Digital Manufacturing

Project 4: Topology Optimization

Instructor:

Hod Lipson

Author:

Yufan Wang

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Section 1: Desk

Requirement:

1. Dimension: 30in high, 24in deep and 60inch wide.

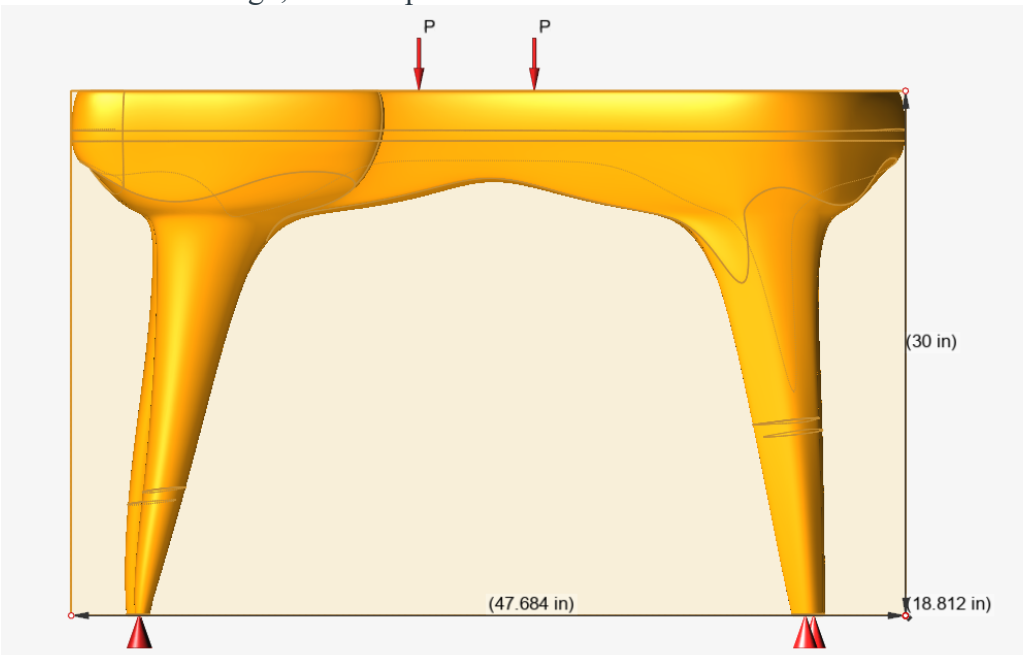


Figure 1. Dimension of the desk.

2. Load: 150kg man standing on top.

   Pressure on the desk surface is calculated by man's weight divided by area of standard foot. The calculations are shown below.

$$W = 150kg * g = 330lbf$$

$$P = \frac{W}{A} = 330\ lbf \div 31in^2 = 10.7lbf/in^2$$

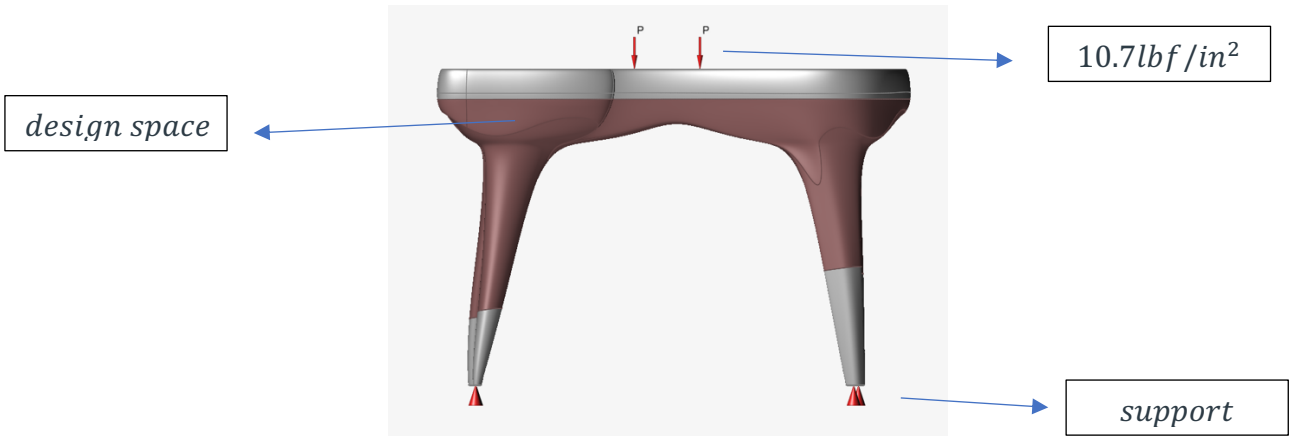


Figure 2. Constriants of the desk.

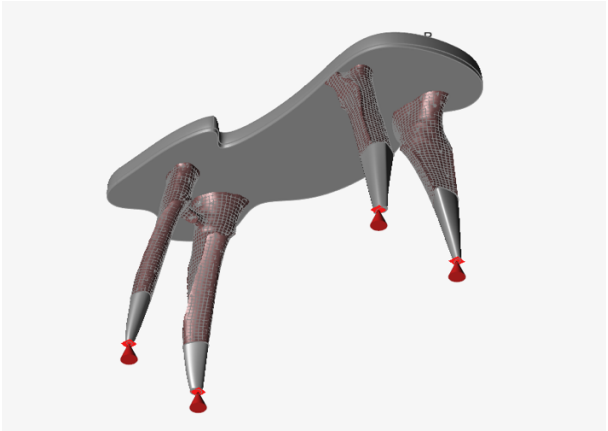
Mass reduction:

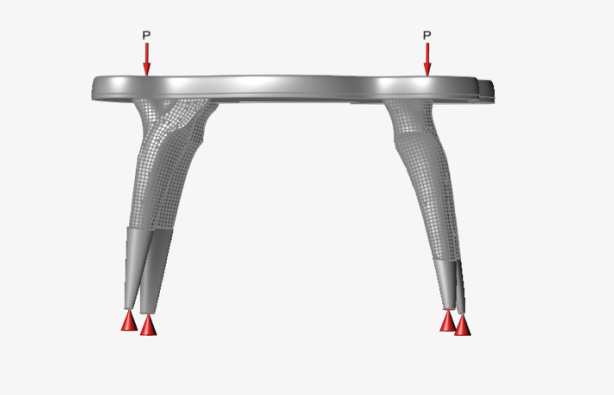
Before optimization:

After optimization:

$$\%\text{mass reduction} = \frac{0.56872 - 0.31478}{0.56872} * 100\% = \ 44.65\%$$

Screenshots:





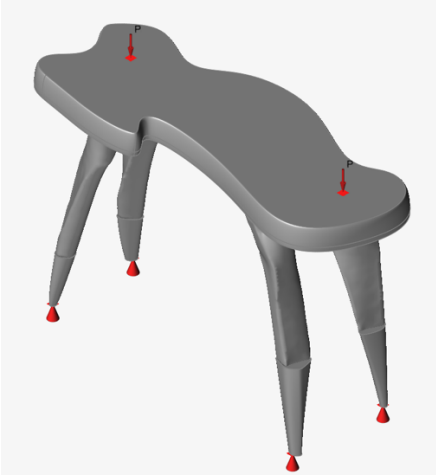


Figure 3. screenshots of the desk.

Section 2: Chair

Requirement:

1. Load: 150kg man standing on top.

   Pressure on the desk surface is calculated by man's weight divided by area of sitting area. The calculations are shown below.

$$W = 150kg * g = 330lbf$$

$$P = \frac{W}{A} = 330\ lbf \div 50in^2 = 6.6lbf/in^2$$

and the pressure when user lean on the back is assumed at angle 10 degree with half human weight:

$$P = \frac{W * \sin(10°)}{A} = 165 * \sin(10°)\, lbf \div 61.5in^2 = 0.465 lbf/in^2$$

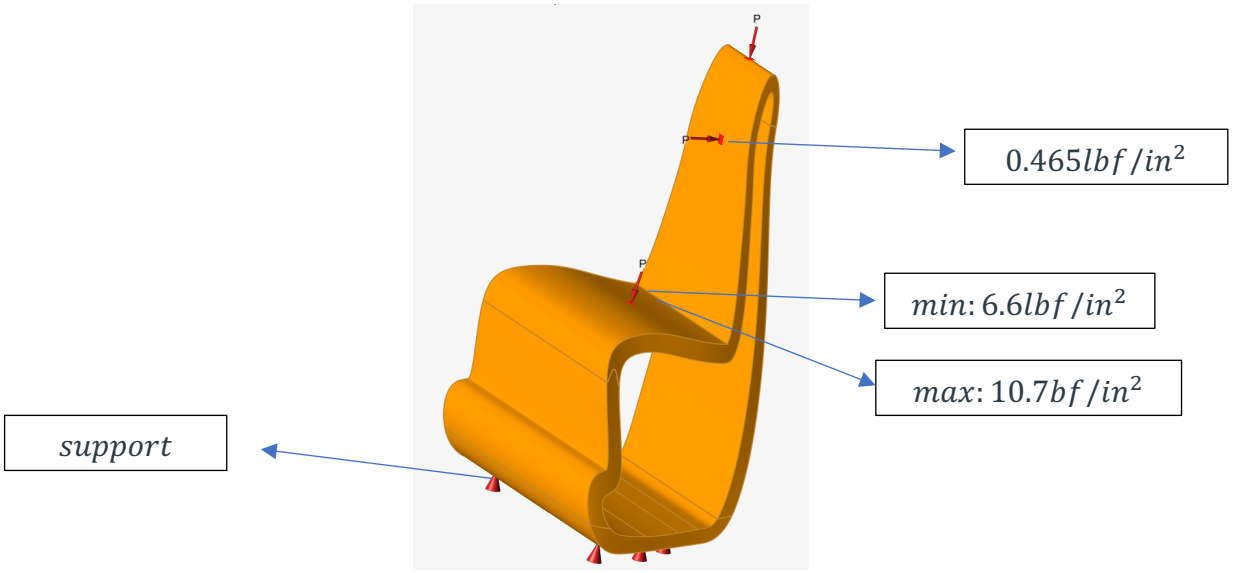


Figure 4. Constraints of the chair

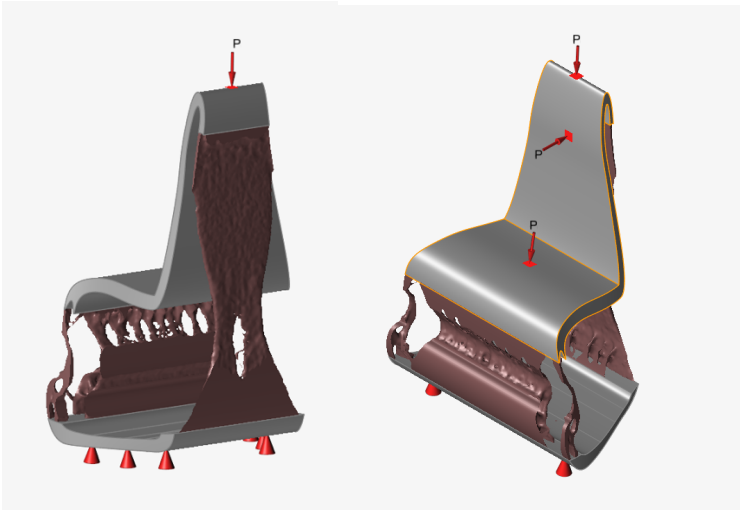


Figure 5. Screenshots of chair

Mass reduction:

Before optimization:

After optimization:

$$\%\text{mass reduction} = \frac{0.3449 - 0.18334}{0.3449} * 100\% = \ 45.4\%$$

Section 3: Final render

Figure 5. final render 1.

Figure 6. final render 2.