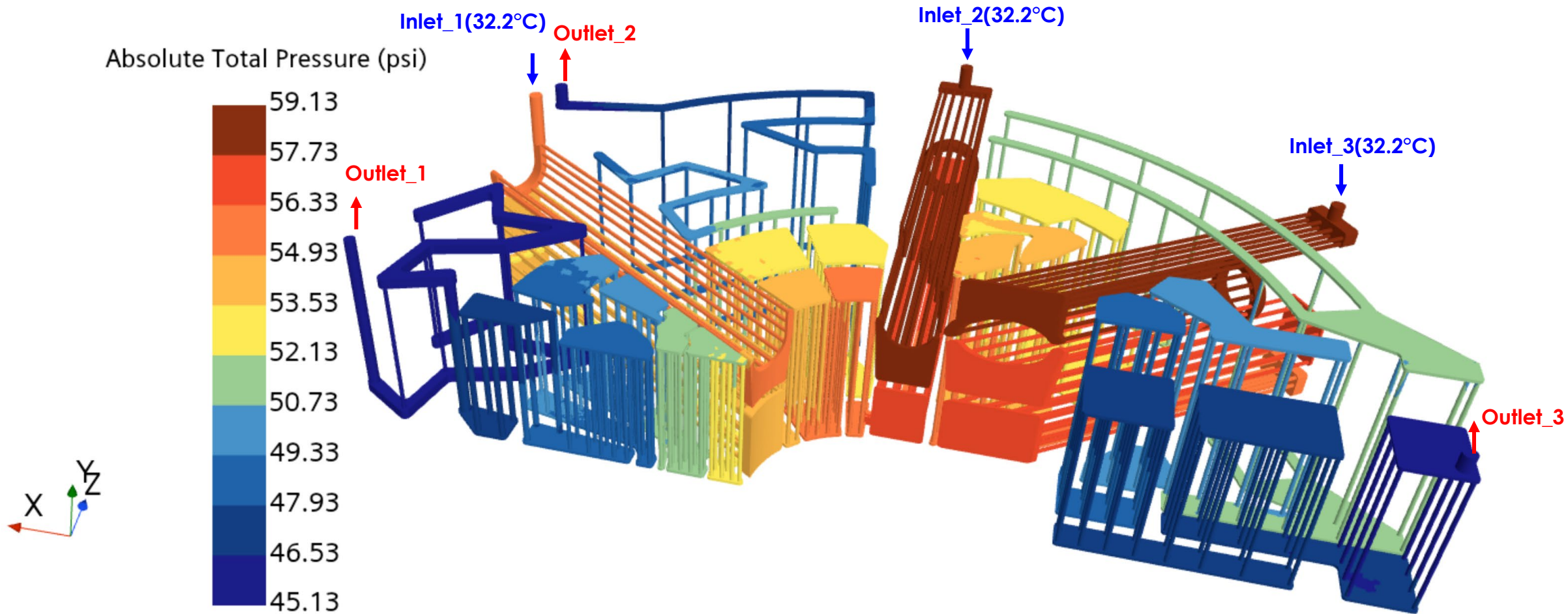


Vessel Systems (S.03.06) Shield Block #3 Thermal and Structural Analysis

Min-Tsung Kao

12/24/2024

Shield Block #3 (Design_31), Water Pressure



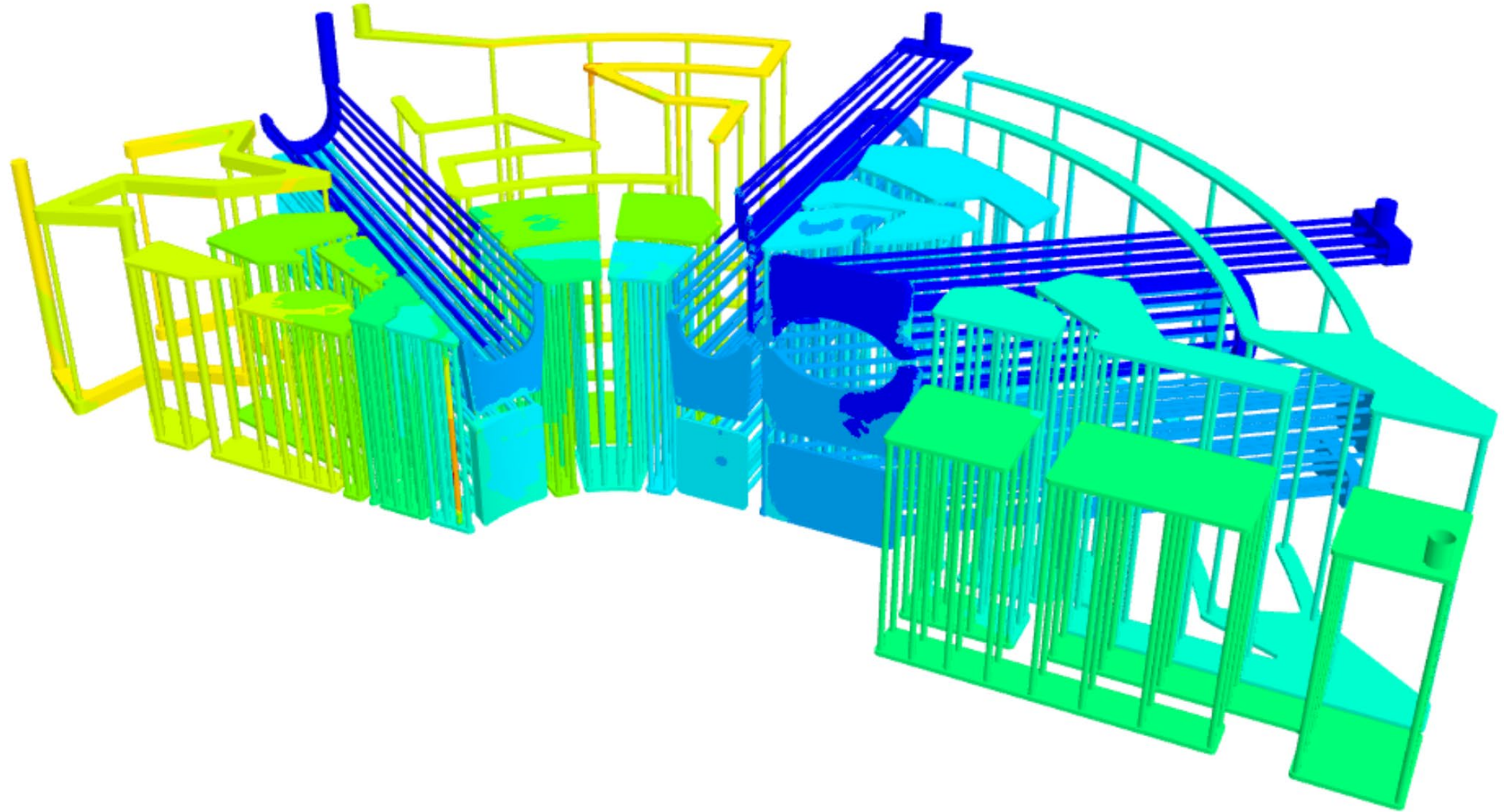
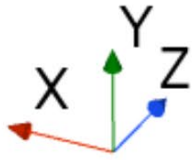
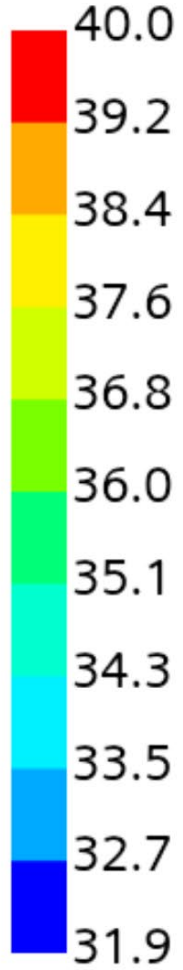
$$\Delta P_{inlet_1-outlet_1} = 9.5 \text{ psi (8GPM)}$$

$$\Delta P_{inlet_2-outlet_2} = 13.2 \text{ psi (8GPM)}$$

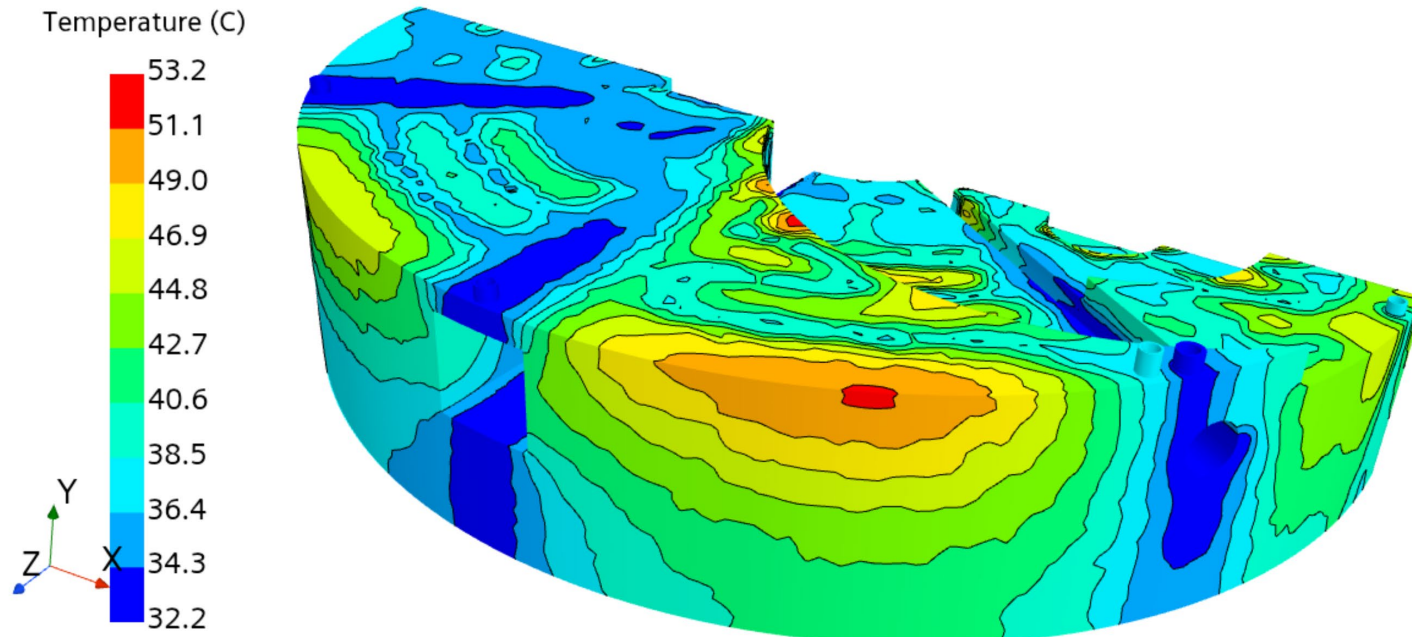
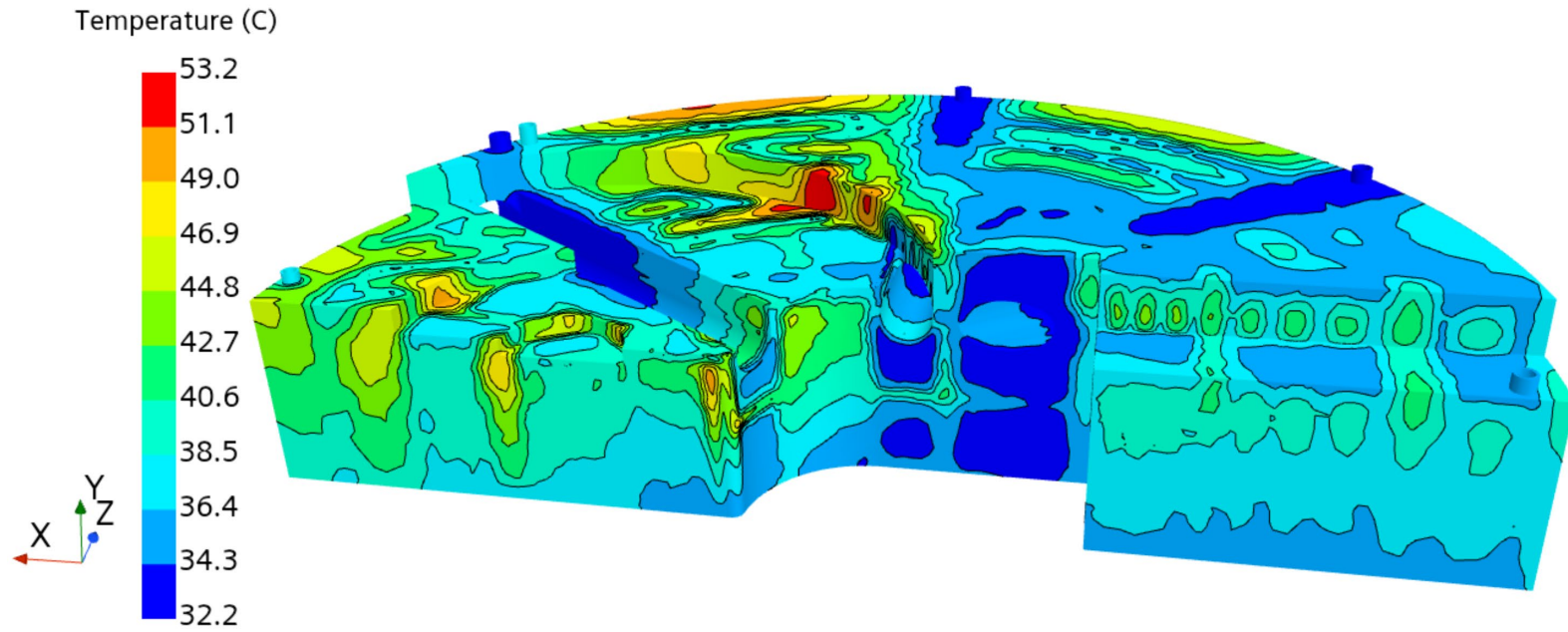
$$\Delta P_{inlet_3-outlet_3} = 12.9 \text{ psi (8GPM)}$$

Shield Block #3 (Design_31), Water Temperature

Temperature (C)



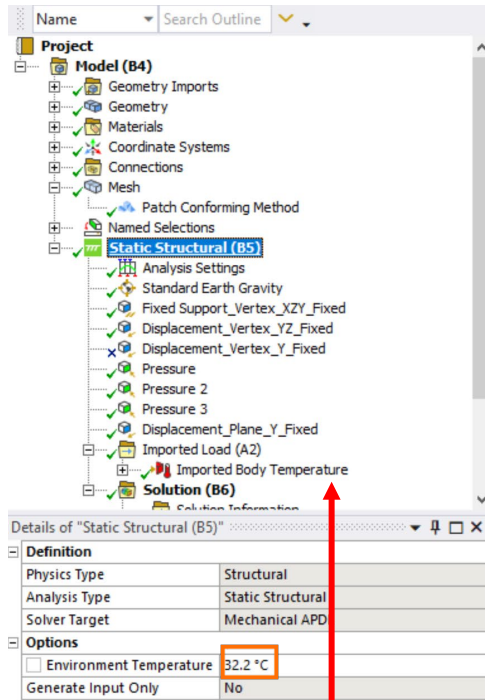
Shield Block #3 (Design_31), SS316 Temperature



Shield Block #3 Structural Analysis

Shield Block #3, SS316 (Design_31)

Structural BCs

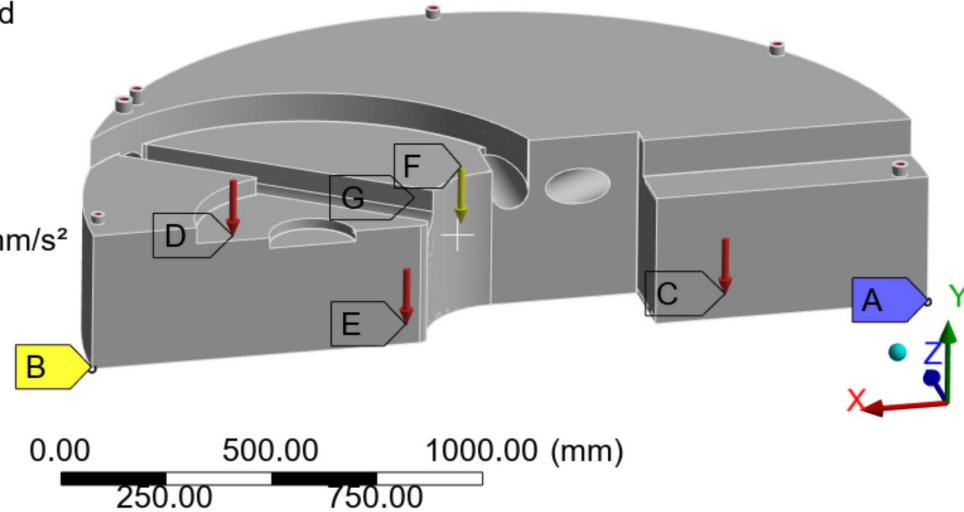


B: Static Structural

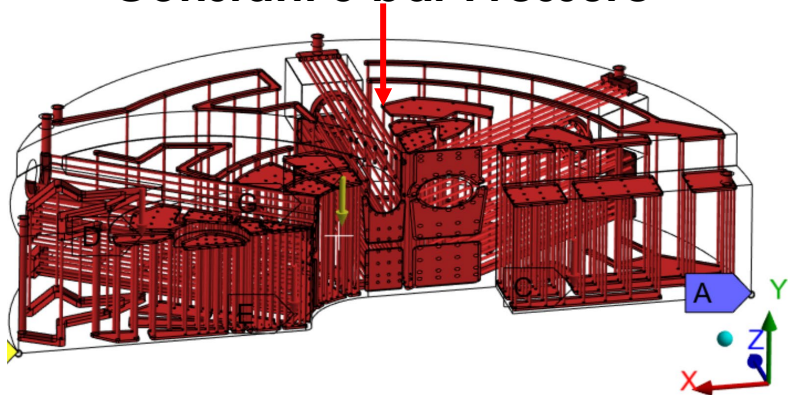
Static Structural

Time: 1. s

- A** Fixed Support_VerTEX_XZY_Fixed
- B** Displacement_VerTEX_YZ_Fixed
- C** Pressure: 0.5 MPa
- D** Pressure 2: 0.5 MPa
- E** Pressure 3: 0.5 MPa
- F** Standard Earth Gravity: 9806.6 mm/s²
- G** Displacement_Plane_Y_Fixed



- **Temperature** from CFD (STARCCM+)
- **Constant 5 bar Pressure**



- BC-A: Point fixed in x, y and z directions
 - Reference point
- BC-B: point fixed in y and z directions.
 - Fixed in y and z : prevent rotation
 - This point can only move in x direction (beam direction)
- BC-G: Plane fixed in y
 - Block rests on flat surface
- BC-F: Gravity (-y direction)
- BC-C-E: Constant 5 bar pressure

Temperature Profiles from CFD (STARCCM+)

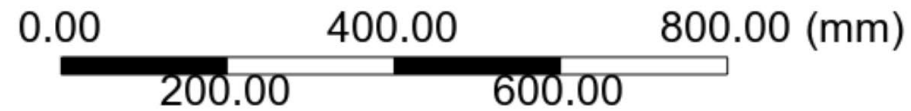
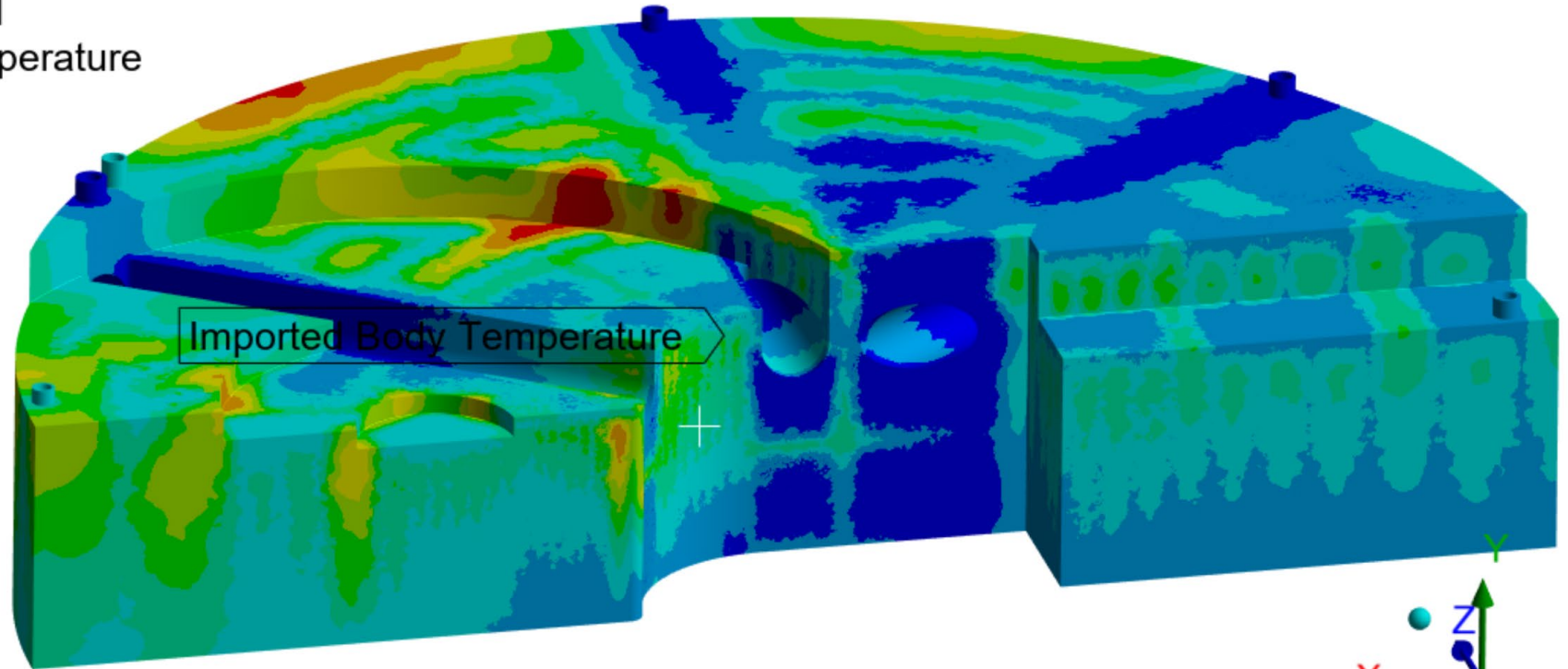
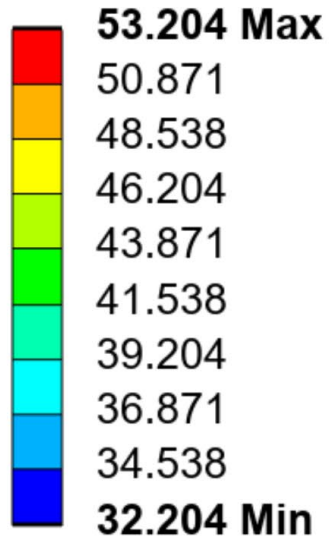
Imported Temperature

B: Static Structural

Imported Body Temperature

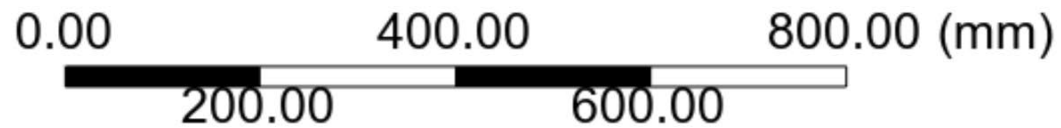
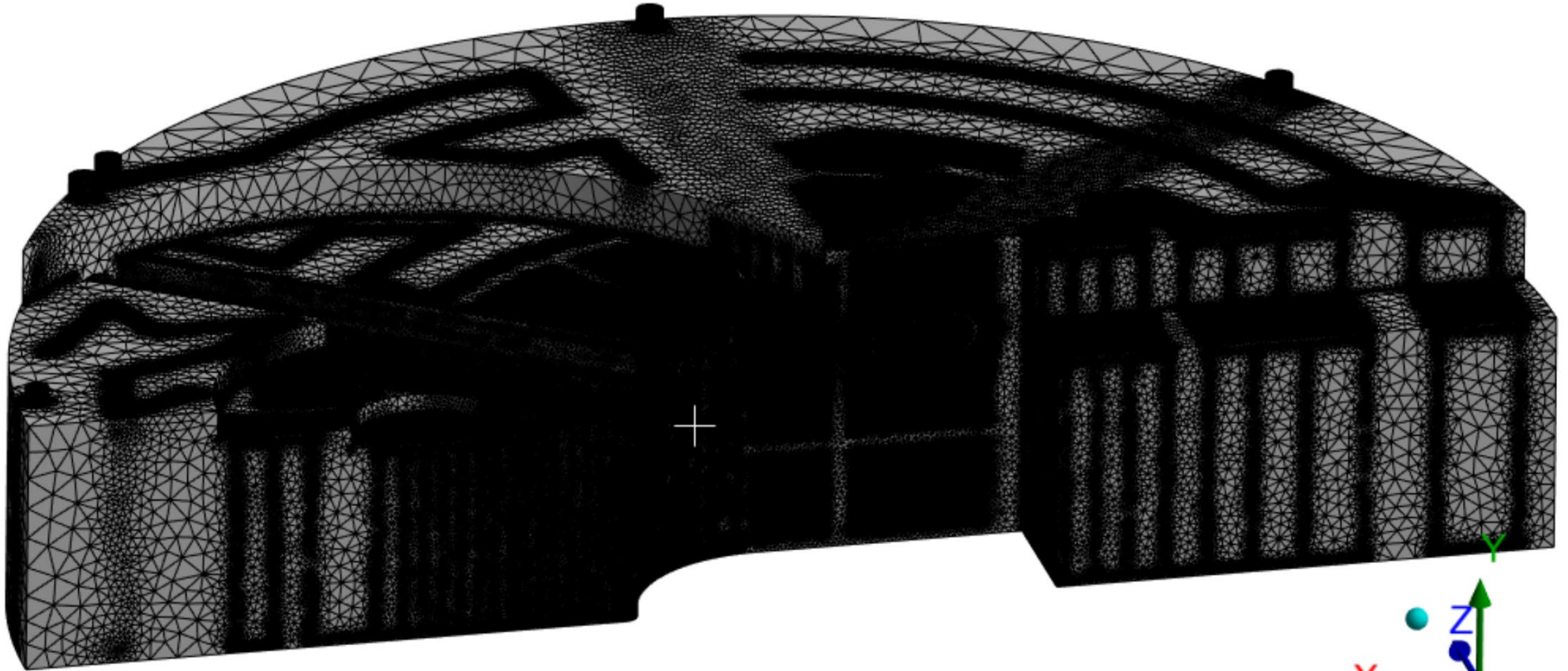
Time: 1. s

Unit: °C



Shield Block #5, Mesh Configuration

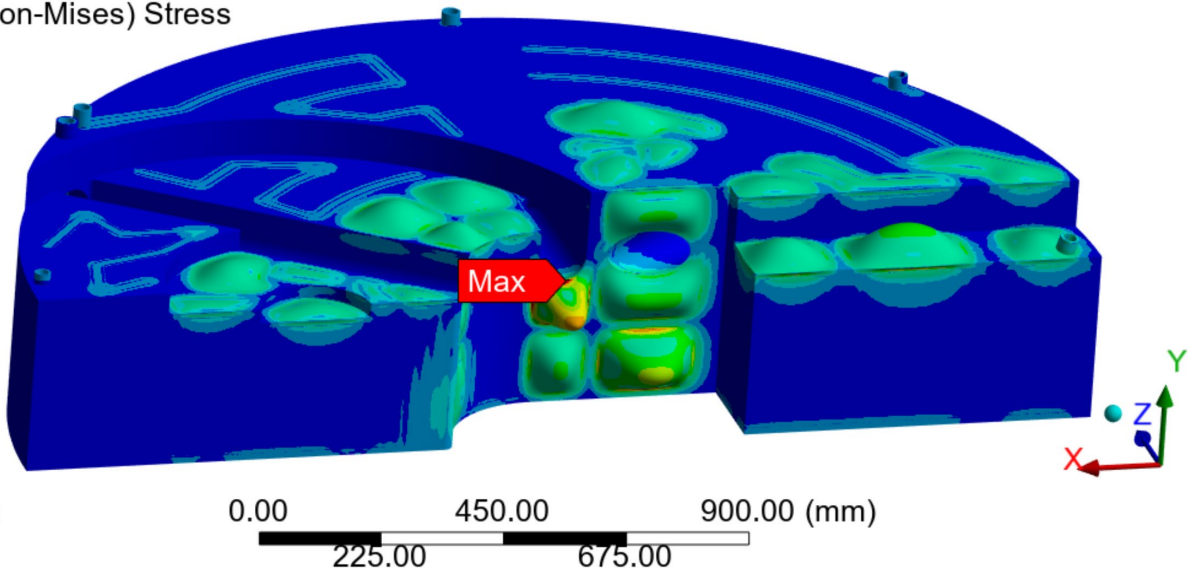
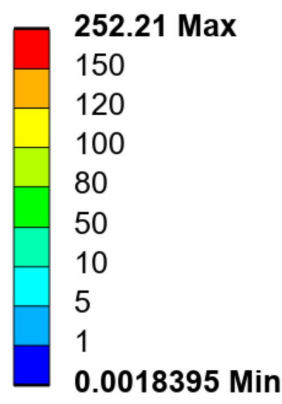
Nodes	12,510,087
Elements	8,303,253



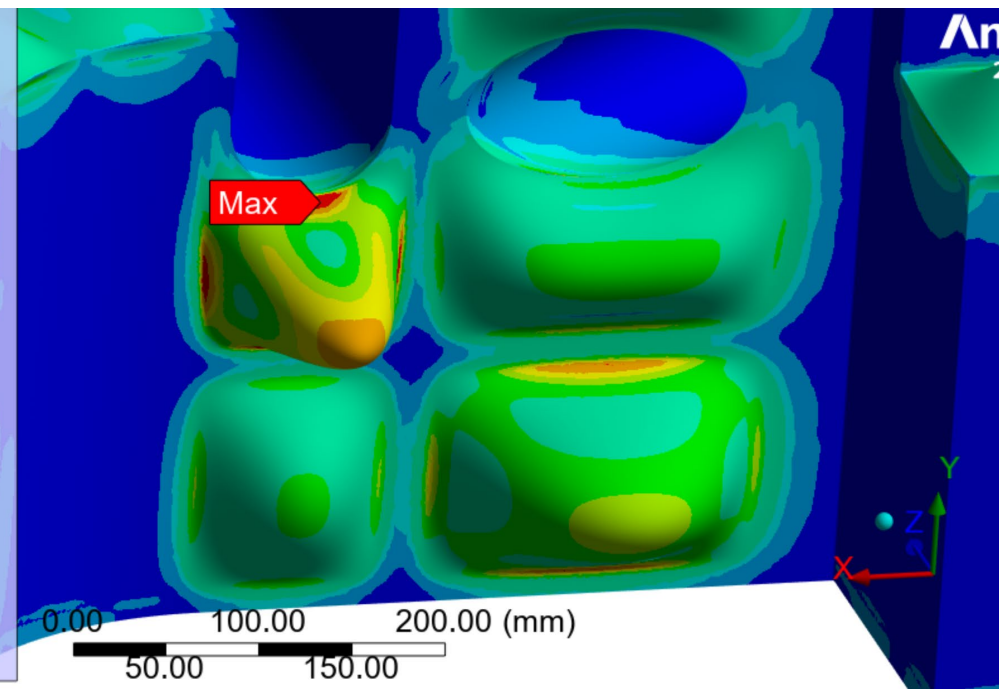
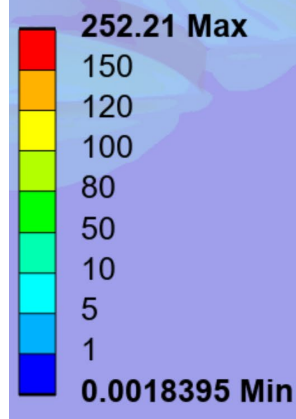
Von-Mises Stress

Peak Stress : 252 MPa
SS316 Yield Strength: 252 MPa

B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s



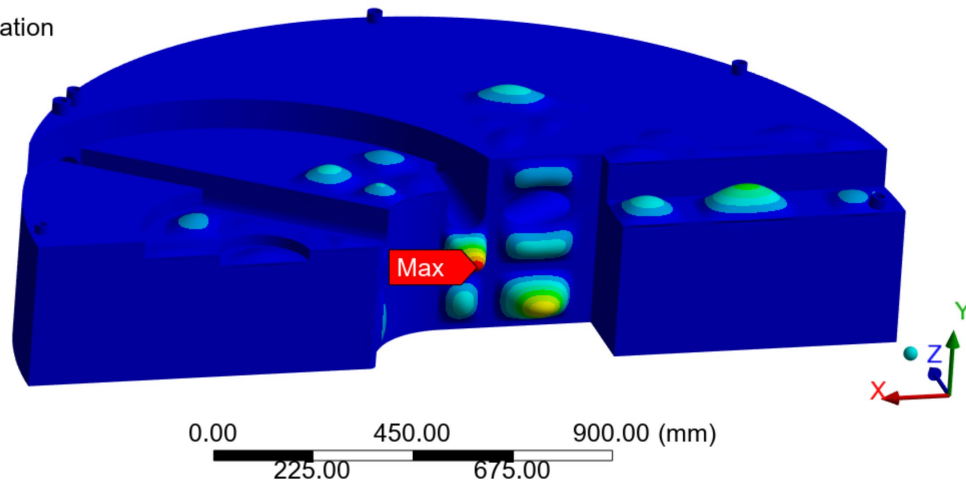
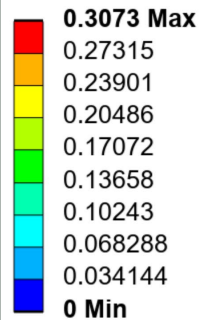
B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s



Displacement

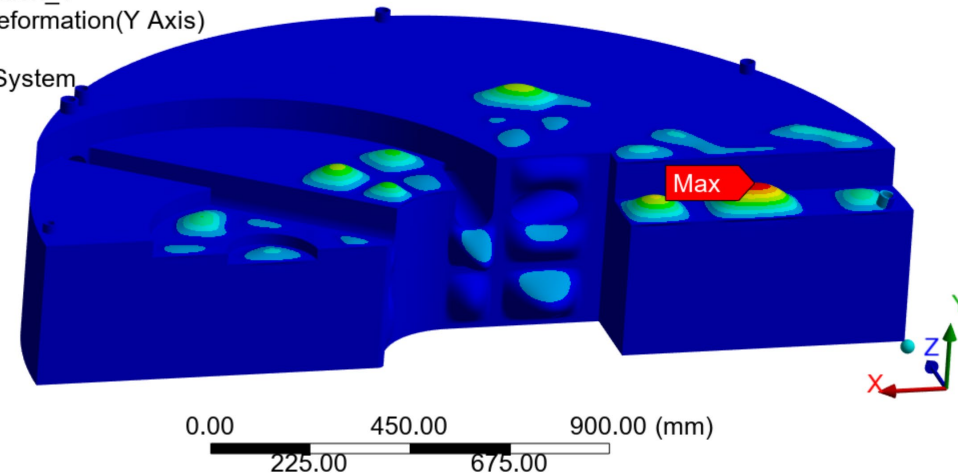
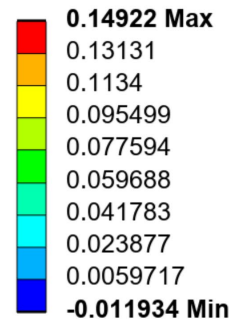
Total Deformation

B: Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1 s



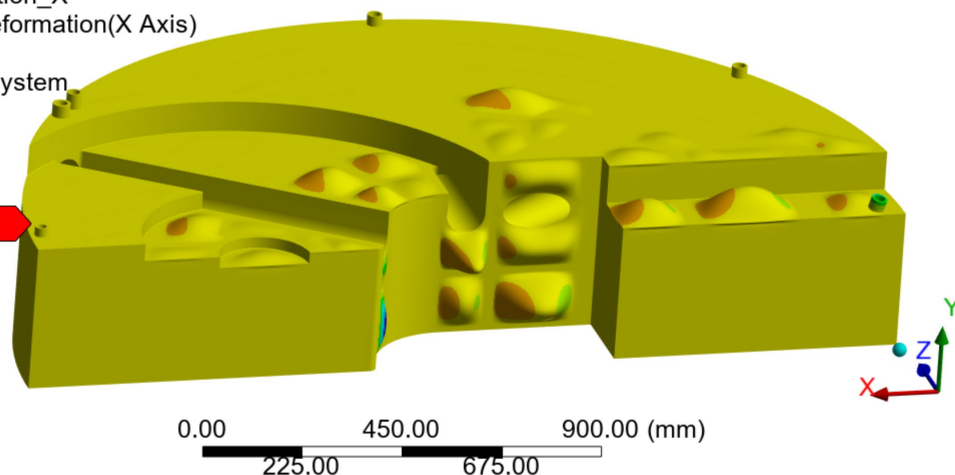
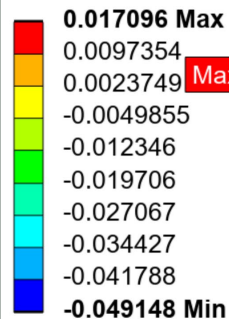
Y - Deformation

B: Static Structural
Directional Deformation_Y
Type: Directional Deformation(Y Axis)
Unit: mm
Global Coordinate System
Time: 1 s



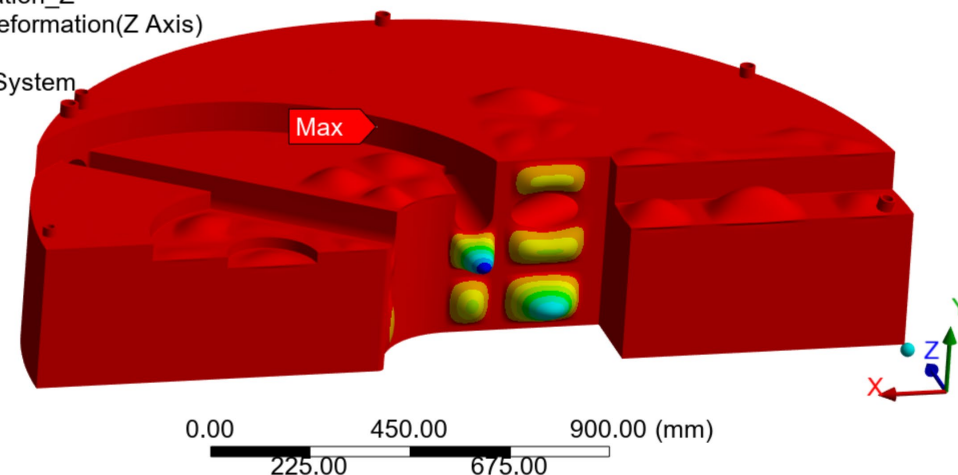
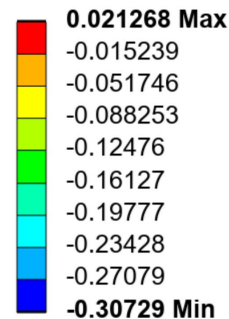
X - Deformation

B: Static Structural
Directional Deformation_X
Type: Directional Deformation(X Axis)
Unit: mm
Global Coordinate System
Time: 1 s



Z - Deformation

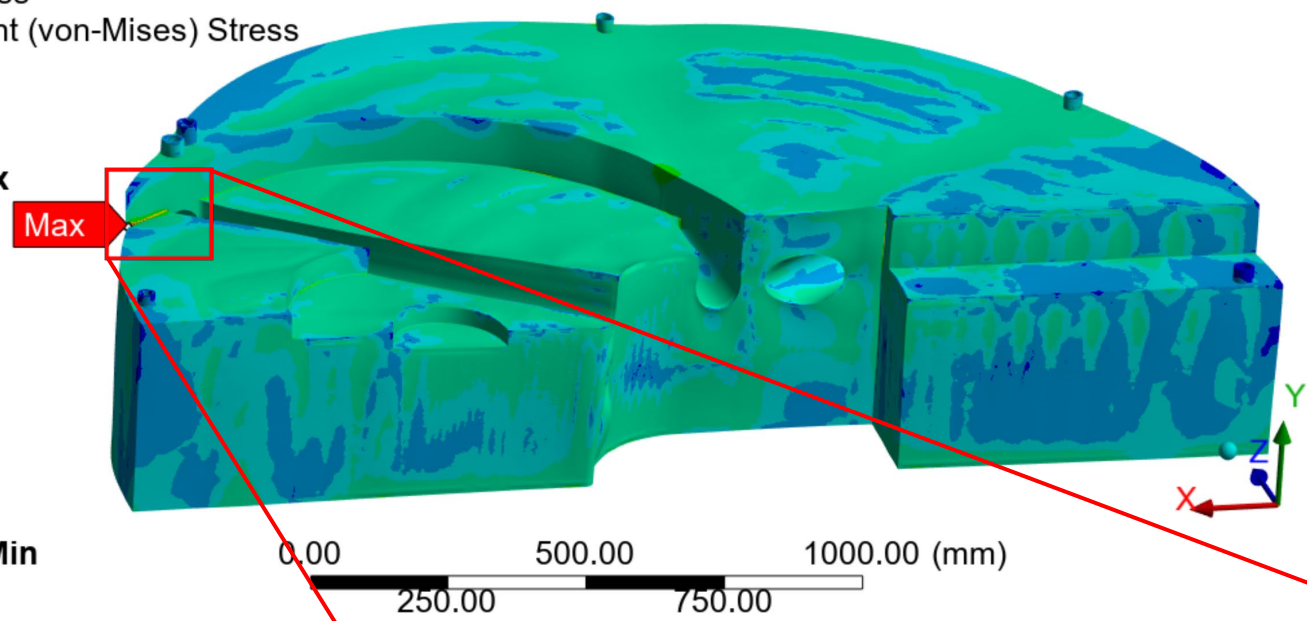
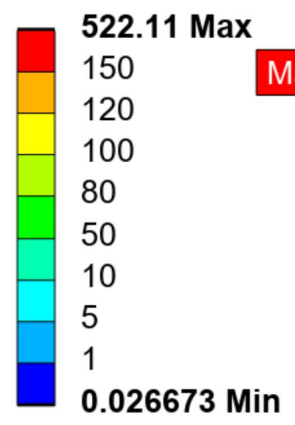
B: Static Structural
Directional Deformation_Z
Type: Directional Deformation(Z Axis)
Unit: mm
Global Coordinate System
Time: 1 s



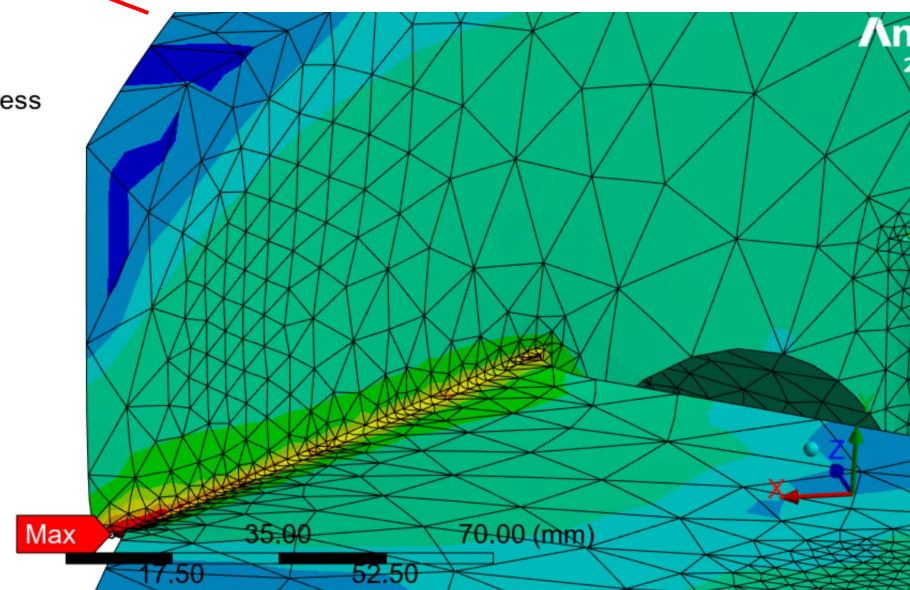
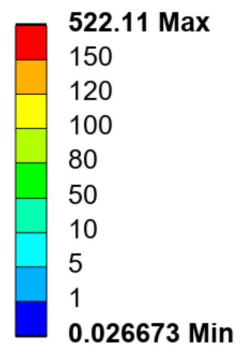
Von-Mises Stress

Peak Stress : 522 MPa
SS316 Yield Strength: 252 MPa

B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s



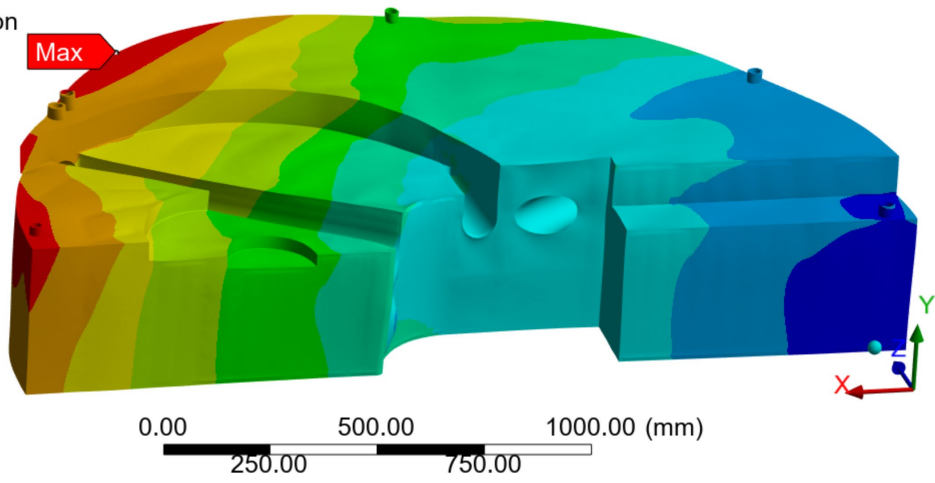
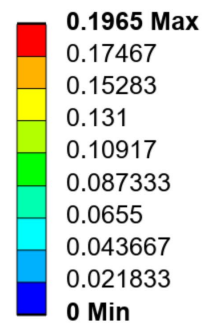
B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s



Displacement

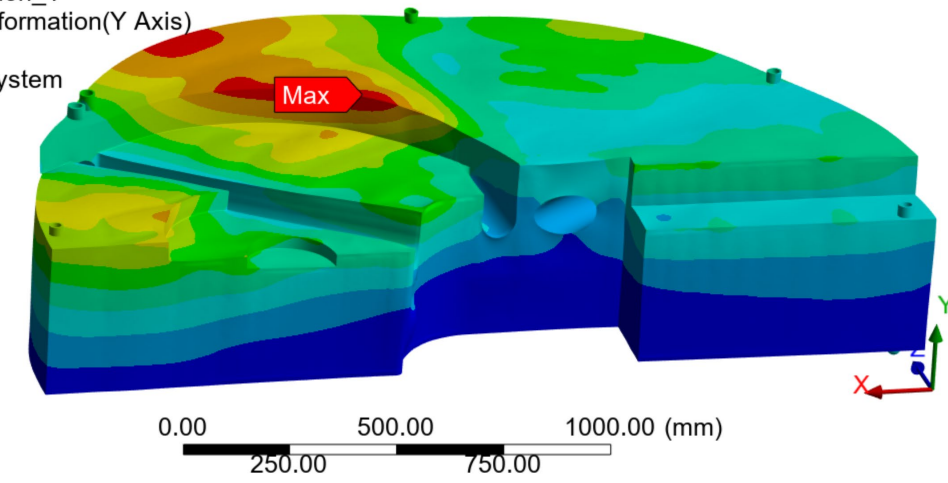
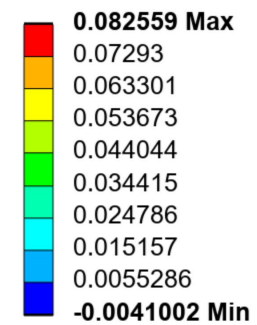
Total Deformation

B: Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1 s



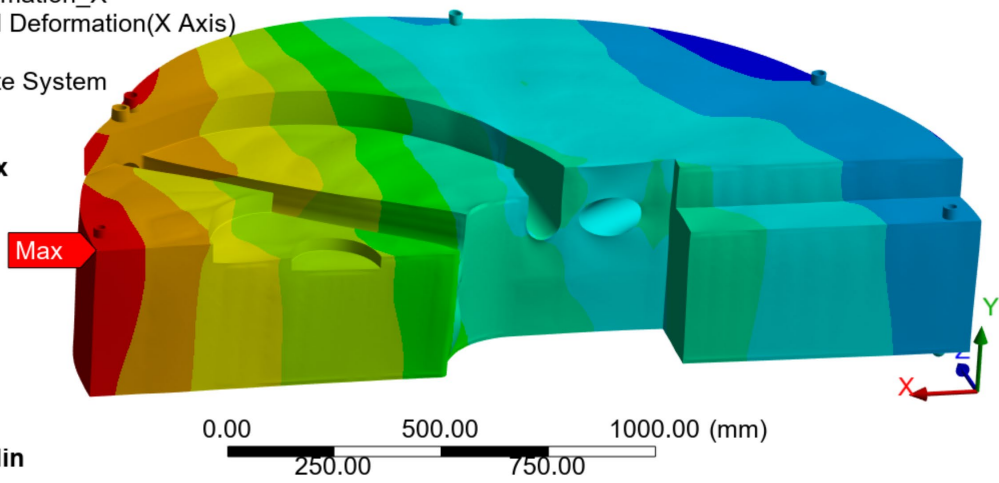
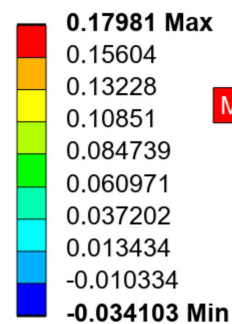
Y - Deformation

B: Static Structural
Directional Deformation_Y
Type: Directional Deformation(Y Axis)
Unit: mm
Global Coordinate System
Time: 1 s



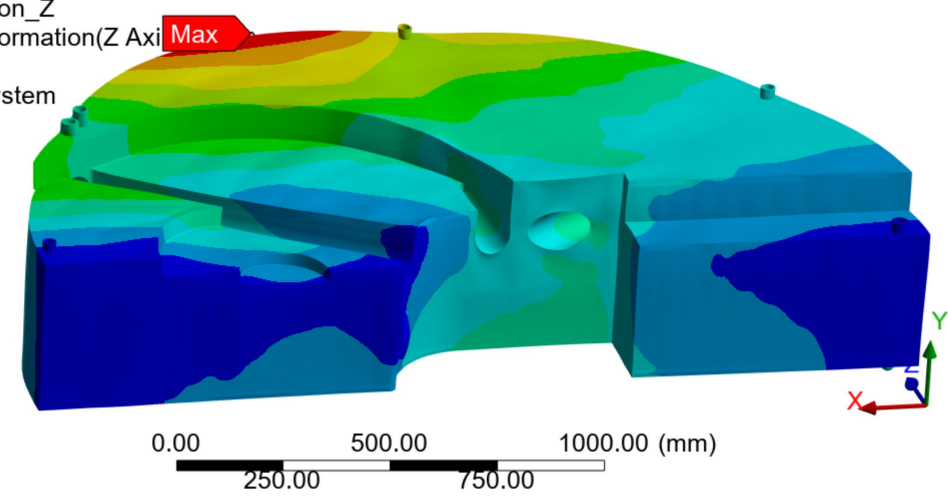
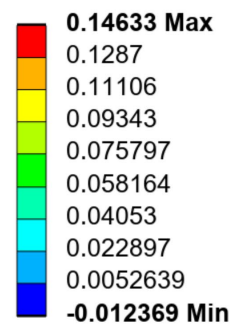
X - Deformation

B: Static Structural
Directional Deformation_X
Type: Directional Deformation(X Axis)
Unit: mm
Global Coordinate System
Time: 1 s



Z - Deformation

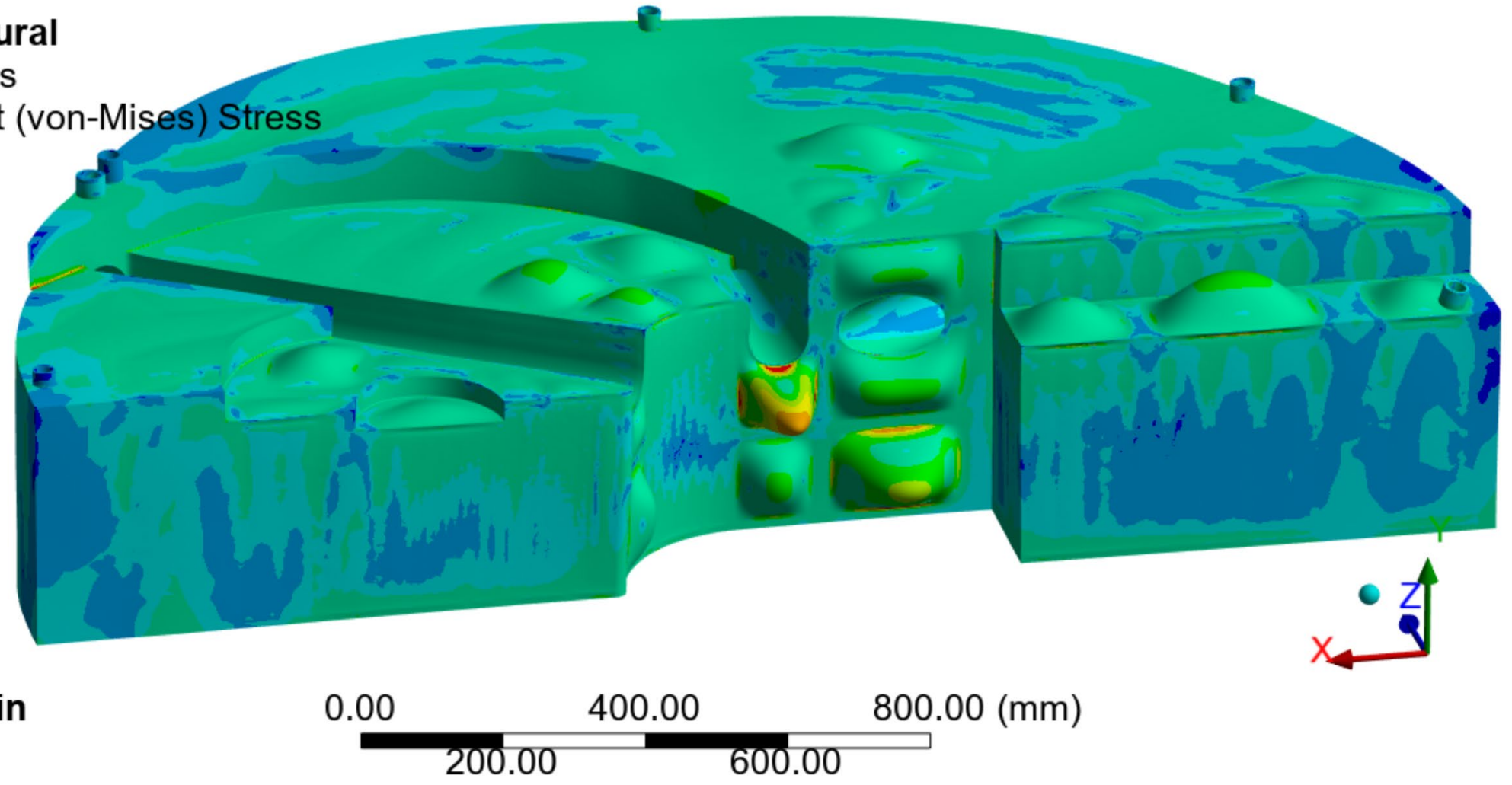
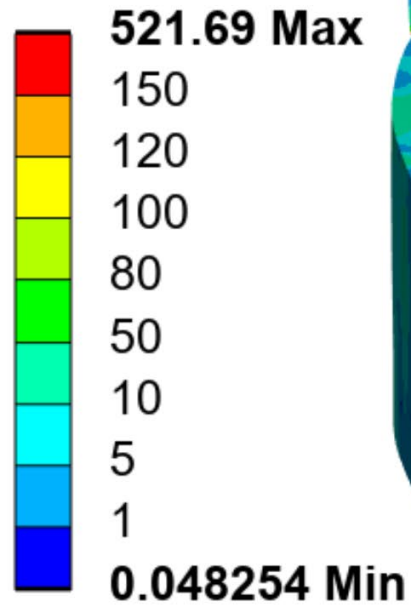
B: Static Structural
Directional Deformation_Z
Type: Directional Deformation(Z Axis)
Unit: mm
Global Coordinate System
Time: 1 s



Von-Mises Stress

Peak Stress : 521 MPa
SS316 Yield Strength: 252 MPa

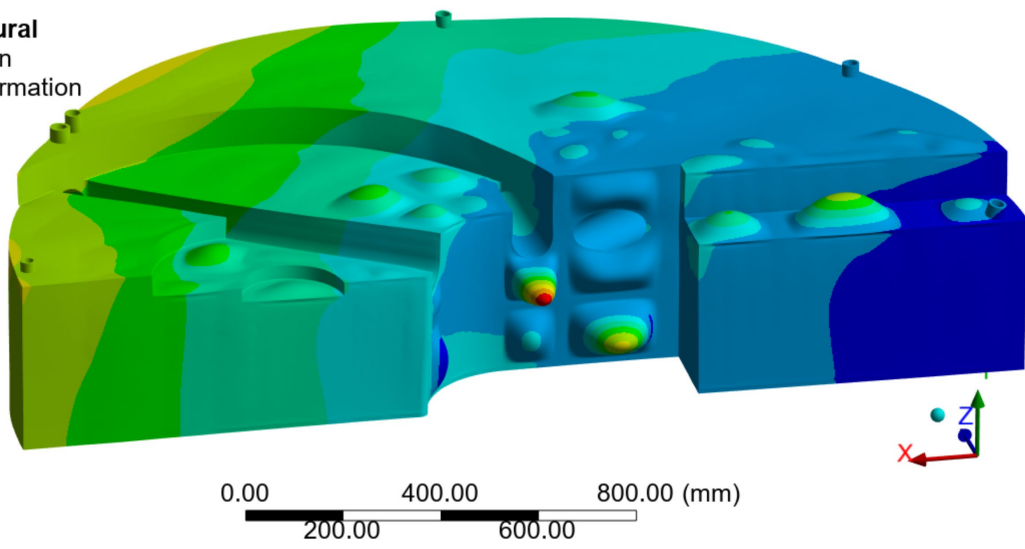
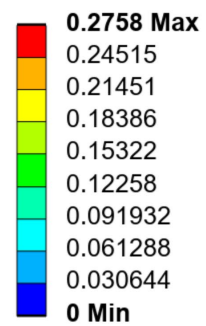
B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s



Displacement

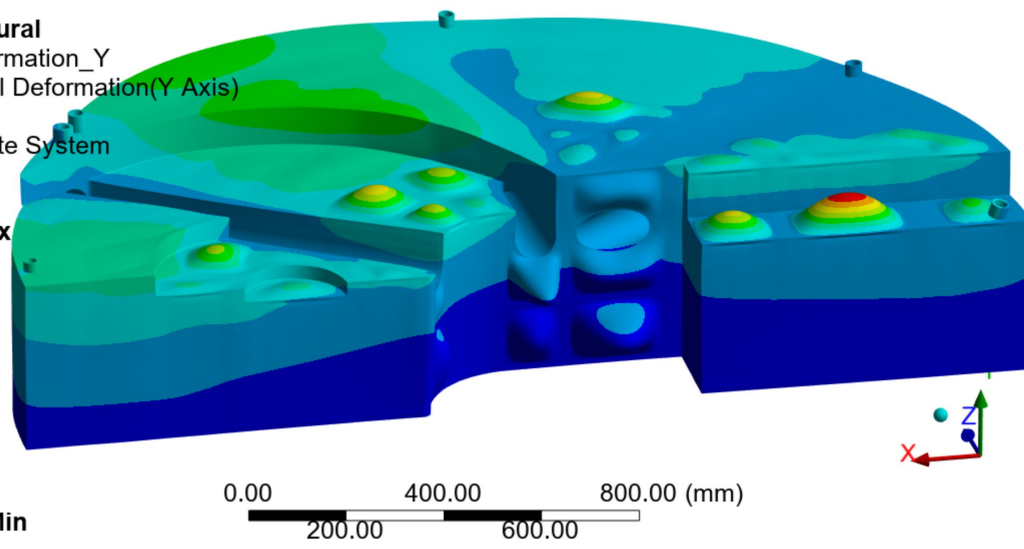
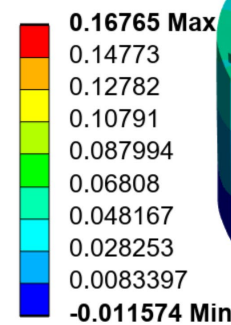
Total Deformation

B: Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1 s



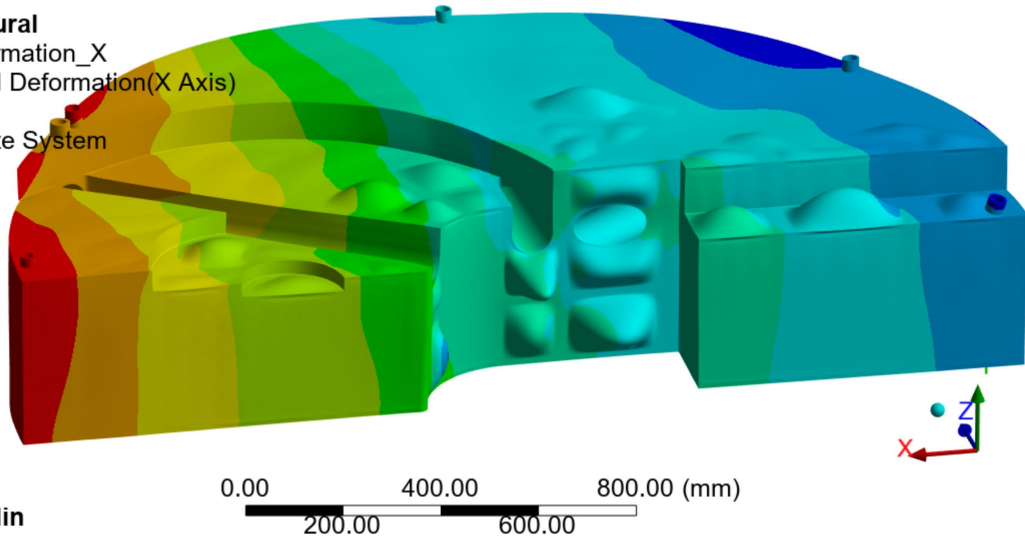
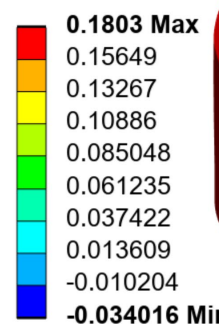
Y - Deformation

B: Static Structural
Directional Deformation_Y
Type: Directional Deformation(Y Axis)
Unit: mm
Global Coordinate System
Time: 1 s



X - Deformation

B: Static Structural
Directional Deformation_X
Type: Directional Deformation(X Axis)
Unit: mm
Global Coordinate System
Time: 1 s



Z - Deformation

B: Static Structural
Directional Deformation_Z
Type: Directional Deformation(Z Axis)
Unit: mm
Global Coordinate System
Time: 1 s

