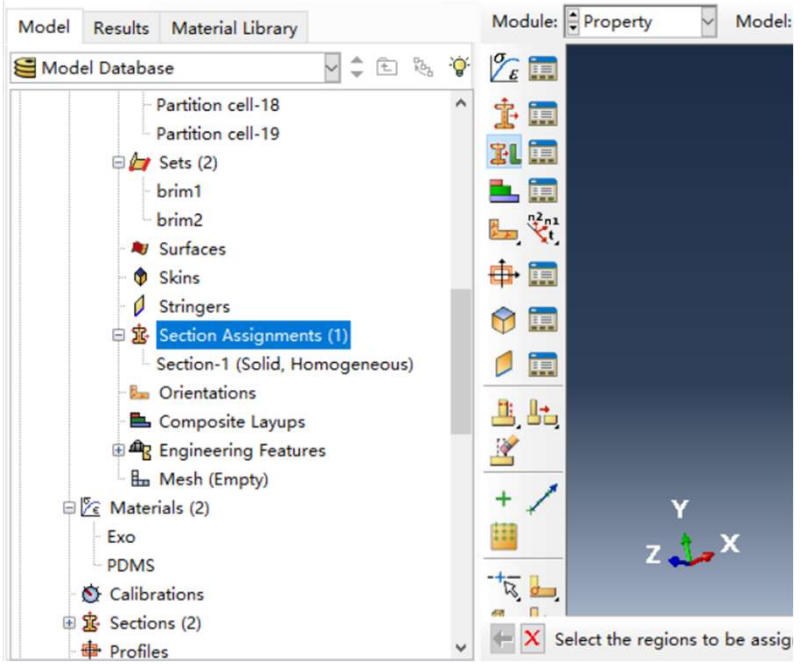
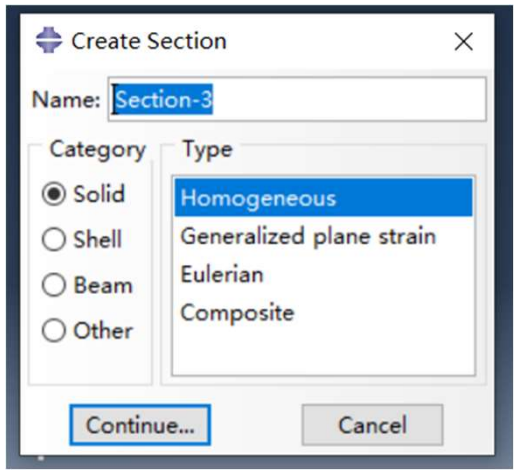


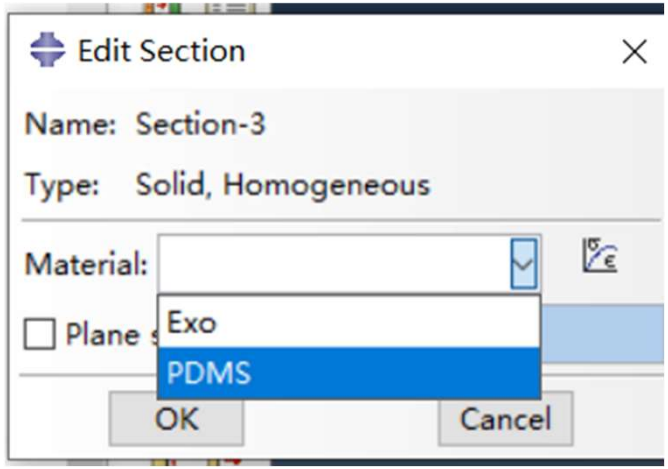
Figure 2

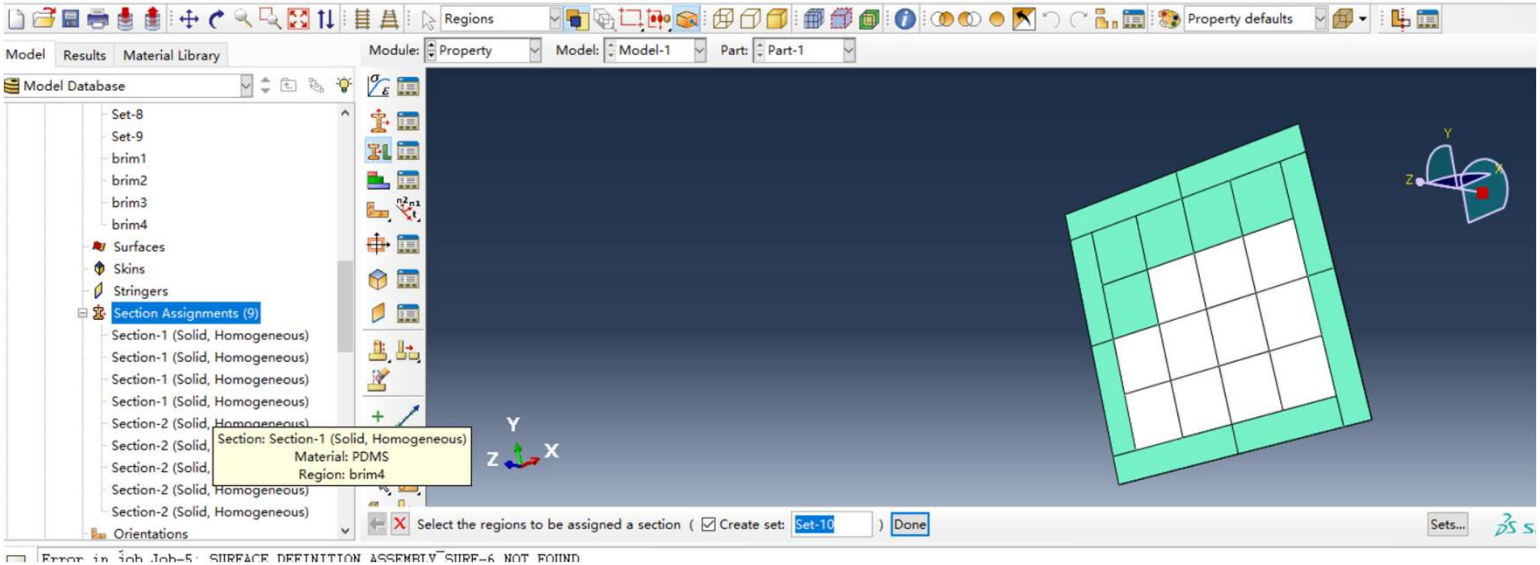


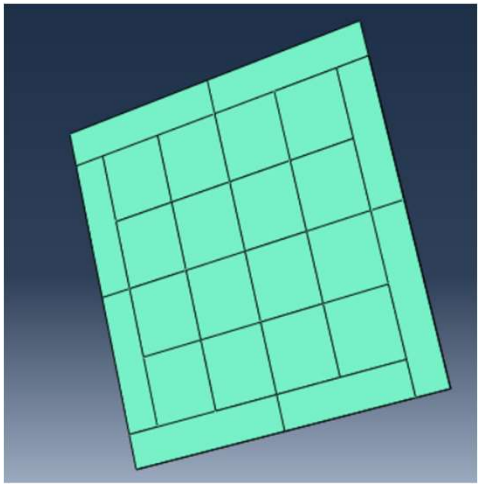
Assign Section

- In Property Module, click Assign Section
- Select all your parts, then click mouse wheel to confirm
- In Edit Section Assignment window , select the section you just created, click “OK”
- After proper setting, all your model will be green



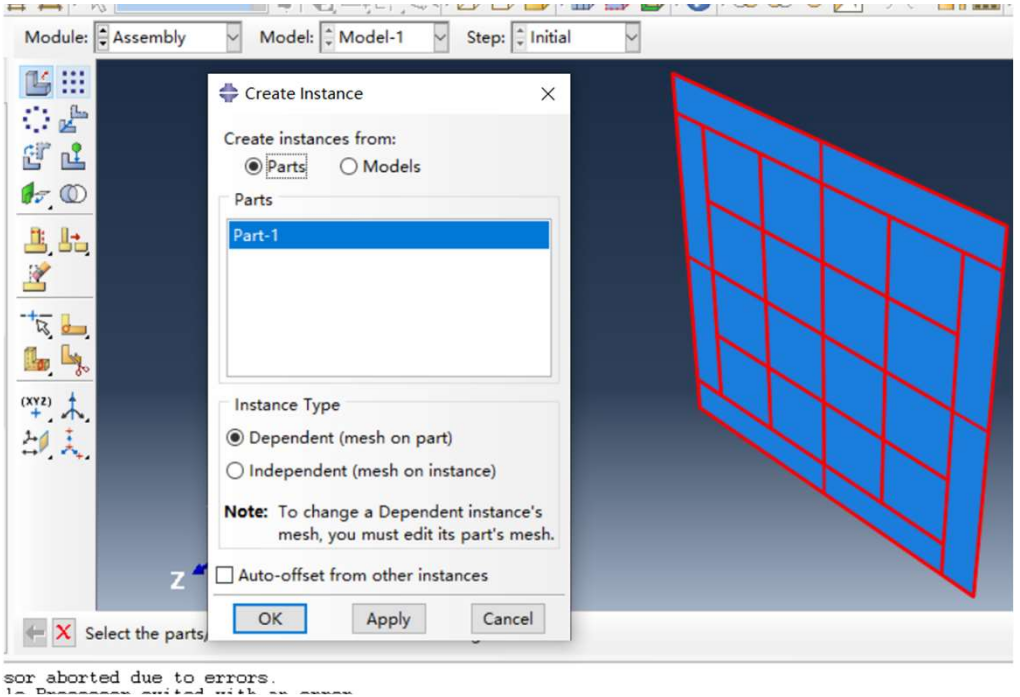


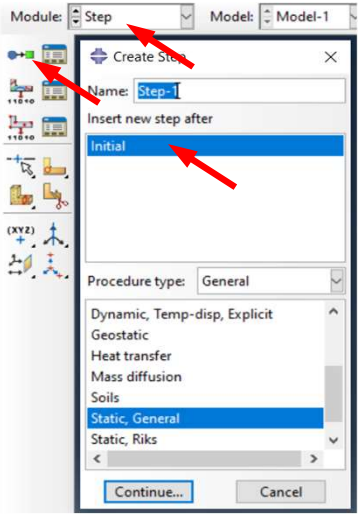


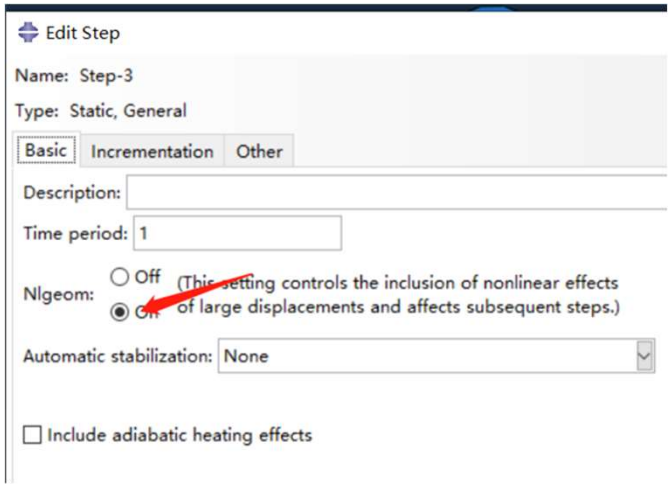


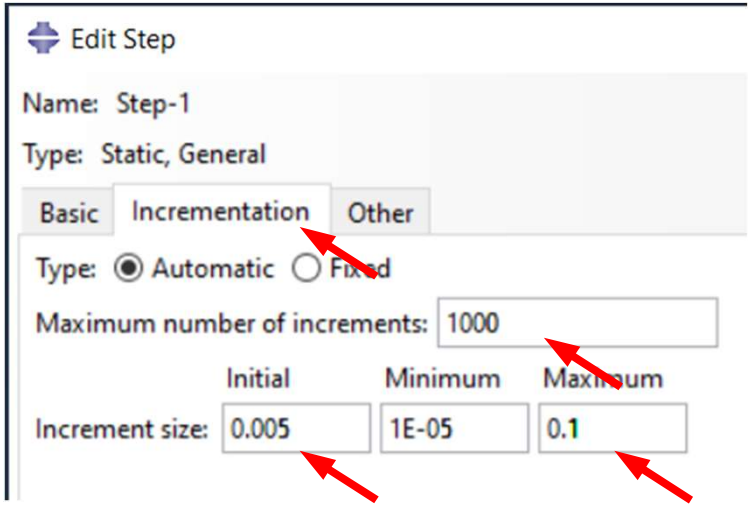
Assembly => Step

- Click Module > Assembly > Create Instance
- After assembly, the part will become bule
- Click Module > Step > Create Step
- In Create Step window, select “Static, General”, Click Continue
- In Edit Step window, click Basic > Nlgeom On
- Click Incrementation, change maximum number of increments = 1000, initial increment size =0.005 and maximum increment size = 0.1
- Use the same method to create Step-2



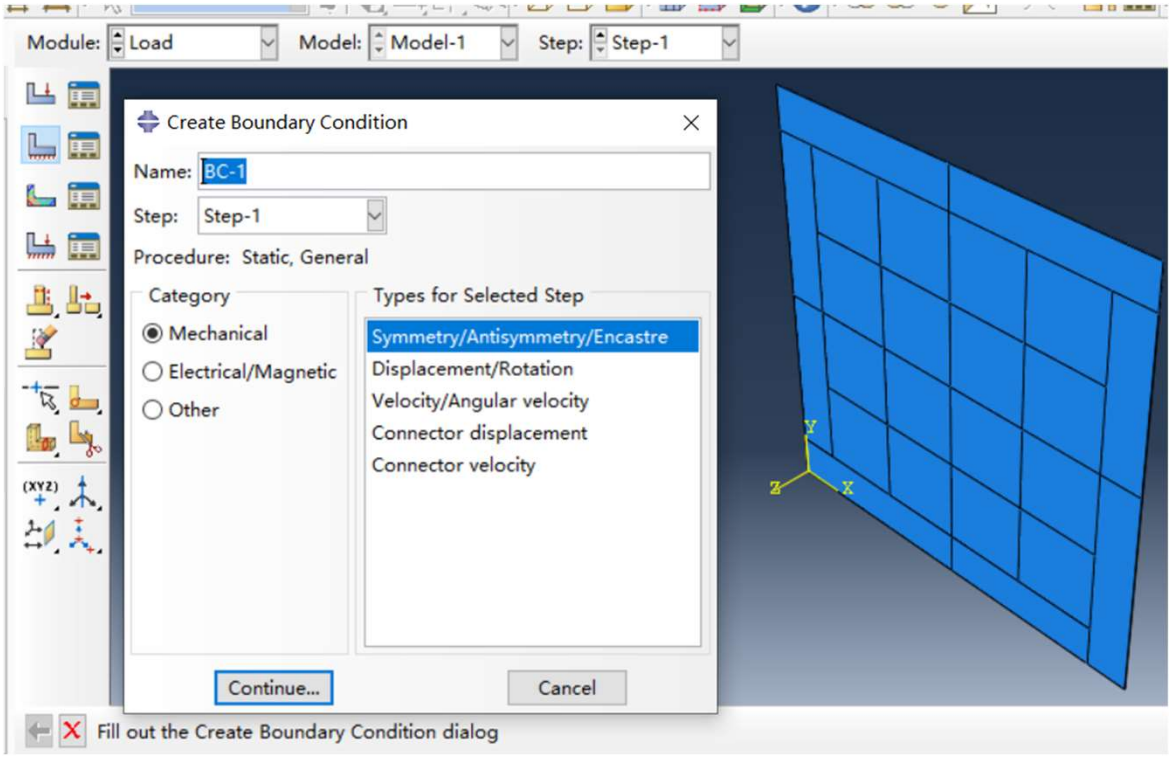


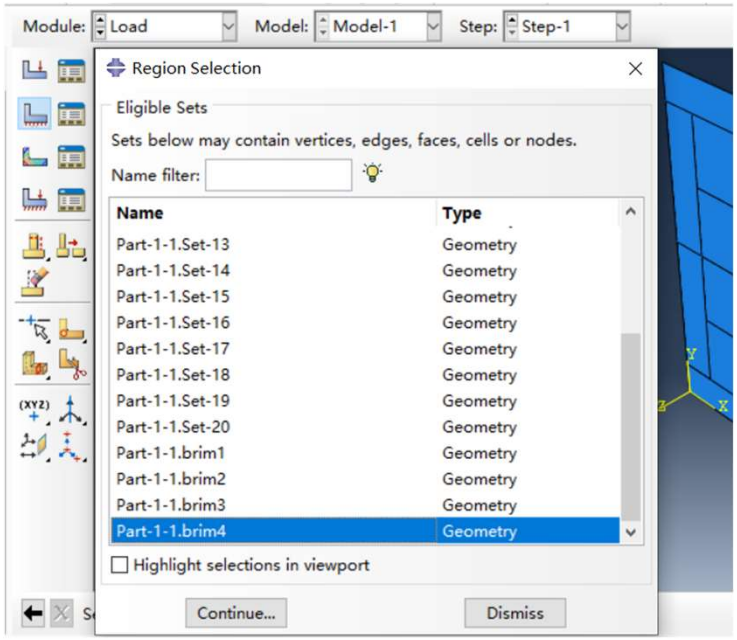


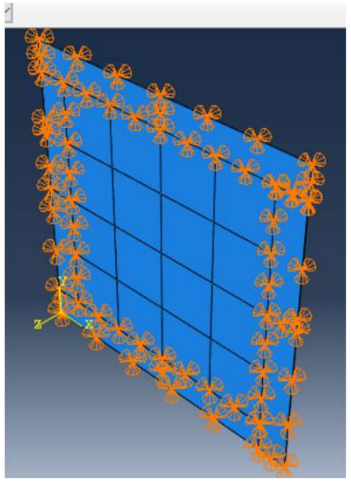


Create Boundary Condition

- Click Module > Load > Create Boundary Condition
- In the Create Boundary Condition window, click Step > Step-1> Mechanical >

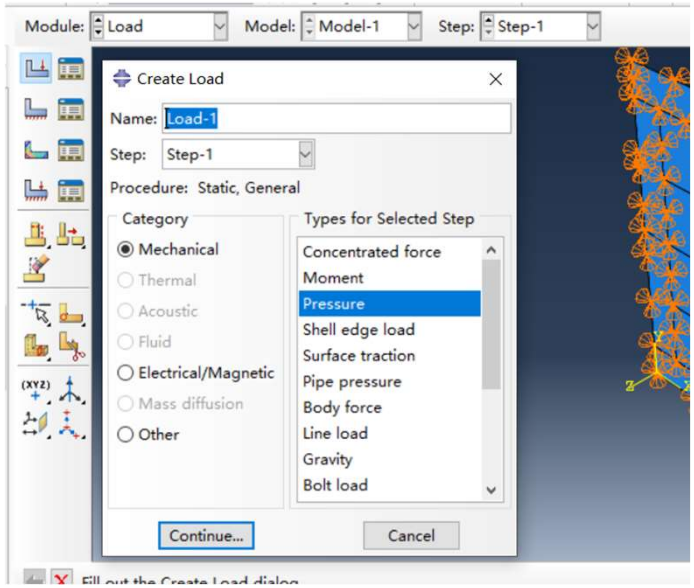


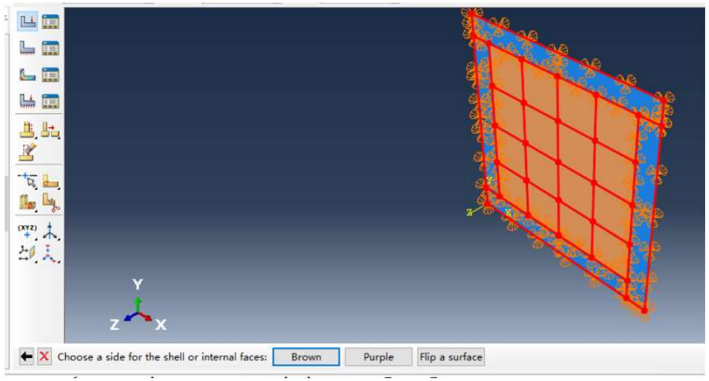


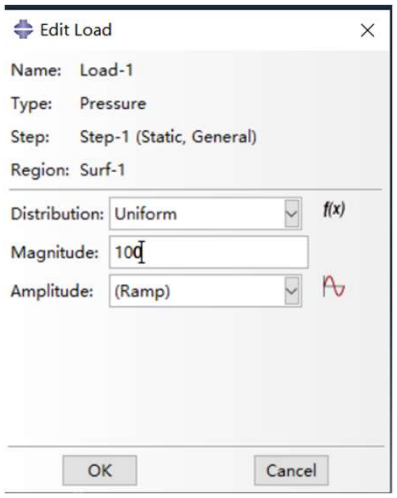


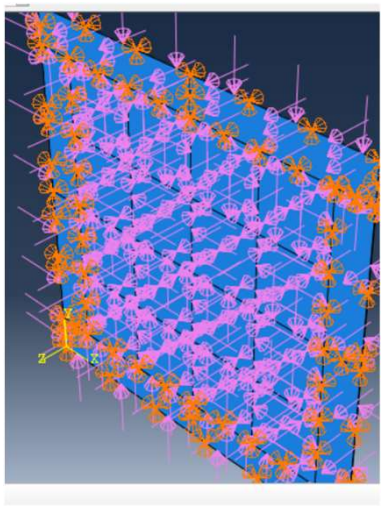
Create Load

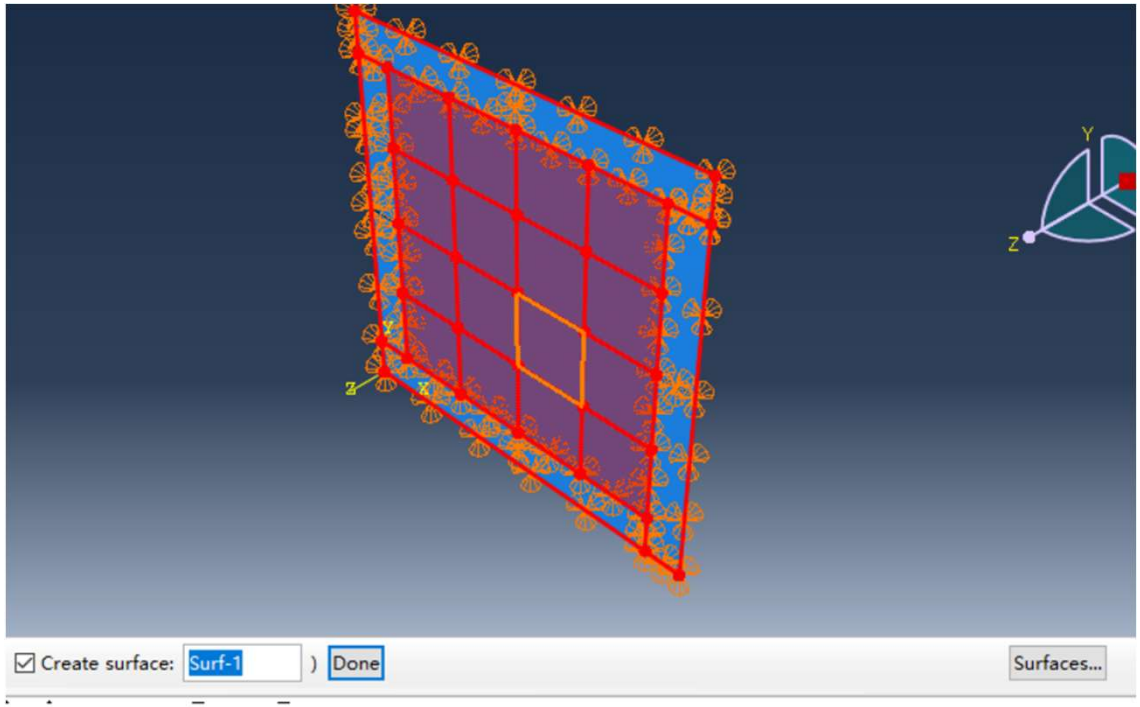
- In Load Module, click Create Load
- In Create Load window, choose the step of Step-1, click Mechanical > Pressure > Continue
- In Edit Load window, input Magnitude = 500,





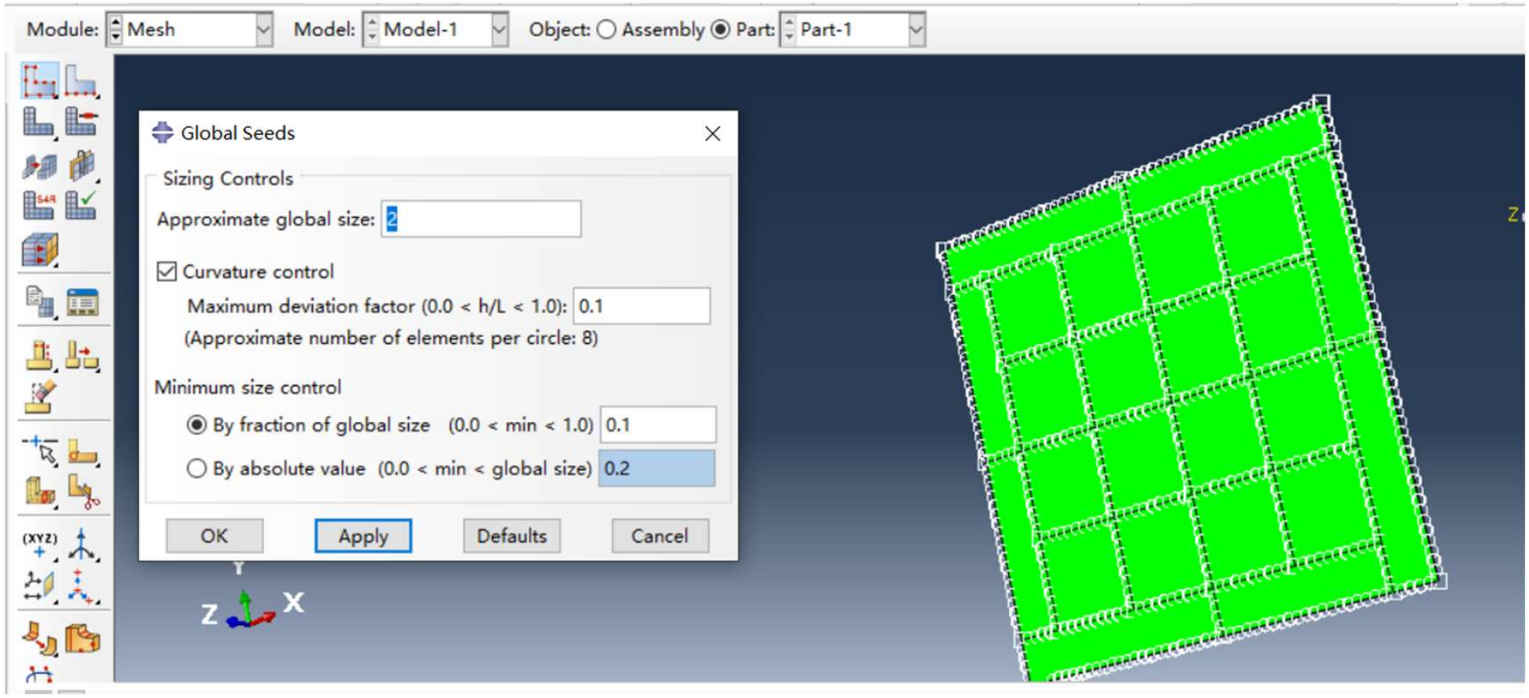


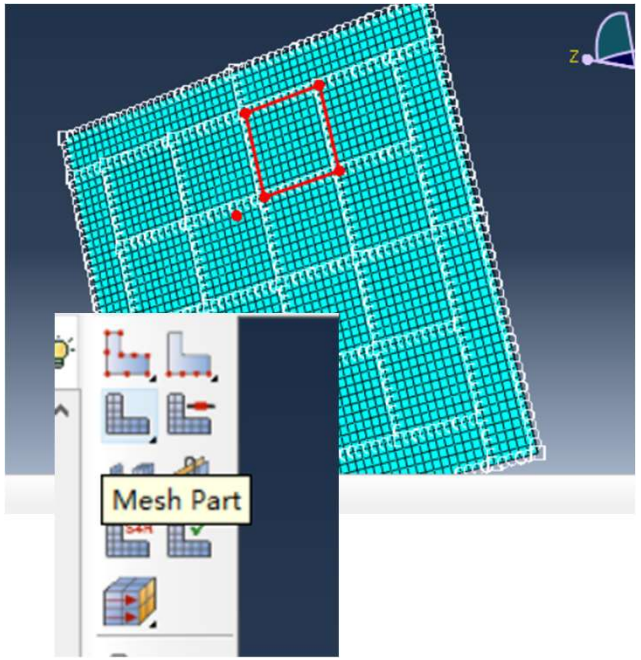




Mesh

- Click Module > Mesh > Object: Part
- After the part became pink, click Seed Part
- In Global Seeds window, set Approximate global size = 2, click “OK”






```
The model database has been saved to "C:\Users\jiao
Global seeds have been assigned.
2500 elements have been generated on part: Part-1
2500 elements have been generated on part: Part-1
```

Job

- Click Module > Job > Create job (Fig.1)
- In Create Job window (Fig.1), create a name of this job, click “Continue”
- In Edit Job window (Fig.2), Click “OK”
- Click Job Manager (Fig.3), select the job and click “Submit”
- The “Status” will show “Submitted” followed by “Running”

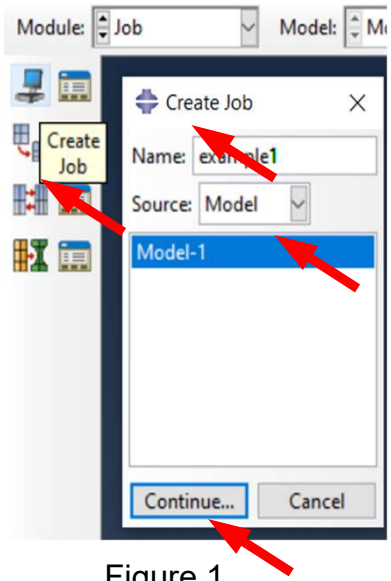


Figure 1

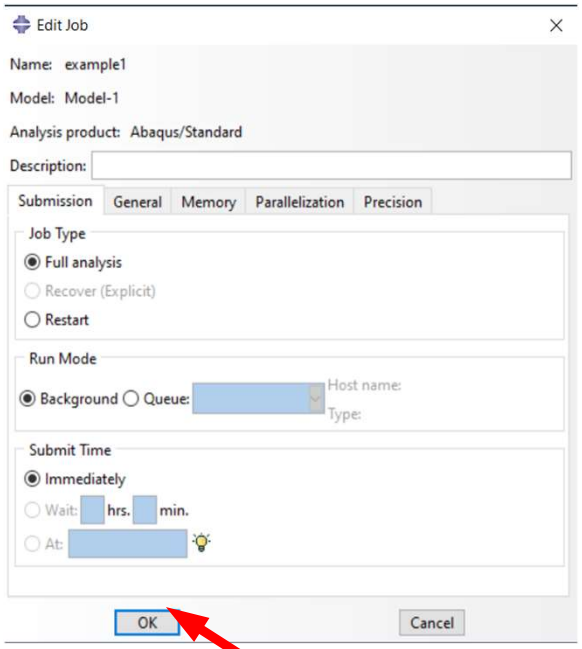


Figure 2

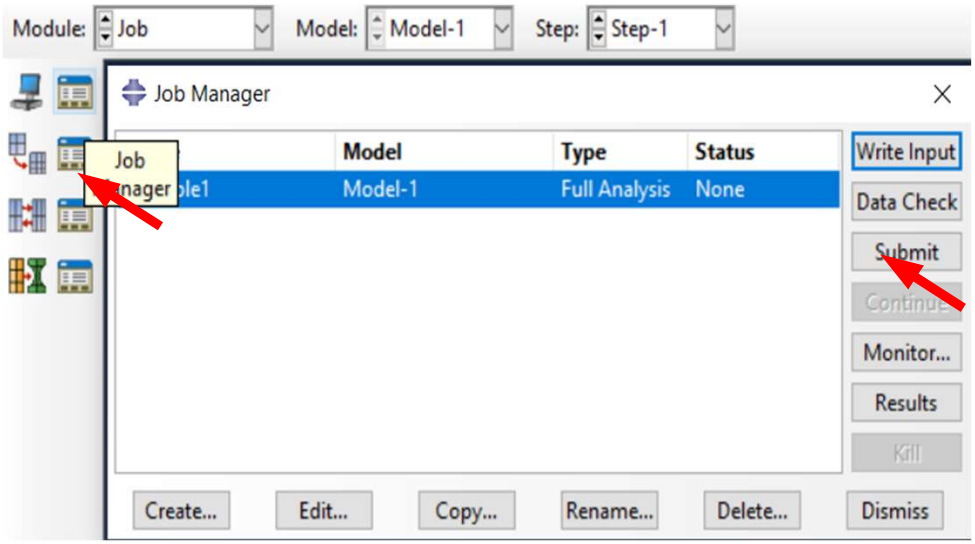


Figure 3

Visualization

- After the job is completed, in job Manager window (Fig.1), click “Result”
- In Visualization Module (Fig.2), click “Plot Contours on Deformed Shape” to show the deformed shape with color gradient
- Click “Animate:Time History (Fig.2)” to show the animation
- Click “Animation Options (Fig.2)” to adjust animation speed

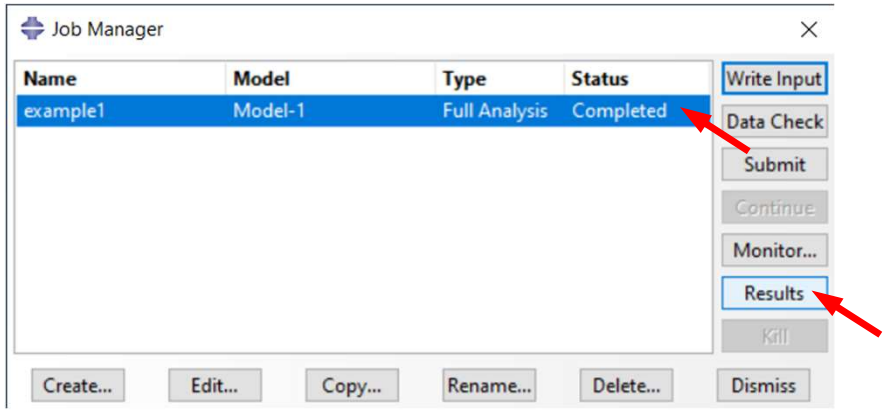


Figure 1

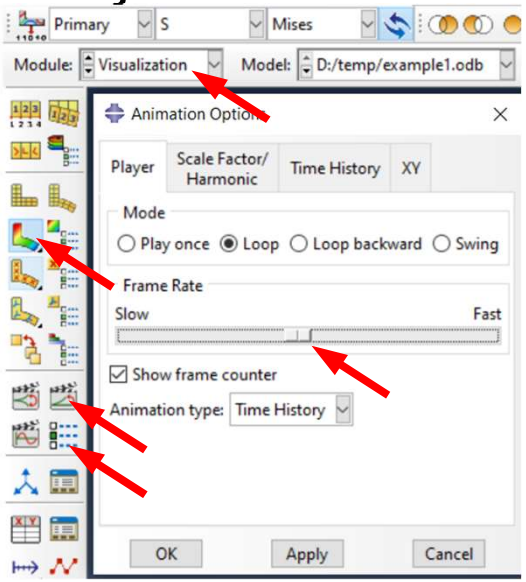
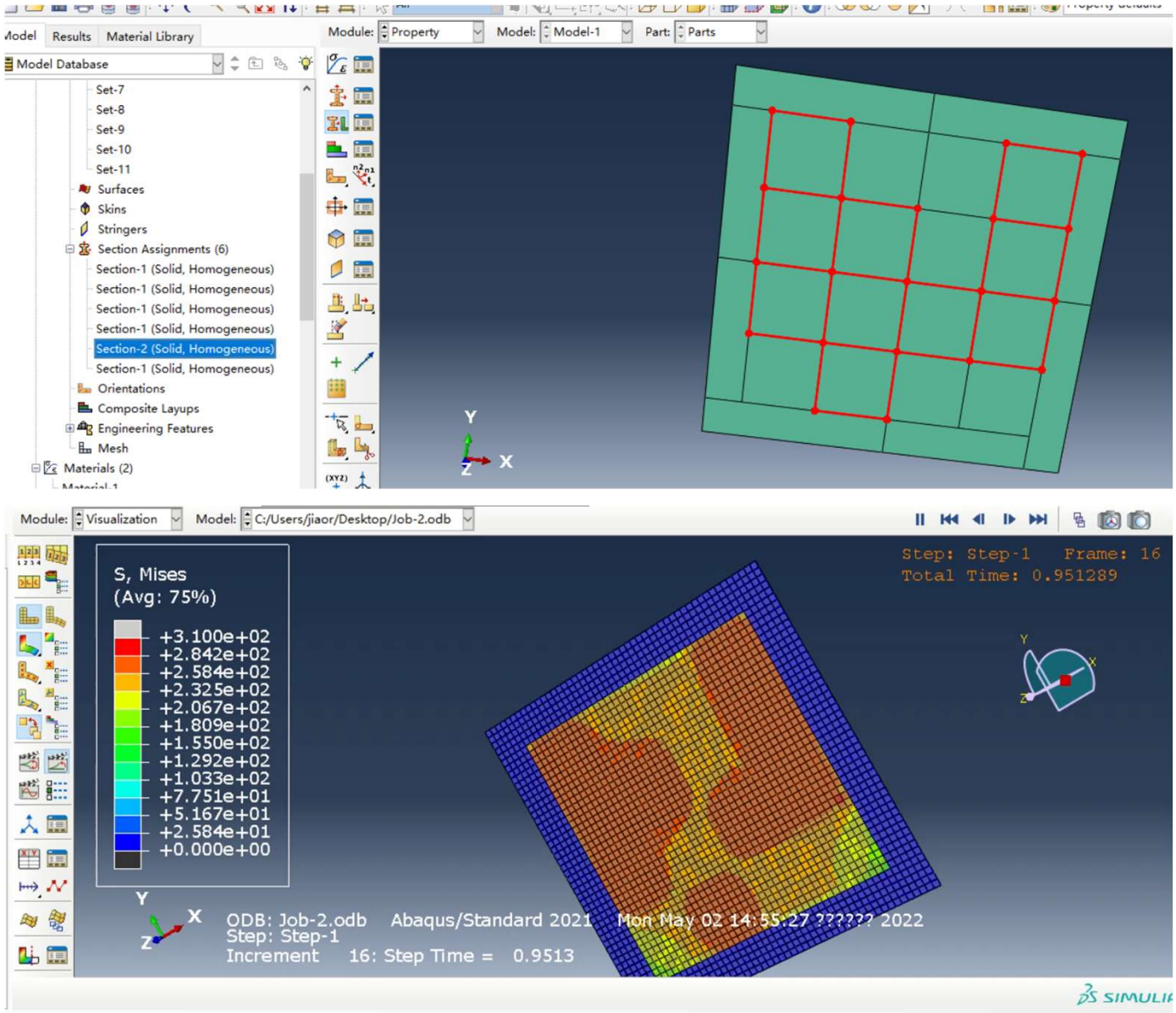
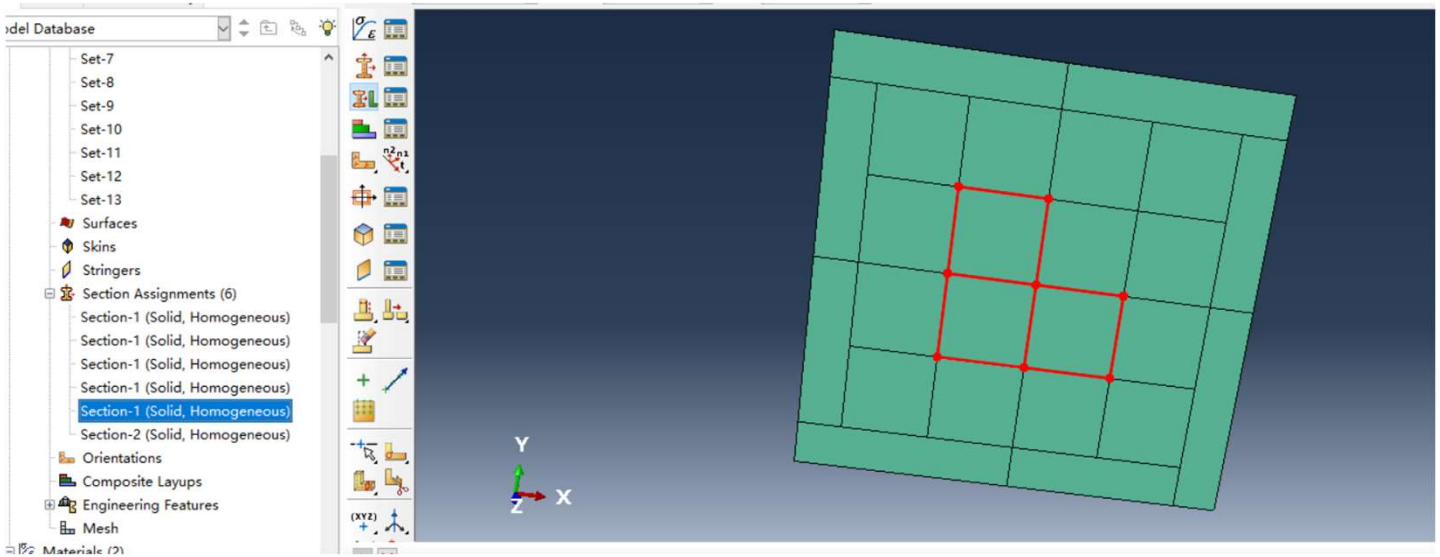


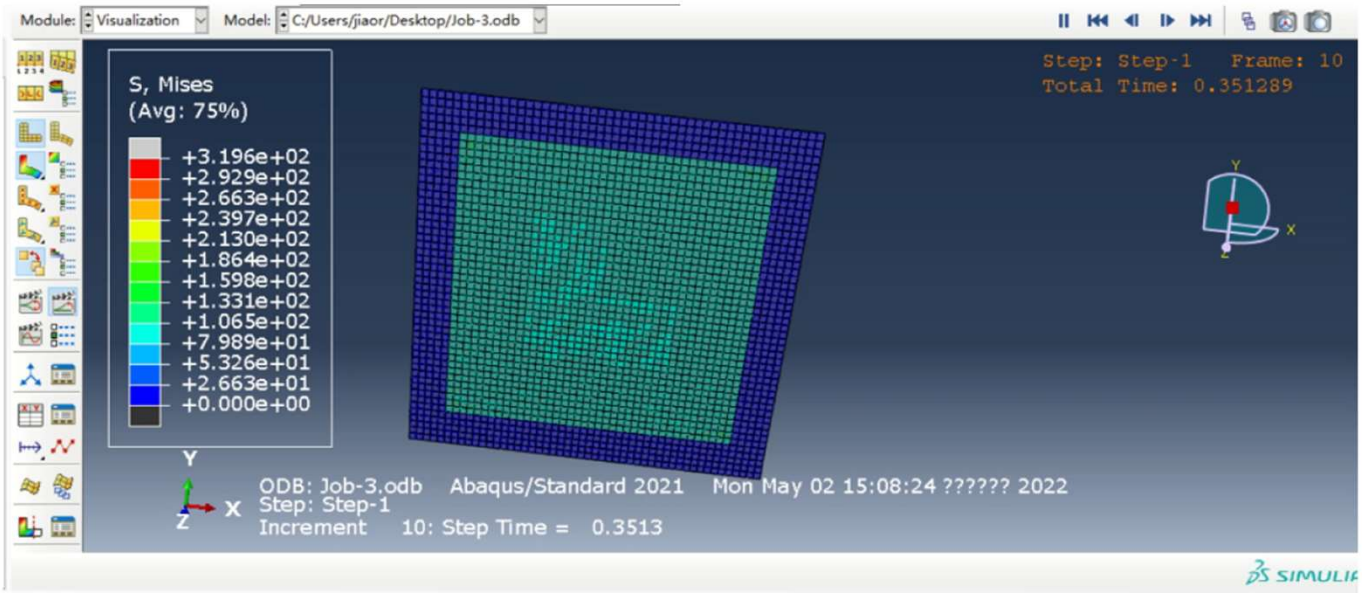
Figure 2


Model
Results
Material Library
Module: Property
Model: Model-1
Part: Parts
Model Database
Set-7
Set-8
Set-9
Set-10
Set-11
Surfaces
Skins
Stringers
Section Assignments (6)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-2 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Orientations
Composite Layups
Engineering Features
Mesh
Materials (2)
Module: Visualization
Model: C:/Users/jiaor/Desktop/Job-2.odb
S, Mises
(Avg: 75%)
+3.100e+02
+2.842e+02
+2.584e+02
+2.325e+02
+2.067e+02
+1.809e+02
+1.550e+02
+1.292e+02
+1.033e+02
+7.751e+01
+5.167e+01
+2.584e+01
+0.000e+00
Step: Step-1 Frame: 16
Total Time: 0.951289
ODB: Job-2.odb Abaqus/Standard 2021 Mon May 02 14:55:27 ?????? 2022
Step: Step-1
Increment 16: Step Time = 0.9513
SIMULIA

Results: 1


del Database
Set-7
Set-8
Set-9
Set-10
Set-11
Set-12
Set-13
Surfaces
Skins
Stringers
Section Assignments (6)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-1 (Solid, Homogeneous)
Section-2 (Solid, Homogeneous)
Orientations
Composite Layups
Engineering Features
Mesh
Y
X
Z

Results: 2


Module: Visualization
Model: C:/Users/jiaor/Desktop/Job-3.odb
S, Mises
(Avg: 75%)
+3.196e+02
+2.929e+02
+2.663e+02
+2.397e+02
+2.130e+02
+1.864e+02
+1.598e+02
+1.331e+02
+1.065e+02
+7.989e+01
+5.326e+01
+2.663e+01
+0.000e+00
Step: Step-1 Frame: 10
Total Time: 0.351289
ODB: Job-3.odb Abaqus/Standard 2021 Mon May 02 15:08:24 ?????? 2022
Step: Step-1
Increment 10: Step Time = 0.3513
SIMULIA