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| **CAE**  **Simulation #3** | **3D Element (Coal Compression Equipment)** | *21900416 Gyeonheal An* |
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# **Introduction**

기계, 공구, 실내이(가) 표시된 사진

자동 생성된 설명

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)

# **Geometry Design (DesignModeler)**

텍스트, 스크린샷, 로켓, 멀티미디어 소프트웨어이(가) 표시된 사진

자동 생성된 설명

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

# **Material (Structural Steel)**

텍스트, 스크린샷, 번호, 라인이(가) 표시된 사진

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Table 1. Material Settings

# **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

# **Boundary Conditions & Load Conditions**

스크린샷, 3D 모델링, 로켓, 미사일이(가) 표시된 사진

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Figure 3. BC & LC

# **Result of Symmetry Model**

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| --- |
| Figure 4. Total Deformation |
|  |
| Figure 5. Equivalent Stress |
|  |
| Figure 6. Directional Deformation |
|  |
| **Figure 7. Force Reaction at C** |
|  |
| Figure 8. Force Reaction D |

스크린샷, 텍스트, 그래픽 소프트웨어, 멀티미디어 소프트웨어이(가) 표시된 사진

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Figure 9. Force Reaction at E

# **Result of Full Model**

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| --- |
| Figure 10. Total Deformation |
|  |
| Figure 11. Equivalent Stress |
|  |
| Figure 12. Directional Deformation |
|  |

# **8. Analysis**

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

텍스트, 스크린샷, 소프트웨어, 번호이(가) 표시된 사진

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Figure 13. Mesh Convergence (Quarter Model)

텍스트, 스크린샷, 멀티미디어 소프트웨어, 그래픽 소프트웨어이(가) 표시된 사진

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

텍스트, 스크린샷, 번호, 라인이(가) 표시된 사진

자동 생성된 설명

Figure 15. Mesh Convergence (Full Model)

텍스트, 스크린샷, 멀티미디어 소프트웨어, 그래픽 소프트웨어이(가) 표시된 사진

자동 생성된 설명

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

1. **Compare the results with those of the quarter model**

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| --- | --- | --- |
|  | **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.