ANSYS - Stepped Shaft

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A Stepped Shaft in Axial Tension

Created using ANSYS 14.0

Problem Specification

This problem is taken from:

- Prantil, V. C., Papadopoulos, C. and Gessler, P. D., *Lying by Approximation: The Truth About Finite Element Analysis*, Morgan and Claypool (2013).

Consider a stepped shaft under an applied axial load, P. A stress concentration is apparent at the step where the cross-sectional area is discontinuous. The cross section is circular.
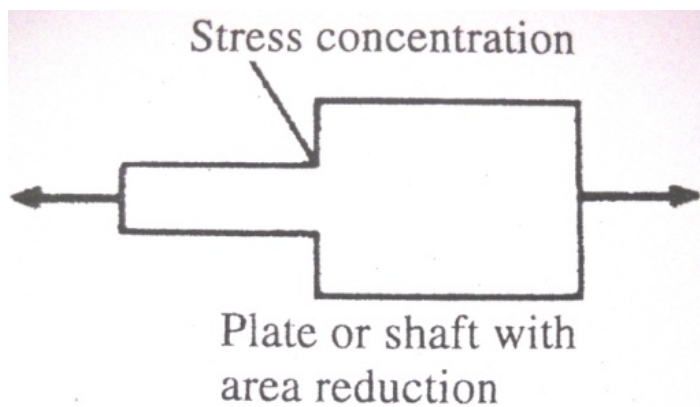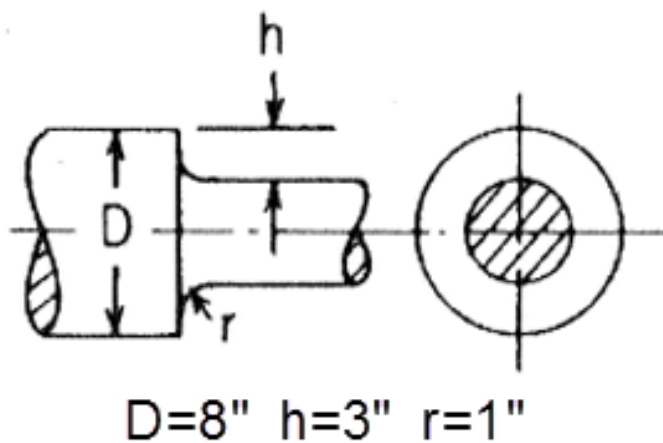
The pressure load P/A on the smaller cross-section is 1000 psi.

Calculate the axial stress concentration factor and compare it to the formula provided in *Roark's Formulas for Stress and Strain*, Warren C. Young and Richard G. Budynas, 2002.

Learning Goals

The purpose of this tutorial is to showcase perhaps the simplest stress concentration and point out that it can be resolved in 2 or 3 dimensions. Simple one-dimensional elements (i.e. simple axial bar elements) that capture constant stress within an element are insufficient to capture stress concentrations, even when many elements are used. That is to say, when the necessary physics is not contained in the element formulation, so-called h-convergence or using more elements captures "no more" of the solution than does a coars(er) discretization. This tutorial is meant to highlight where it is relatively straightforward to apply FEA and resolve a solution correctly that belies analytical treatment with uniaxial formulae (such as axial_stress = P/A).

Go to Step 1: Pre-Analysis & Start-Up

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