# Stress distribution in a bicycle brake lever

Figure 1 shows a force of magnitude 85lbf is acting at 2.65” from flat face. Fixed support at cable end and hinged support at brake lever pivot. Material selected is AISI 347 Annealed Stainless Steel from the materials library in Solidworks.

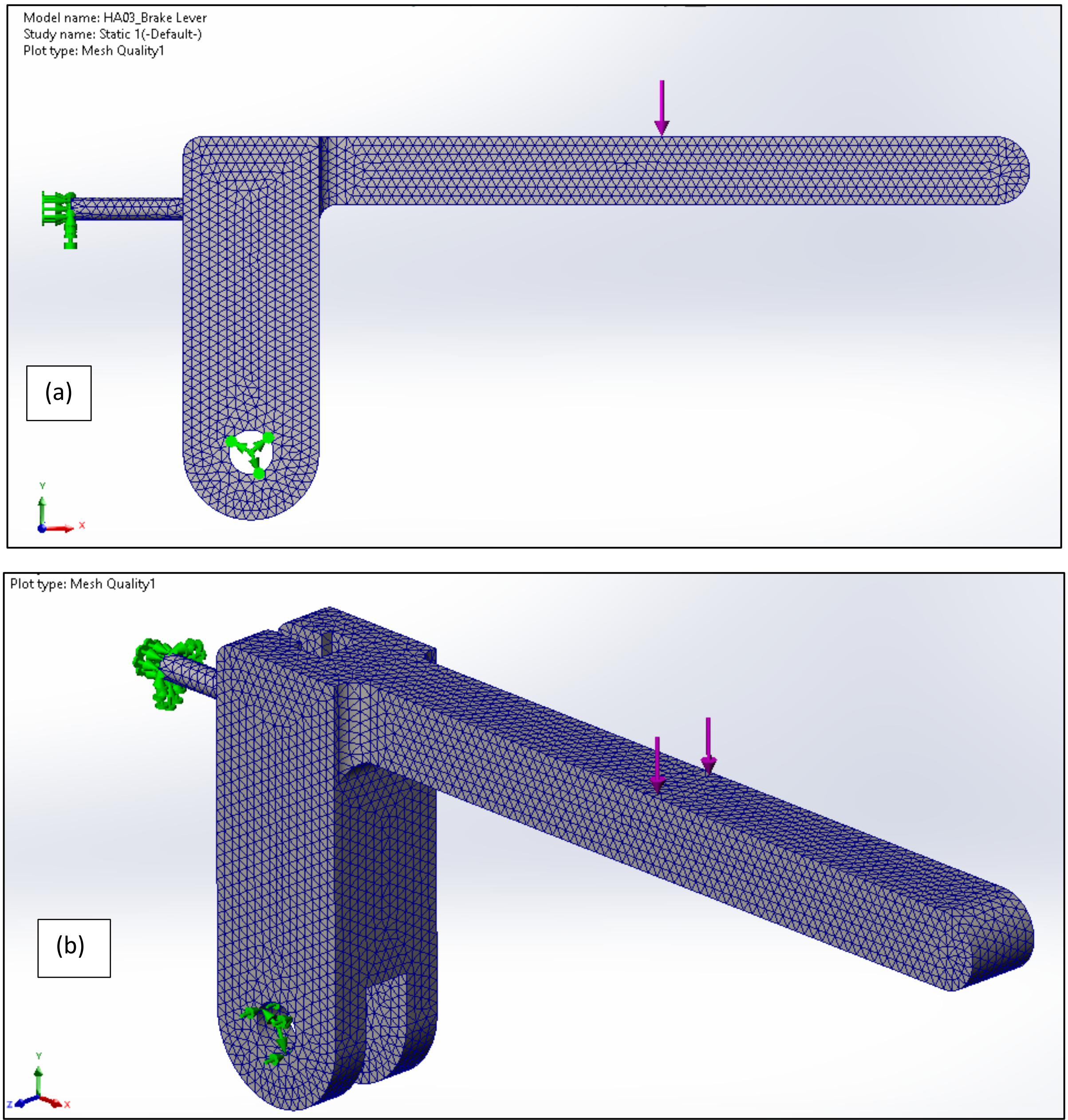


*Fig. 1. Fixtures, load, and mesh applied for FEA simulation (a) Side view (b) Isometric view.*

a.) For bending stress, we will observe the X-normal stress plot results. Figure 2 shows the X-normal stress distribution in the brake lever due to applied load and constraints. The bending stresses in the lever are along the X-direction and thus X-normal stress distribution gives us appropriate bending stress. Figure 3 shows Von-Mises stress distribution along with yield strength and max/min values. Here, the factor of safety is 1.2 approximately.

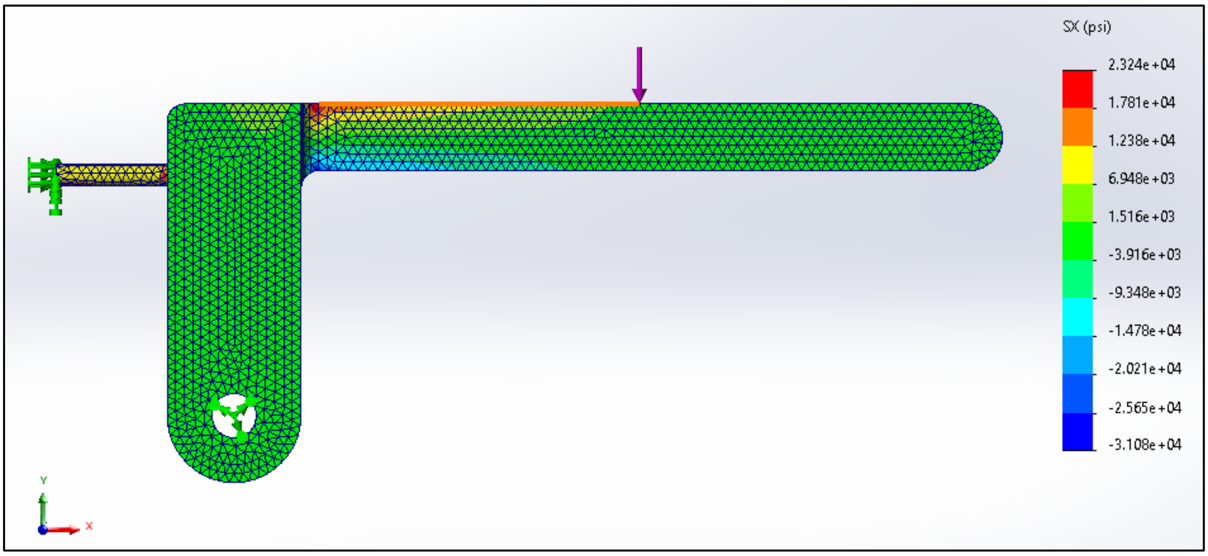


*Fig. 2. X-normal stress distribution in the modified brake lever.*

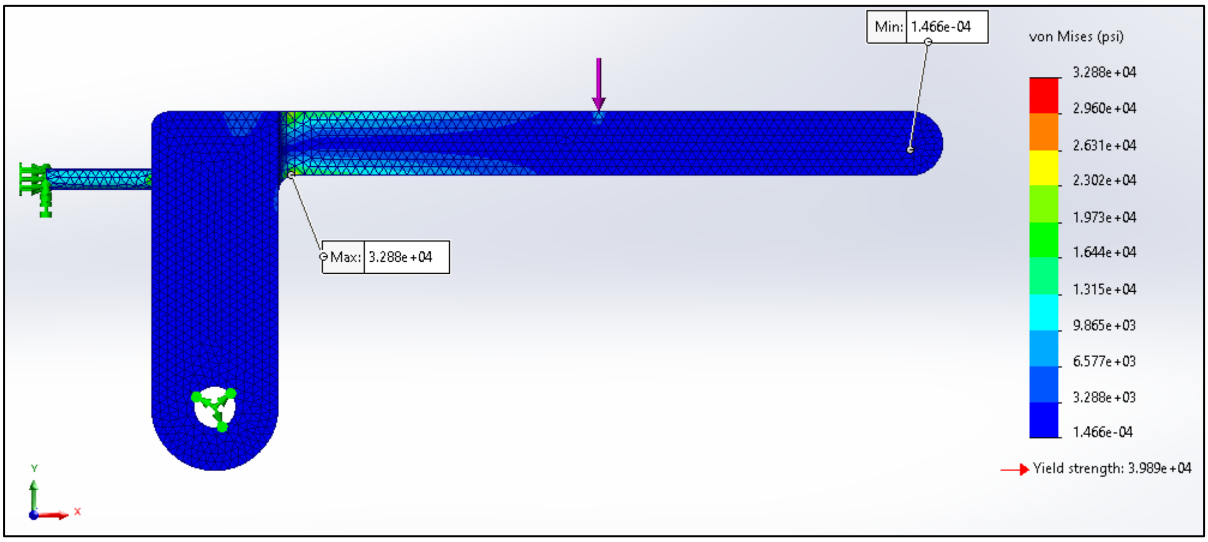


*Fig. 3. Von-Mises stress distribution in the modified brake lever.*

b.) Probing the results along the fillet tendency line for the bending stress (X-normal), the plot obtained for stress vs parametric distance is shown in figure 4. Here, 0 is at the top surface (tension) and 1 is at the bottom surface (compression).

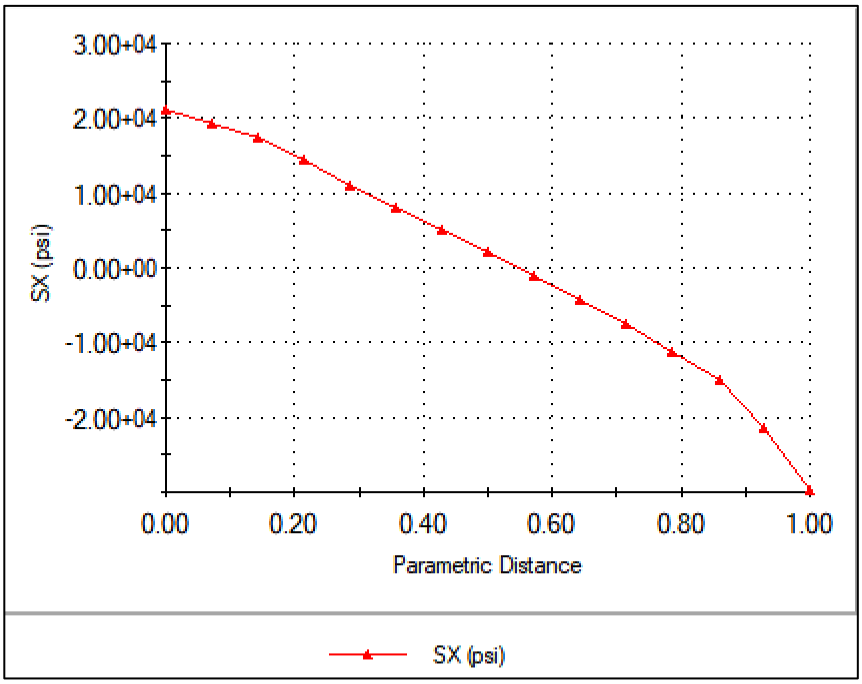


*Fig. 4. Graph of shear stress due to bending along the fillet tendency line.*

c.) Manual calculation of bending stress on the top face of the brake lever:

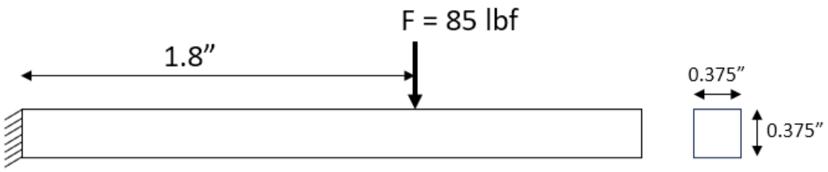


*Fig. 5. Cantilever beam for manual calculations.*

Assuming cantilever beam with uniform cross section (0.375”x0.375”) and fixed support at the fillet tangency line of interest. Distance measured from fillet tangency line to applied force is 1.8”.

To calculate bending stress on the top face of the brake lever, where it meets the fillet tangency line,

F = 85 [*lbf*]  M = F x 1.8 = 85 x 1.8 [*lbf.in*]

a = 0.375 [*in*]  y = a/2 = 0.375/2 [*in*]

For square cross-section, I = $a^4/12$ = $0.375^4/12$ $[in^4]$

Bending stress at top face,

$$\sigma_{max} = \frac{M.y}{I} = \frac{85\times1.8\times0.375\times12}{0.375^4\times2} = 17408\ [psi] = \mathbf{1.741\times10^4}\ [psi]$$

d.) Comparing simulation results with analytical solution:

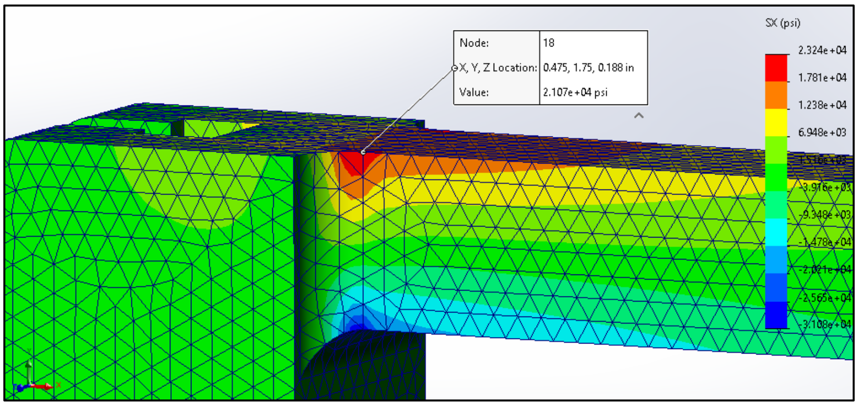


*Fig. 6. Bending stress on top face of lever where it meets the fillet tangency line from simulation.*

From figure 6, the value obtained from simulations is $2.107 \times 10^4\ psi$, which is greater than the analytical value $1.741 \times 10^4\ psi$. The deviation observed is due to the assumptions made for ease of manual calculations.