1-2. Stress Concentration of A Plate with Hole

1. Compare maximum stress and deformation for the two cases. (plate length 300mm, height 120mm, thickness 30mm)

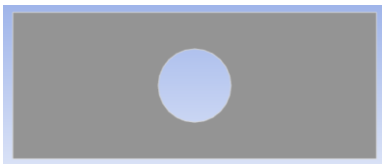
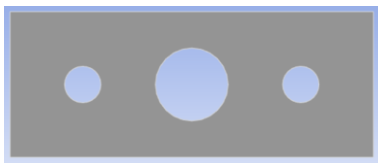
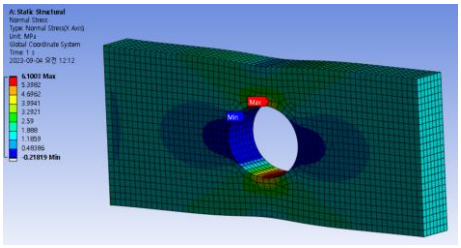
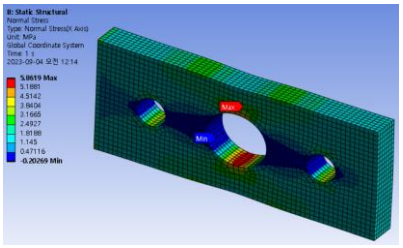
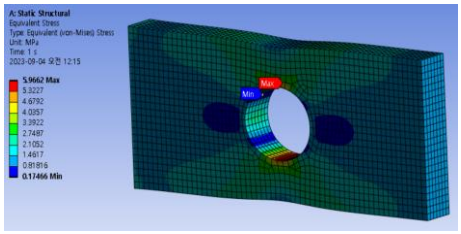
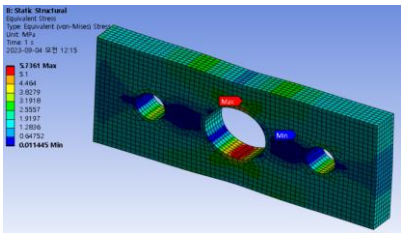
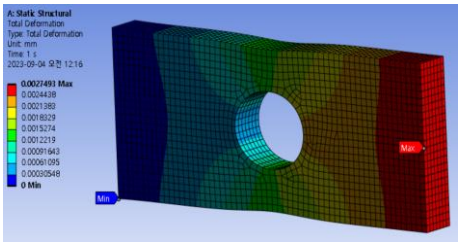
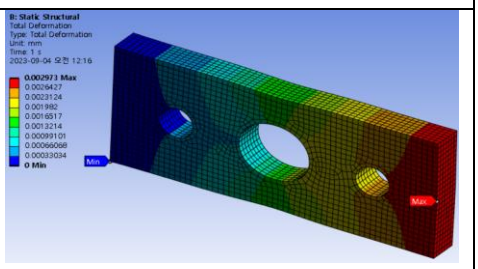
	Case1	Case2
		
Maximum normal stress	 6.1003 MPa	 5.8619 MPa
Maximum equivalent (Von-Mises) stress	 5.9662 MPa	 5.7361 MPa
Maximum deformation	 2.7493×10^{-3} mm	 2.973×10^{-3} mm

Table 1. Comparison between Case 1 and Case 2

- In terms of Maximum normal stress and Maximum equivalent (Von-Mises) stress, Case1 is about 2MPa larger than Case2. But, In terms of Maximum deformation, Case 1 is about 0.2×10^{-3} mm lesser than Case 2.
- There is also a difference in the value of the stress concentration factor K. The stress concentration factor can be obtained using the following equation.

$$K = \frac{\sigma_{max}}{\sigma_{avg}}, \quad \sigma_{avg} = \frac{P}{(w-d)t}$$

	Case 1	Case 2
σ_{avg}	$\frac{P}{(w-d)t} = \frac{5000}{(120-60)30} = 2.78$	$\frac{P}{(w-d)t} = \frac{5000}{(120-60)30} = 2.78$
K	$\frac{\sigma_{max}}{\sigma_{avg}} = \frac{6.1003}{2.78} = 2.19$	$\frac{\sigma_{max}}{\sigma_{avg}} = \frac{5.8619}{2.78} = 2.11$

Table 2. Stress-concentration factor

- Since the two objects have the same length, height, and thickness, σ_{avg} is the same. However, since the maximum stress is different, the concentration stress factor is different. As the maximum stress of Case 1 is higher than that of Case 2, it could be verified from Table 2 that the concentrated stress factor of Case 1 is larger.

2. Which of the design will you select from an analysis standpoint?

- Case1 has greater maximum stress than Case2, but the maximum deformation is smaller. Case1 objects and Case2 objects have the same length, height, and thickness. The maximum stress under the same conditions is about 2 MPa less in Case2 than in Case1. This means that Case 2 receives relatively less force, and the concentration of force is lower than Case 1. Therefore, from an analysis standpoint, Case 2 will be selected by determining that Case 2 will be safer.

3. Which of the design will you select from a manufacturing standpoint?

- Case 1 has fewer holes than Case 2. Although the maximum stress is higher in Case 1, it offers the advantage of being easier and more cost-effective to manufacture since it requires less hole processing. Additionally, because of the difference in the number of holes, the design of Case 1 is simpler than Case 2, which reduces production time, allowing for the production of more items. Although there is a subtle difference in maximum deformation between the two objects, if I have to compare those, Case 1 has less deformation than Case 2, making it safer from a deformation perspective. Therefore, from a manufacturing standpoint where factors such as cost and production time and others are crucial, Case 1 would be the preferred choice.