ANSYS AIM - I Beam

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A non-slender cantilever beam under point tip loading

Created using ANSYS 17.1

Problem Specification

Consider a fixed-end, aluminum cantilever I-beam point-loaded at its tip as shown in the figure below. We will be solving for directional deformations and normal stresses in this tutorial.

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P = 1000 lbf, L = 24 in, c = 4 in

The cross-sectional area and second moment of inertia are A = 9.45 in^2 and I = 112.3 in^4 respectively. These values correspond to the I-beam cross-section shown in the next figure along with a fully three-dimensional solid model of the beam for purposes of visualization. Use the following material properties for the aluminum beam:

Young's Modulus = 1e7 psi, Poisson's Ratio = 0.33

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Learning Goals

The purpose of this tutorial is to showcase, in a relatively simple situation, where simple beam theory is no longer as valid as it is in the limit of a long and slender beam geometry. In some commercial codes, simple one-dimensional cubic beam elements for bending deflection, do not capture shear deflection when the beam is no longer slender. Alternatively in ANSYS, if shear deflection is accounted for in the 1D element formulation, results for the beam's tip deflection will not agree with tip deflections predicted by simple Euler-Bernoulli beam theory. Again, attempts to capture this effect by using more elements will ultimately fail. Either the necessary physics is not contained in the element formulation or it is and the results are compared to simpler theory. Either way, using more elements captures “no more” of the solution than does a coarser discretization.

This tutorial is meant to highlight where it is relatively straightforward to apply 3D FEA and resolve a correct solution, which contradicts analytical treatment with simple formulae such as bending tip deflection =

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

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