CAE
Simulation #3

3D Element (Coal Compression Equipment)

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1. Introduction

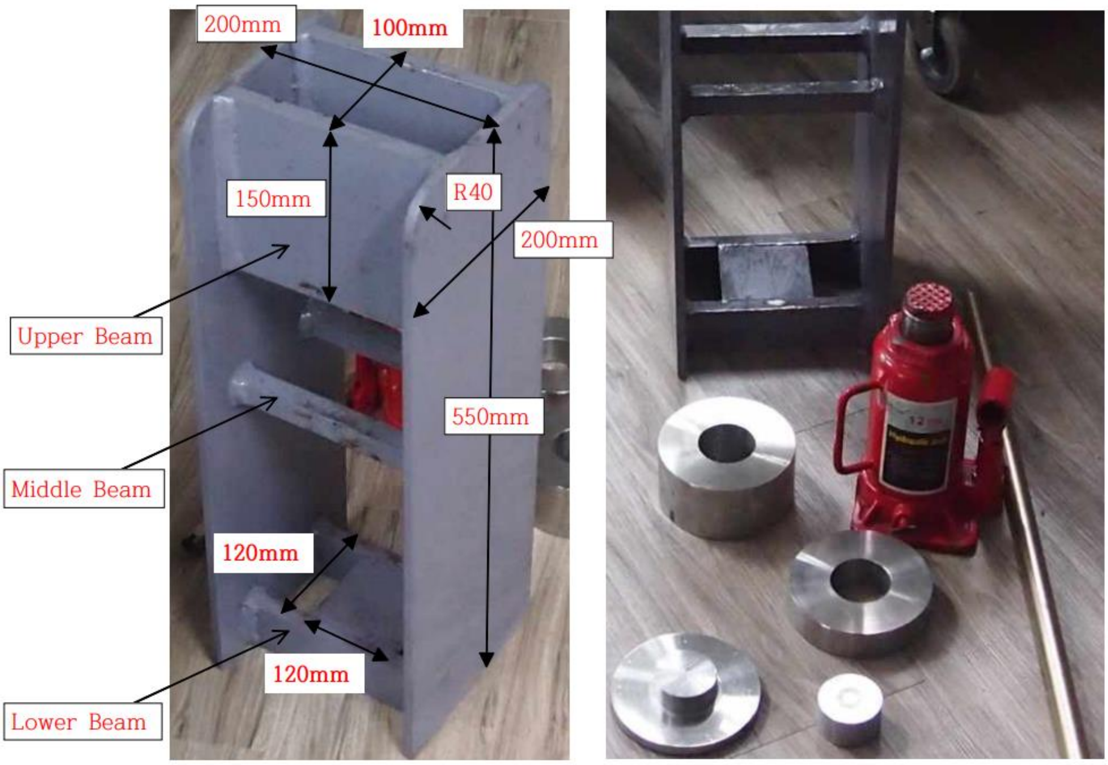

Figure 1. Coal Compression Equipment

We are trying to manufacture a coal compression equipment.(Material SS400) The hydraulic jockey placed on the lower beam can apply a force of up to 12 tons to the molding cylinder placed on the center beam. At this time, the molded cylinder is in contact with the upper beam and the upper beam is loaded, and the raw coal is squeezed inside the cylinder to manufacture the formed coal. The hydraulic jack is placed on the lower beam. A 1/4 CAD model is used for simulation considering the geometric symmetry. (Video: https://youtu.be/LC7YaSgJk3A, 3D CAD model provided)

2. Geometry Design (DesignModeler)

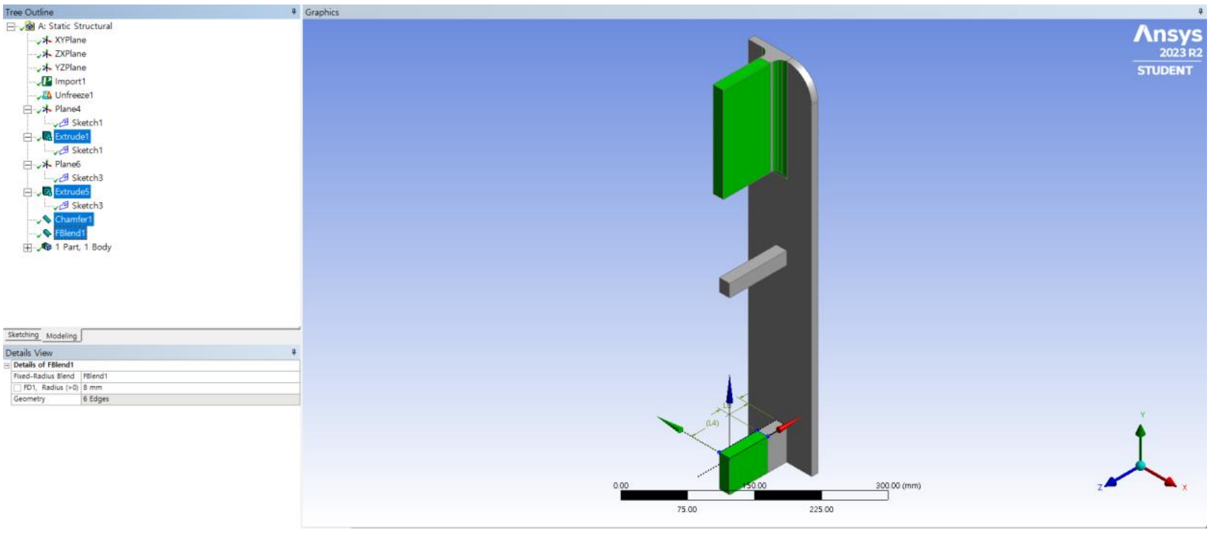

Figure 2. Making Imprinted Design, Chamfer and Blend in Geometry (Design Modeler)

3. Material (Structural Steel)

Properties of Outline Row 3: Structural Steel

	A	B	C	D	E
1	Property	Value	Unit		
2	Material Field Variables	Table			
3	Density	7850	kg m^-3		
4	Isotropic Secant Coefficient of Thermal Expansion				
6	Isotropic Elasticity				
12	Strain-Life Parameters				
20	S-N Curve	Tabular			
21	Interpolation	Log-Log			
22	Scale	1			
23	Offset	0	Pa		
24	Tensile Yield Strength	2.5E+08	Pa		
25	Compressive Yield Strength	2.5E+08	Pa		
26	Tensile Ultimate Strength	4.6E+08	Pa		
27	Compressive Ultimate Strength	0	Pa		

Table 1. Material Settings

4. Experimental Condition

Used Material	Structural Steel
Mesh	SOI(2mm, 20mm radius), 5mm, hexa-dominant
Force	Plane A: 29,430N, Plane B: -29,430N
Solution	Total Deformation
	Equivalent Stress
	Directional Deformation
	Force Reaction at C
	Force Reaction at D
	Force Reaction at E

Table 2. Simulation Conditions

5. Boundary Conditions & Load Conditions

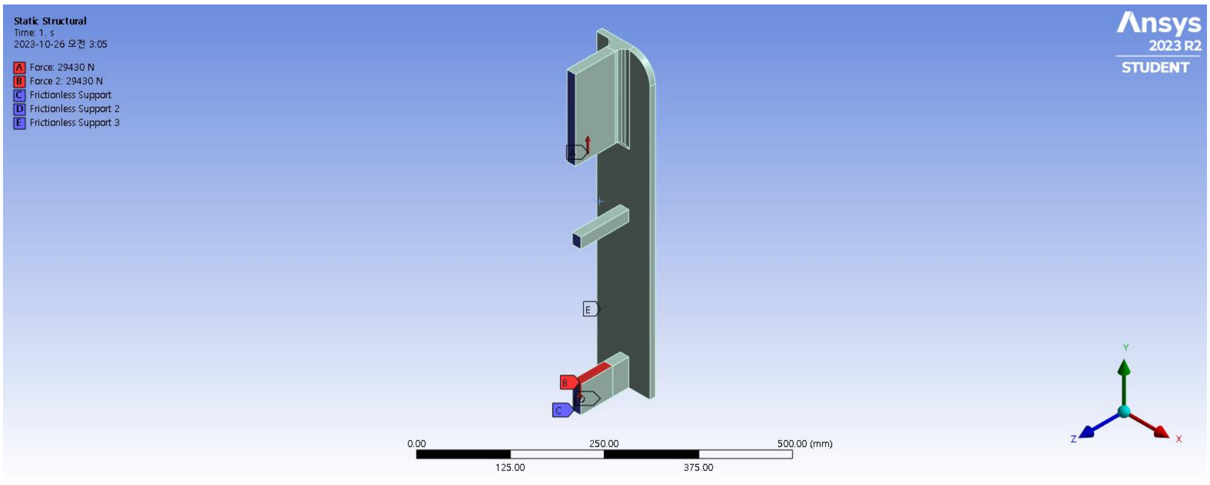

Figure 3. BC & LC

6. Result of Symmetry Model

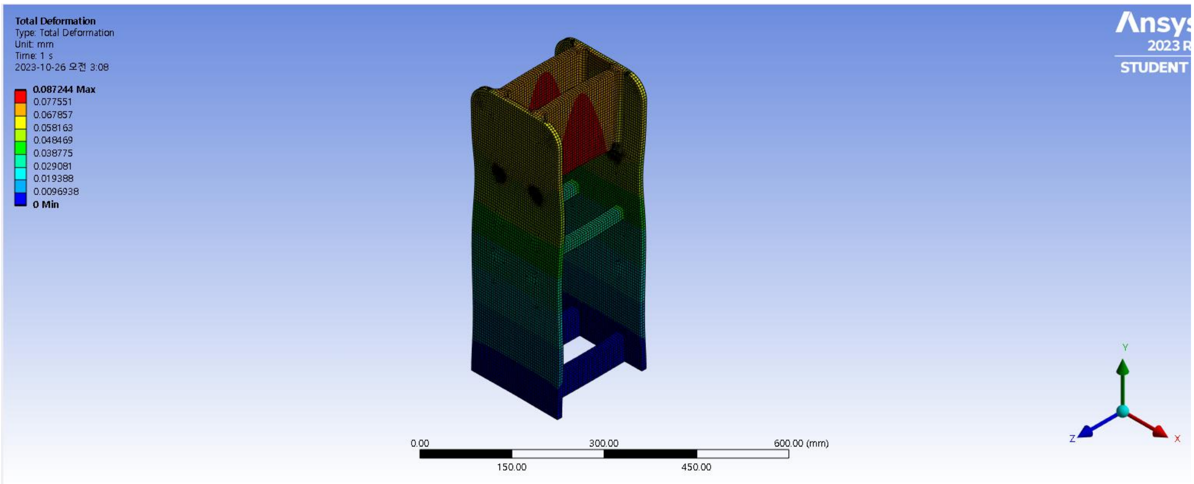

Figure 4. Total Deformation

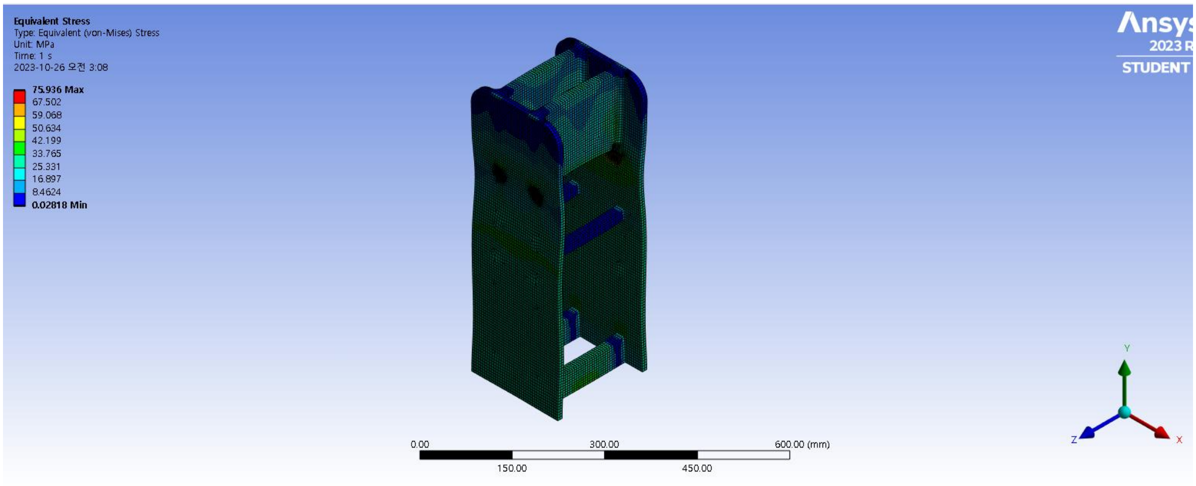

Figure 5. Equivalent Stress

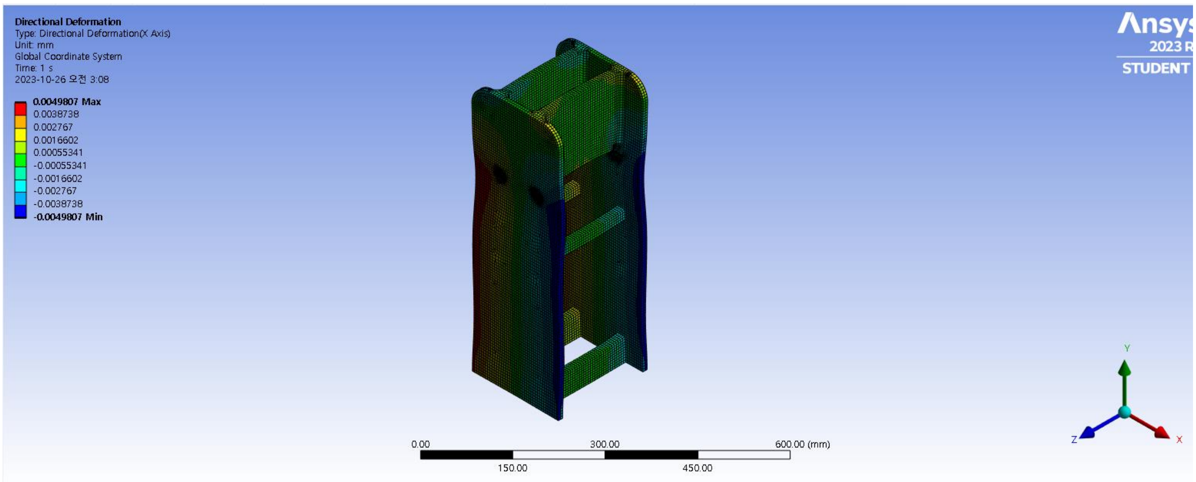

Figure 6. Directional Deformation

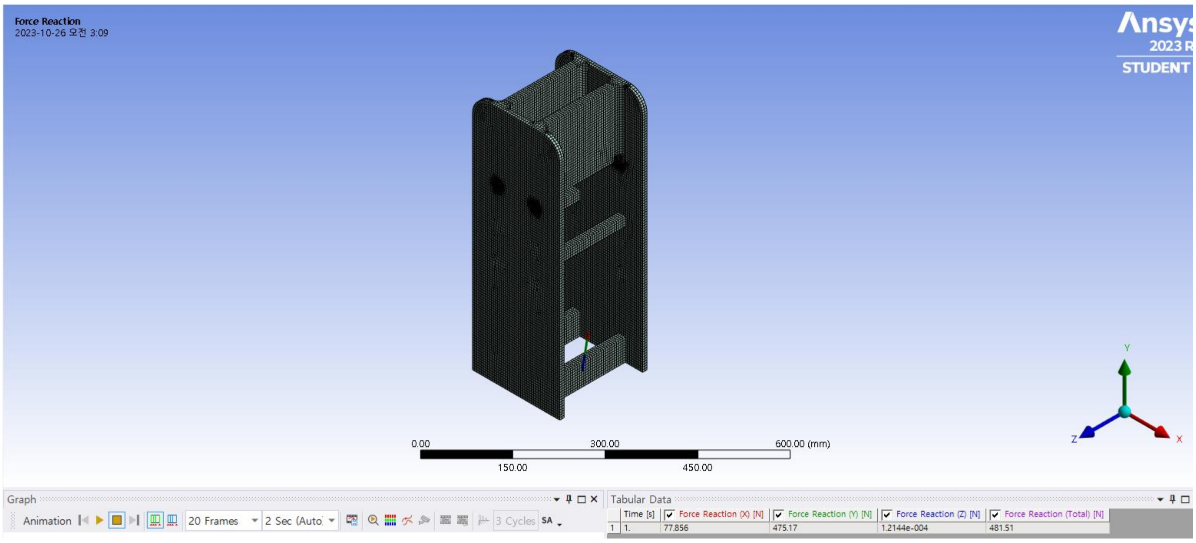

Figure 7. Force Reaction at C

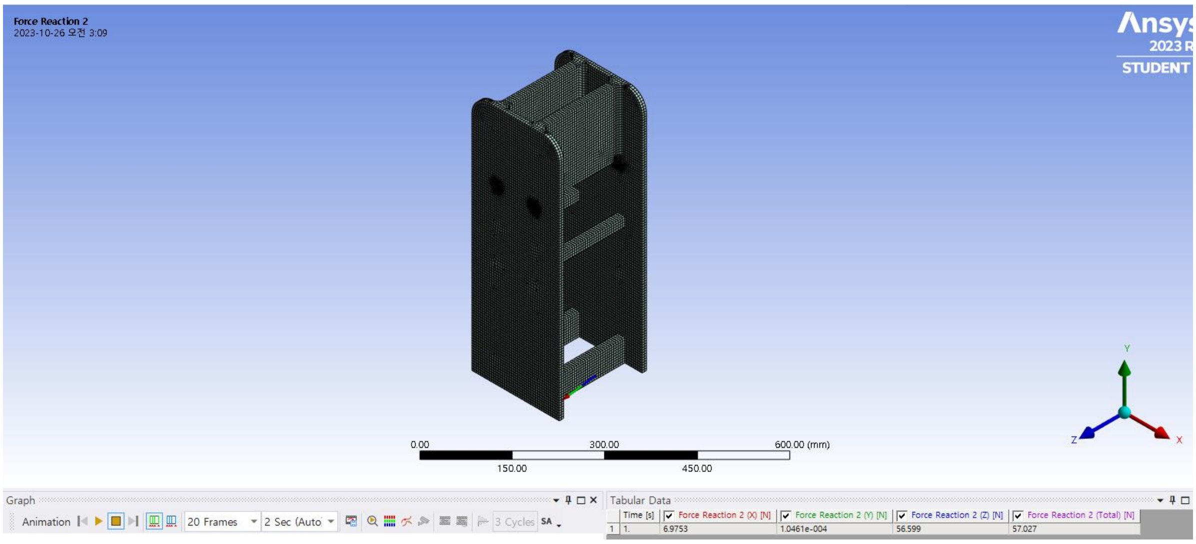

Figure 8. Force Reaction D

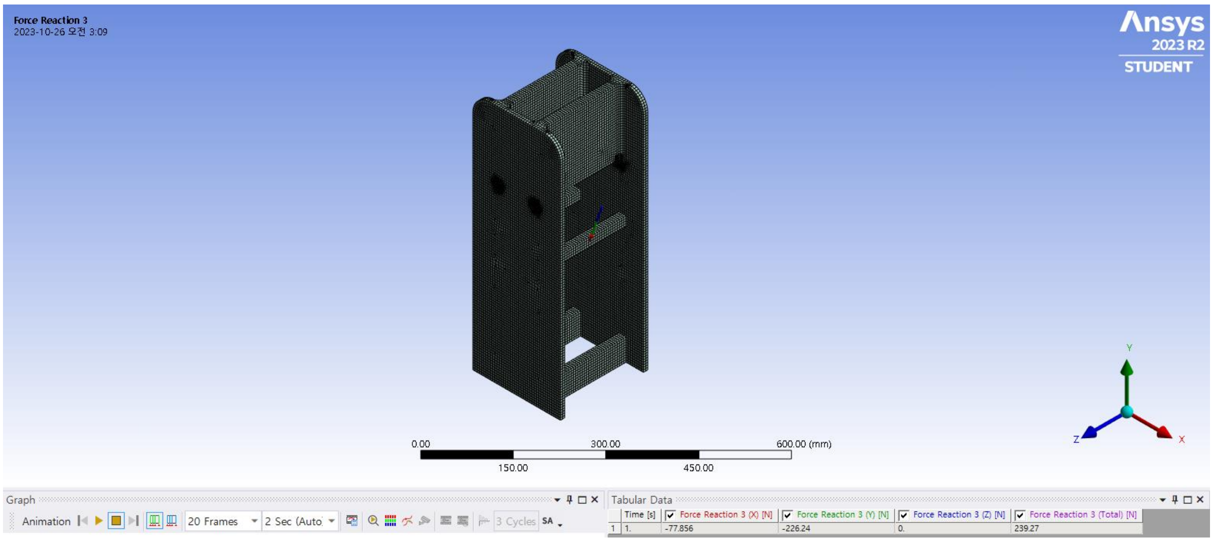

Figure 9. Force Reaction at E

7. Result of Full Model

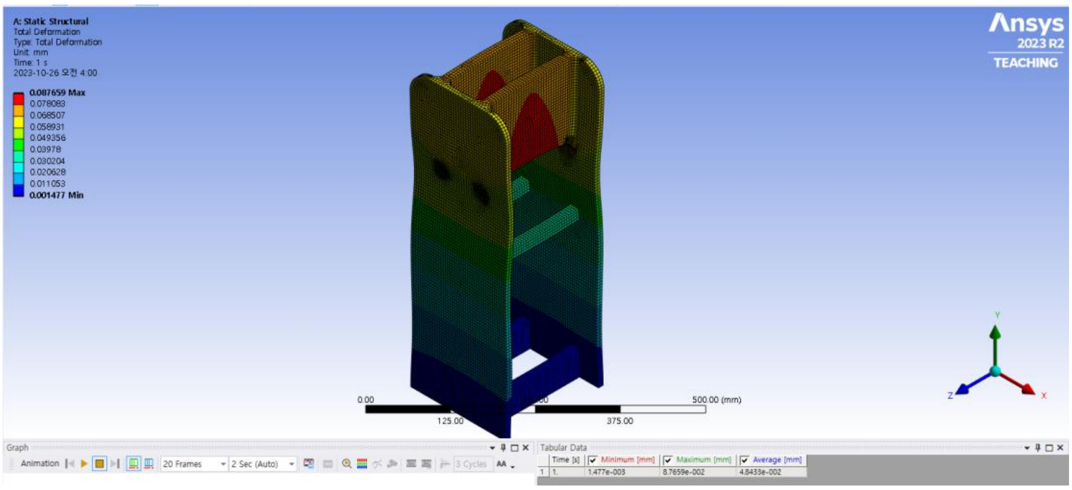

Figure 10. Total Deformation

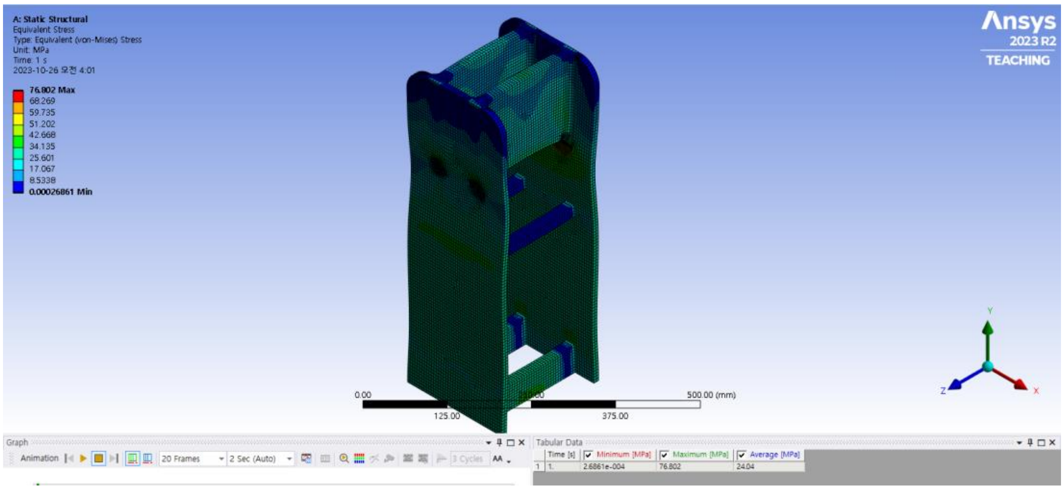

Figure 11. Equivalent Stress

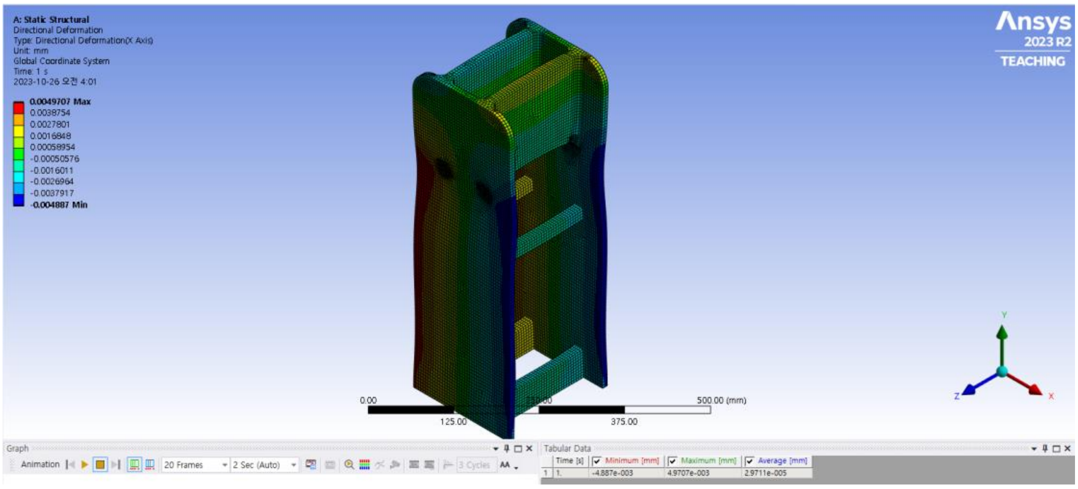

Figure 12. Directional Deformation

8. Analysis

① **Check for mesh convergence of your model.**

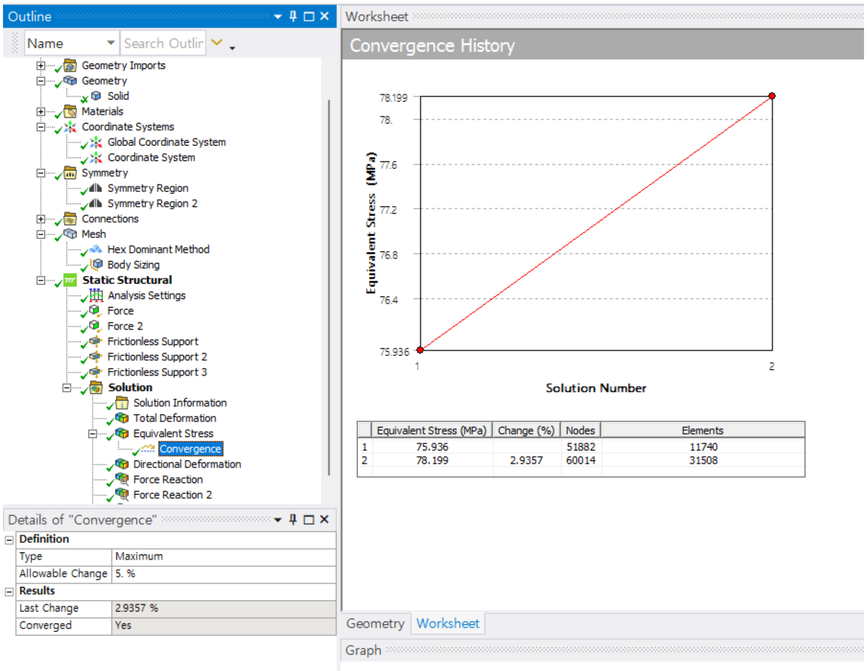

Figure 13. Mesh Convergence (Quarter Model)

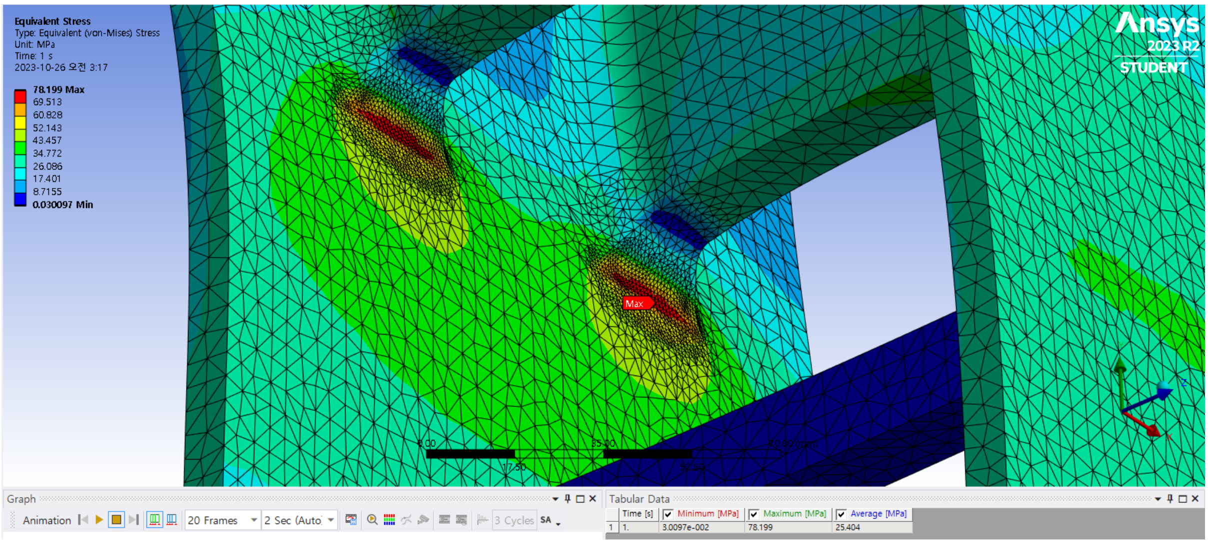

Figure 14. 5% inside Allowable Change Mesh Sized (Quarter Model)

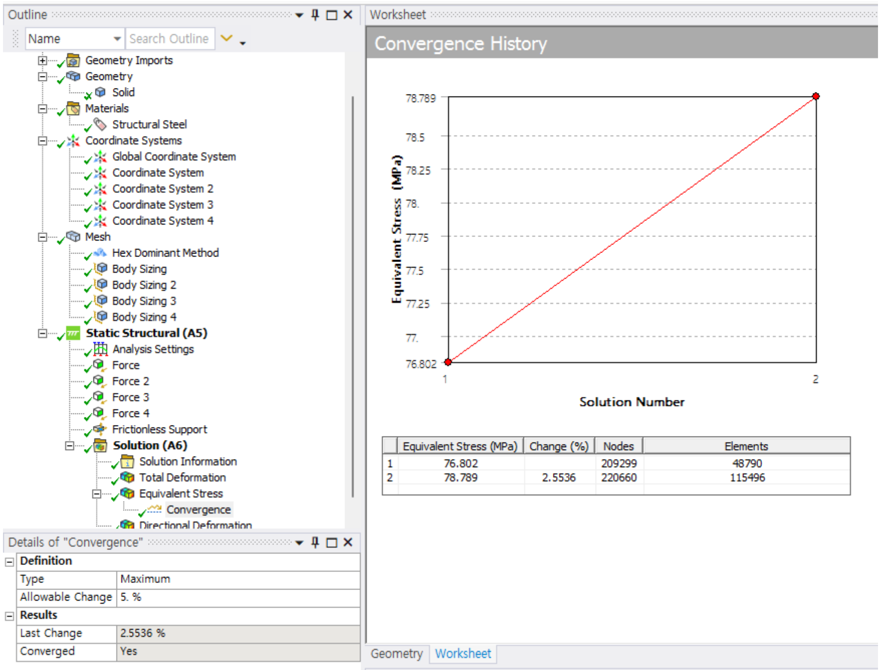

Figure 15. Mesh Convergence (Full Model)

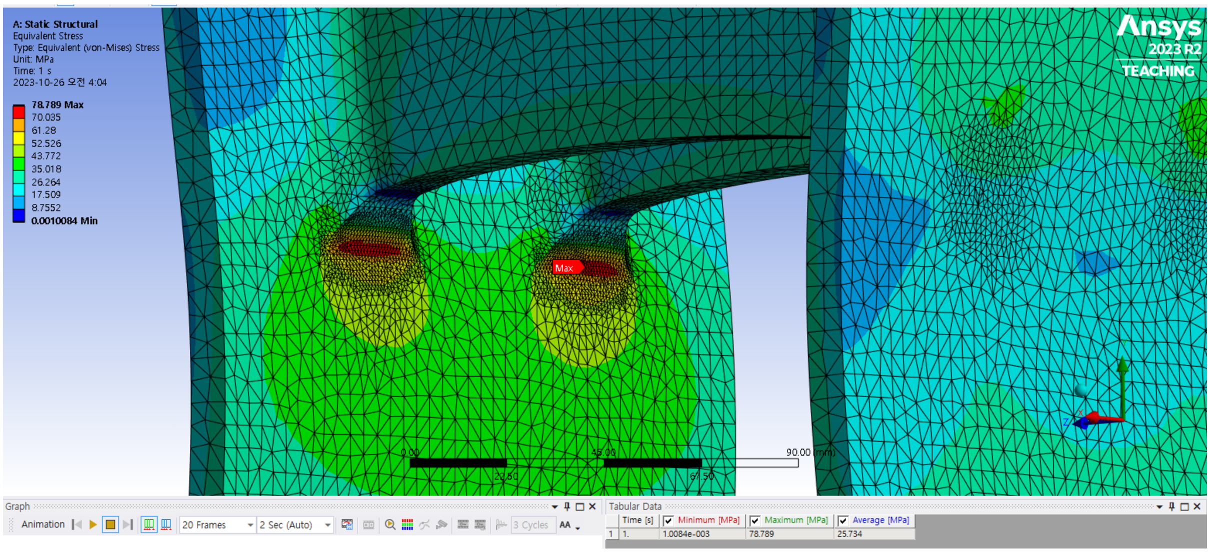

Figure 16. 5% inside Allowable Change Mesh Sized (Full Model)

② **Compare the results with those of the quarter model**

	Quarter Model	Full Model
Total Deformation [mm]	0.0872	0.0877
Von-mises Stress [Mpa]	75.936	76.802
Directional Deformation [mm]	0.00498	0.00497

Table 3. Before Mesh Convergence

	Stress [Mpa]	Nodes	Elements
Quarter Model	75.936 → **78.199**	51,882 → **60,014**	11,740 → **31,508**
Full Model	76.802 → **78.789**	209,299 → **220,660**	48,790 → **115,496**

Table 4. After Mesh Convergence (5% allowable change)

The results obtained through Ansys indicate a close similarity between the analysis of the 1/4 model using symmetry and the full model. In the case of the Coal Compression Equipment, stress is concentrated in the regions where the curved surfaces are created using the Chamfer and Blend functions. It is observed that at these stress-concentrated regions, both the Quarter Model and Full Model produce nearly identical Von-Mises Stress values of 78.2 and 78.8 [Mpa], respectively, when a 5% convergence is achieved through Mesh Convergence. The node and element details can be found in Table 3.