University of California, Berkeley
CEE C133/ME C180, Engineering Analysis Using the Finite Element Method
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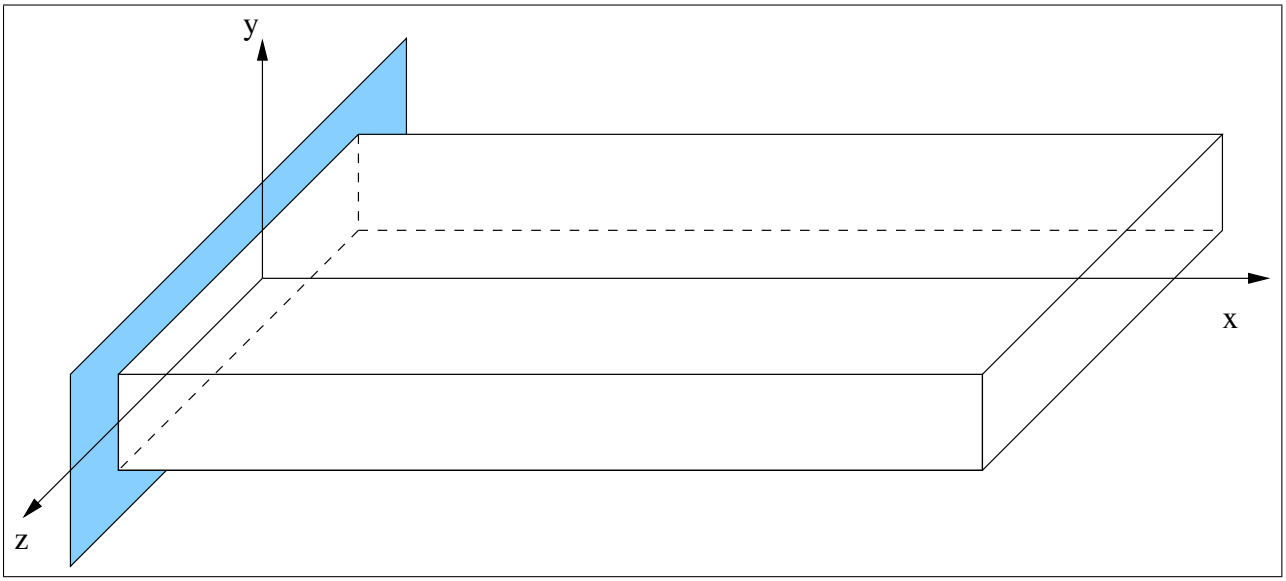
Lab 09: Beam Bending in 2D and 3D

- Consider the following figure. It consists of a three-dimensional beam subject to bending loading. The dimensions are $L = 1.0$ in the x direction, $h = 0.1$ in the y direction, and $d = 1.0$ in the z direction. The boundary conditions are totally fixed at $X = 0$, and at $X = L$, a uniform traction in the y=direction, with the magnitude $t_y = -1e8$, which results in the flexure of the beam. The material properties are $E = 2e11$ and $\nu = 0.40$.



- Recall that the plane strain solution assumes that there is zero displacement (strain) in the out-of-plane direction. This assumption is typically represented by the idealization of the body having a very large out-of-plane dimension. Alternately, plane stress assumes no stress in the out-of-plane direction, which is manifested in the representation of the body having a very small out-of-plane dimension.

- Knowing what you do about the plane strain and plane stress assumptions, model the $x - y$ plane of this beam using both plane strain and plane stress, as well as in three dimensions.

- In your results, include the following: 1) plots of the y-displacement along the line $Y = 0$ for all three cases on the same plot, and 2) checks of the respective plane solution assumptions with respect to the 3D case. Also, comment on your results.