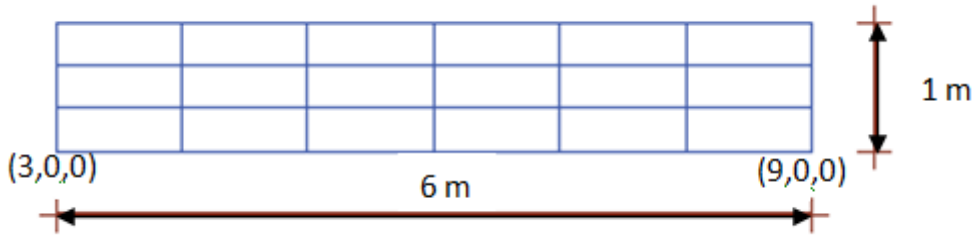
STATIC ANALYSIS OF A PRESSURE VESSEL USING AXI-SYMMETRIC ELEMENT



Problem definition:

Plate dimensions are shown in the figure.

Analysis Type: Static Analysis

Modulus of elasticity, E = $1000 N/m^2$

Poisson's Ratio, υ = 0.3

Element Type = Axisymmetric

Loads and boundary conditions:

- Pressure load 1Pa is applied normal to the left edge.
- Top and bottom edges are arrested along y-direction.

PROCEDURE

1. Creation of geometry

- **Create 4 points at (3,0,0) (9,0,0) (9,1,0) and (3,1,0)**

Commands : POINT, ADD

Menu : Geometry → Key point → Create → By X/Y/Z

Parameters : (To be filled by the user)

Coordinate Data	3/0/0
Coordinate Type	0
Entity ID	1

- **Create quadrilateral surface on four points**

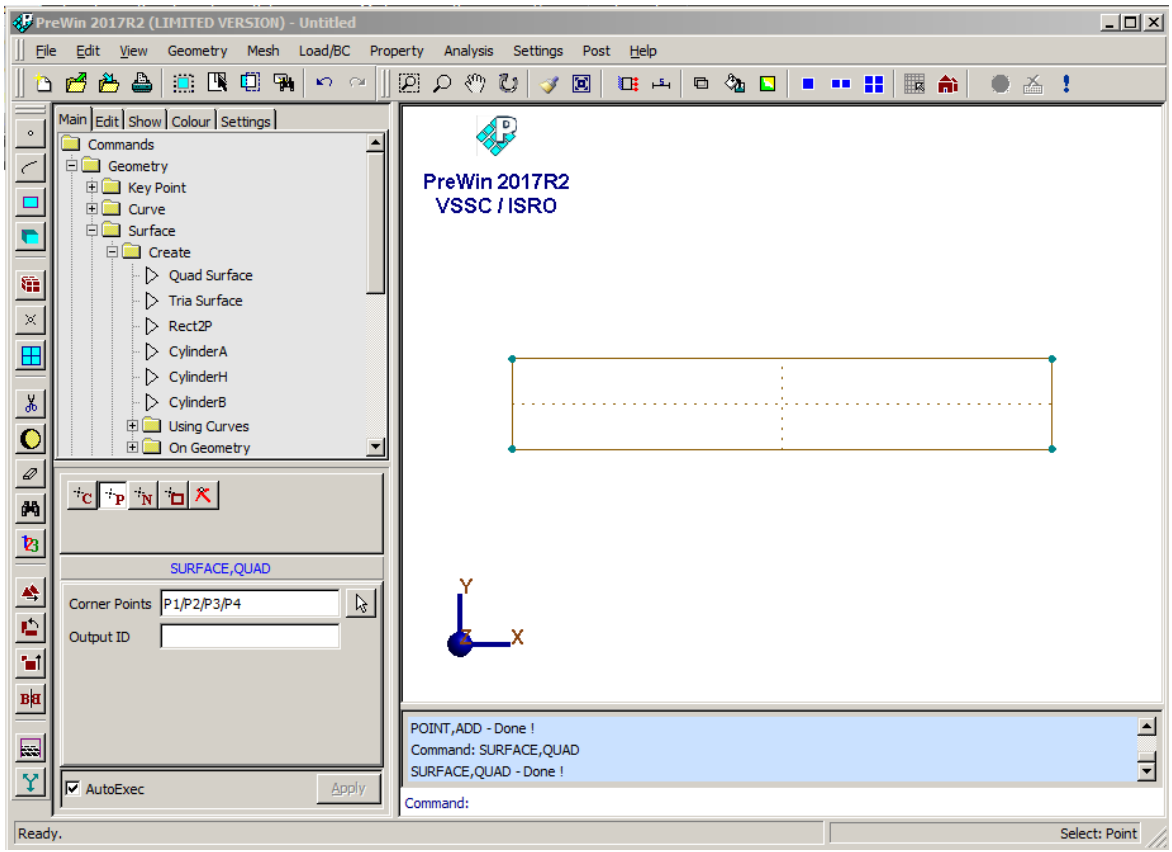
Command : SURFACE, QUAD

Menu : Geometry → Surface → Create → Quad Surface

Parameters : (To be filled by the users)

Corner points	Use mouse to pick the points. P1/P2/P3/P4
Entity ID	1

At the end of this operation, the screen looks like this.



2. Meshing using quadrilateral elements

Command : FEM,QUAD

Menu : Mesh → FE Mesh → QUAD

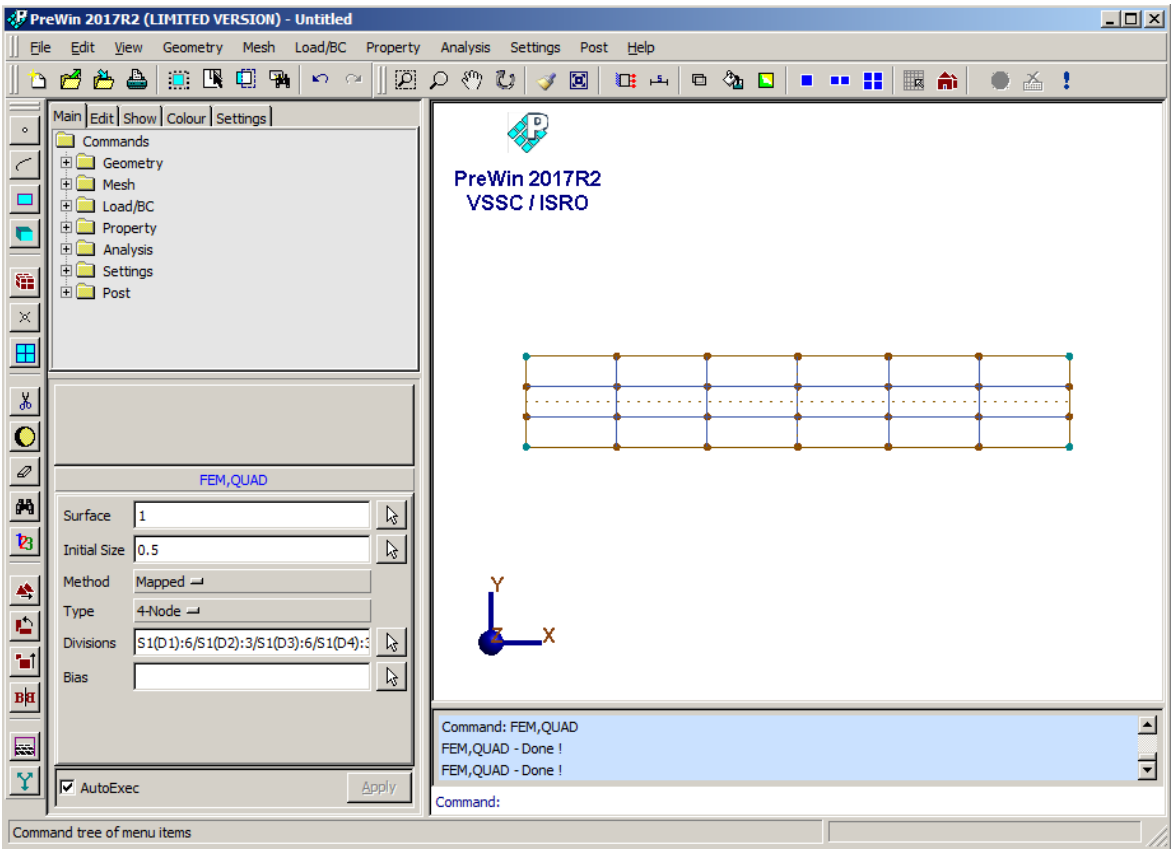
Parameters :

Surface	Use mouse to select the surface
Initial size	0.5
Method	Mapped
Type	4-node
Divisions	S1(D1):6/S1(D2):3/S1(D3):6/S1(D4):3

Note:

Divisions along each edge can be varied by selecting the corresponding edges and right/left clicking the mouse point to adjust the subdivisions. Eg: S1(D1)/6 shows 6 sub divisions along edge1 & S1(D2)/3 shows 3 sub divisions along edge2 of surface1.

At the end of this operation, the screen looks like this.



3. Convert the QUAD4 element to QUAD8 element

Command : ELEMENT,CONVERT

Menu : Mesh → Element → Modify→ Convert

Parameters :

Element IDs	All
Convert to	QUAD8

4. Change the element type

Command : ELEMENT,TYPE

Menu : Mesh → Element → Modify→ Type

Parameters :

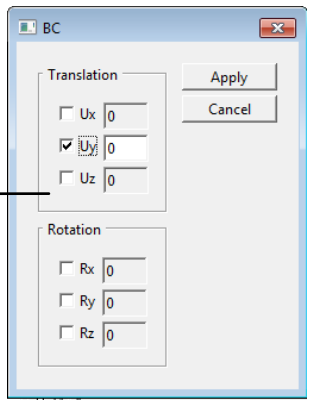
Element IDs	All
Element Type	Axisymmetric

5. Specify displacement boundary conditions

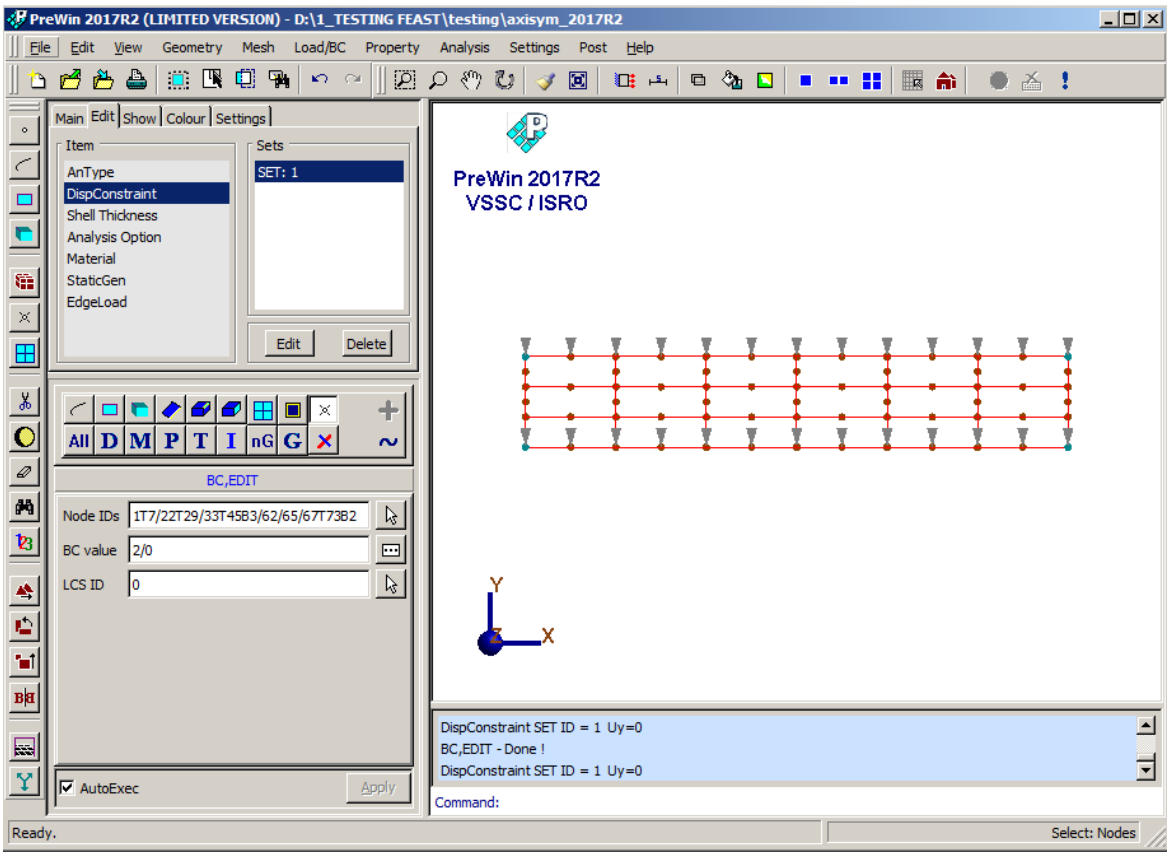
Command : BC, ADD

Menu : Load/BC → Displacement BC → Add

Node ID	Select the nodes on the top and bottom boundary edges
BC Value	2/0
LCS ID	0
Set ID	1



At the end of this operation, the screen looks like this.



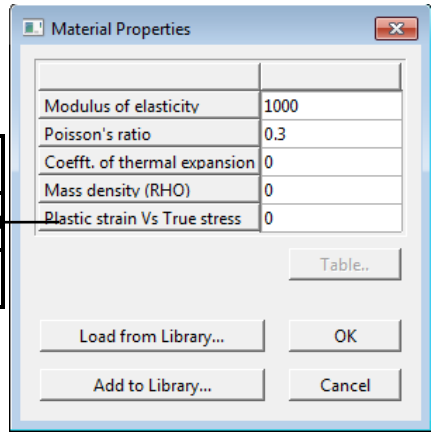
6. Specify material properties

Command : MATERIAL, ISO

Menu : Property → Material → Isotropic → Add

Parameters :

Element IDs	All
Material Data	1000/0.3/0/0/0
Material ID	1



7. Specify shell thickness

Command : THICKNESS, ADD

Menu : Property → Physical → Thickness → Add

Parameters

Element IDs	All
Thickness	1
Set ID	1

8. Specify edge load

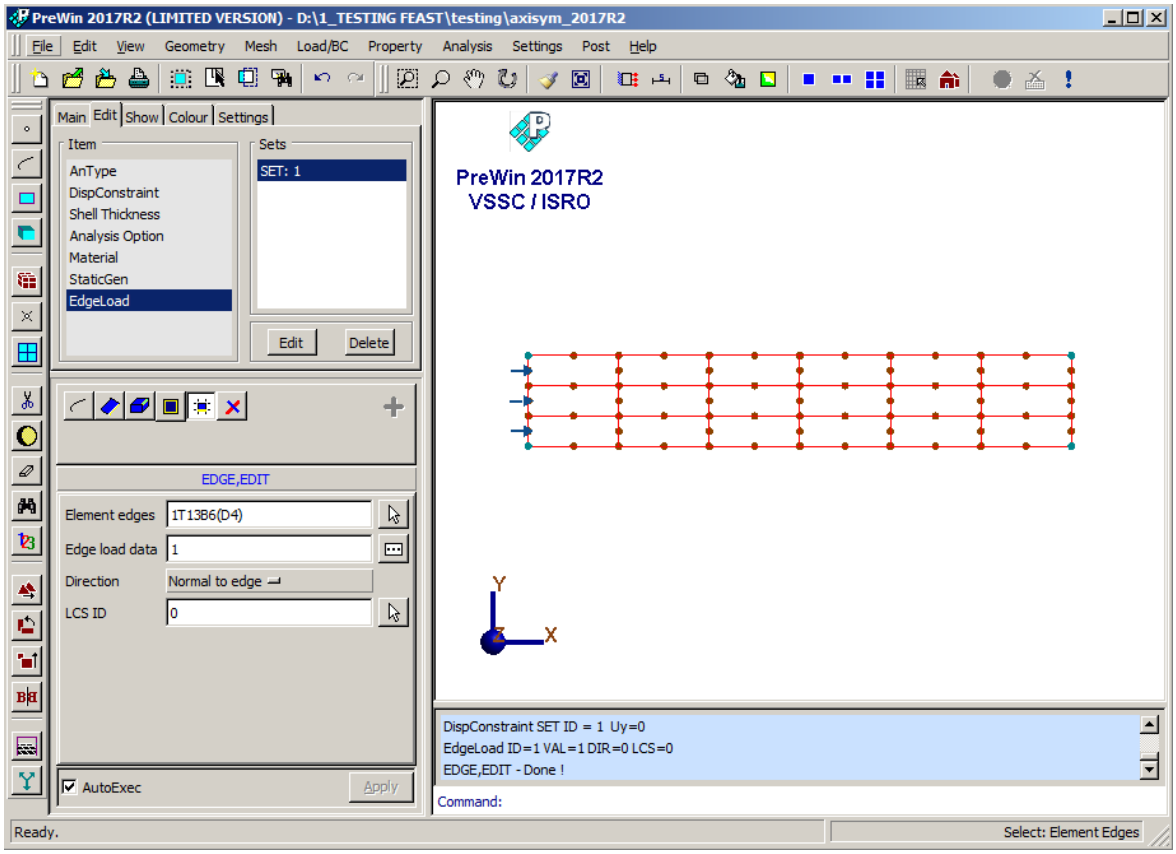
Command : EDGE,ADD

Menu : Load/BC → Edge Loads → Add

Parameters :

Element edges	Left boundary edges.
Edge load data	1
Direction	Normal to edge
LCS ID	0
Set ID	1

At the end of this operation, your screen should look like this



9. Specify analysis type

Commands : ANTYPE, SET

Menu : Analysis → Analysis Type

Parameters : (To be filled by the user)

Analysis Type	Static

10. Specify analysis options

Commands : ANOPTION, SET

Menu : Analysis → Analysis Options

Parameters : (To be filled by the user)

Linear Solver	Multi Frontal

11. Specify static general properties

Commands : STATGEN,ADD

Menu : Analysis →Static →General →Add

Parameters : (To be filled by the user)

Stress Output	Yes

12. Save the data file

Menu : File→ Save

13. Submit the job into FEAST

Menu : Analysis →Run Solver

```
Writing Results...
ELAPSED TIME  : 0 H :: 0 M :: 1 S
Finished successfully
```

After the solution is completed the message "*successfully completed*" appears in the *message box.*

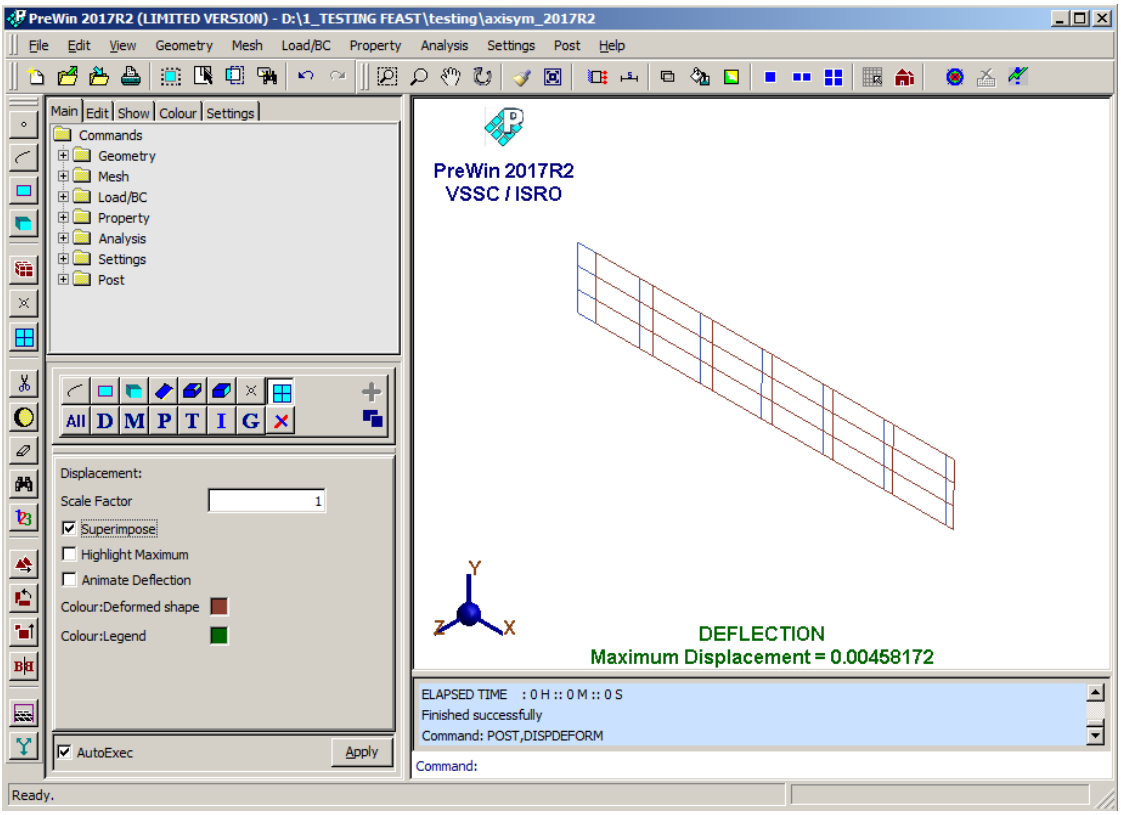
14. Post processing

a) Deformed shape

Command : POST,DISPDEFORM

Menu : Post → Deformed Shape

At the end of this operation, the screen looks like this.



b) Displacement Contour

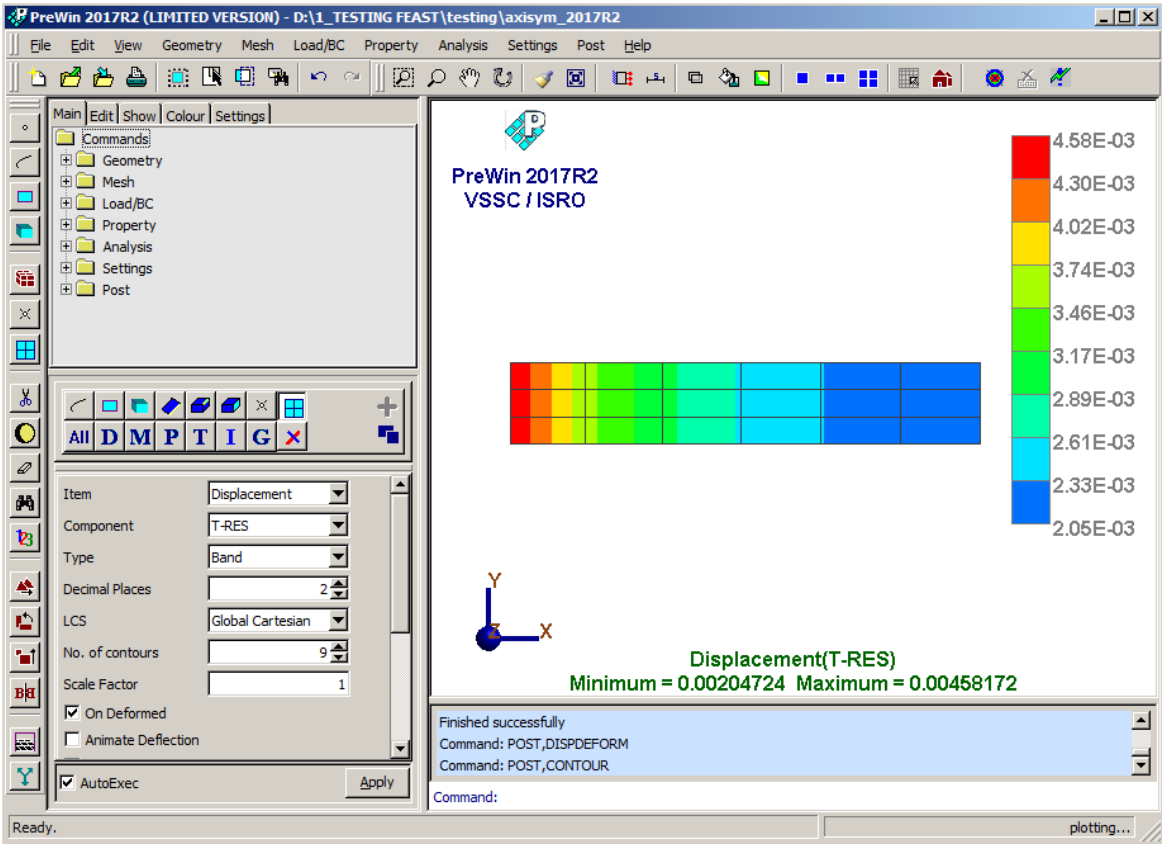
Command : POST,CONTOUR

Menu : Post → Contour

Parameters :

Item	Displacement
Component	T-RES
Type	Band
Decimal Places	3
LCS	Global Cartesian
No. of contours	9

At the end of this operation, the screen looks like this.



c) Stress Contour

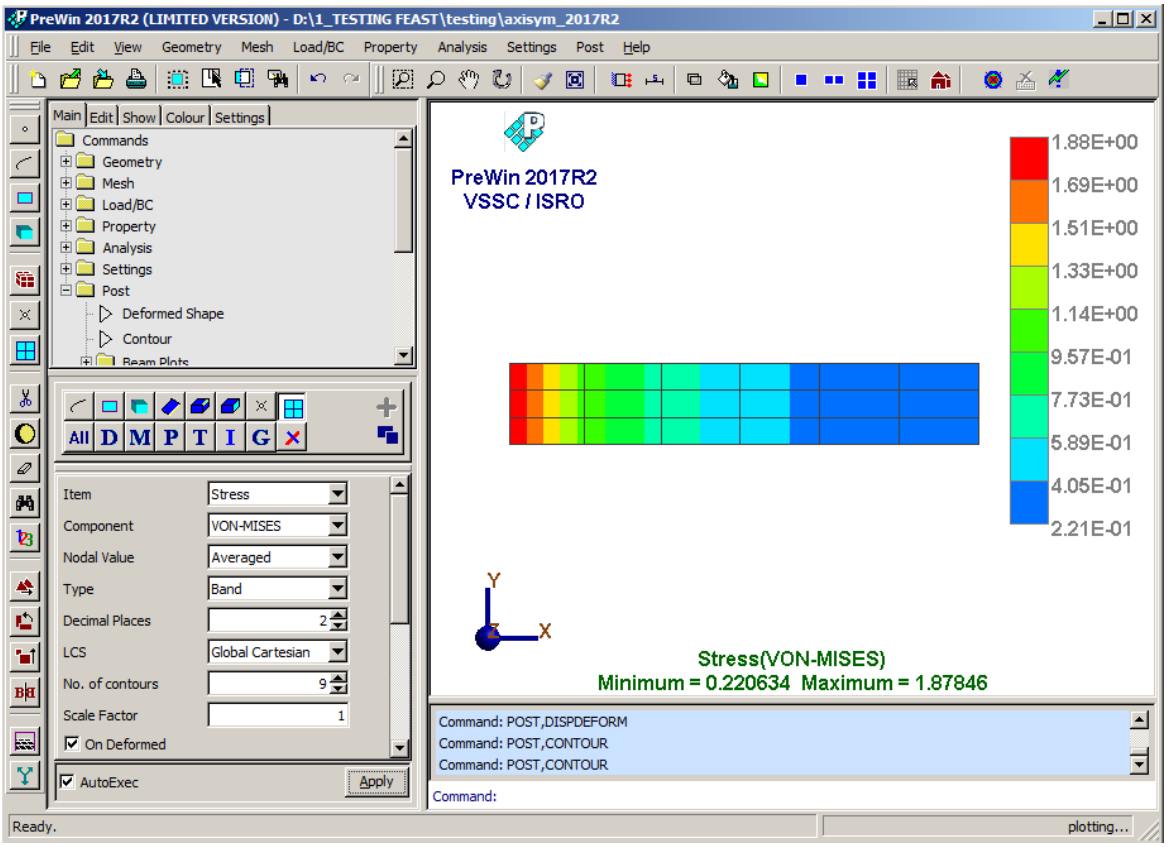
Command : POST,CONTOUR

Menu : Post → Contour

Parameters :

Item	Stress
Component	Von-mises
Nodal Value	Averaged
Surface	Middle
Type	Band
Decimal places	3

At the end of this operation, the screen looks like this.



a) Graph plot

Menu : Post → Path Plot

Command : POST, PATHPLOT

Parameters :

Item	Displacement
Component	T-RES
Nodal Path	Select bottom boundary edge nodes. 1T7/29/33/36T45B3

At the end of the above operations a graph as shown appears in the viewport

d) Output file can be seen in *.OUT