Stepped Shaft - Pre-Analysis & Start-Up

Authors: Rajesh Bhaskaran and Vincent Prantil

Pre-Analysis & Start-Up

Pre-Analysis

It is recommended that you make some back-of-the-envelope estimates of expected results before launching into your computer solution. Here

$$h = 3\ in$$

$$r = 1\ in$$

$$D = 8\ in$$

$$\frac{h}{r} = 3$$

$$\frac{2h}{D} = \frac{3}{4} = 0.75$$

for which the following formula for the axial stress concentration factor, K, holds (*Roark's Formulas for Stress and Strain*, Warren C. Young and Richard G. Budynas, 2002):

$$K = C_1 + C_2 \frac{2h}{D} + C_3 \left(\frac{2h}{D}\right)^2 + C_4 \left(\frac{2h}{D}\right)^3$$

$$C_1 = 1.225 + 0.831\sqrt{h/r} - 0.010\left(h/r\right) = 2.634$$

$$C_2 = -1.831 - 0.318\sqrt{h/r} - 0.049\left(h/r\right) = -2.529$$

$$C_3 = 2.236 - 0.5220\sqrt{h/r} + 0.176\left(h/r\right) = 1.8599$$

$$C_4 = -0.63 + 0.009\sqrt{h/r} - 0.117\left(h/r\right) = -0.965411543$$

$$\Rightarrow K = C_1 + C_2 \frac{2h}{D} + C_3 \left(\frac{2h}{D}\right)^2 + C_4 \left(\frac{2h}{D}\right)^3 = 1.3766$$

where

$$\sigma_{MAX} = K\sigma_{NOM} = K\frac{P}{A_{MIN}} = K\frac{4P}{\pi\left(D-2h\right)^2} = 1376\ psi$$

We'll compare the above axial stress concentration factor to the value obtained from ANSYS.

Start-Up

Launch ANSYS Workbench and start a "Static Structural" analysis in the project page as shown in the video below.

Go to Step 2: Geometry

Go to all ANSYS Learning Modules