MECH 360 Notes

By AJ Wong and Eugene Lee

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1 Pure Bending

1.1 Unsymmetric Bending Analysis

Any given section possess *principal centroidal axes* even if it is unsymmetric. Principal centroidal axes can be determined

1. analytically
2. or using Mohr's circle.

If **M** is along the principal centroidal axis, the N.A. will be along the axis of **M**, then the equations for symmetric members can be used to compute the stresses. The principal of superposition is used to determine stresses in general for unsymmetric cases.

Given some a couple momment **M**, we have

$$M_z = M\cos\theta, \quad M_y = M\sin\theta,$$

then using superposition,

$$\sigma_x = \frac{-M_z y}{I_z} + \frac{+M_y z}{I_y}.$$

Points along the N.A. have no stress, thus let $\sigma_x = 0$, and using $M_z = M\cos\theta, \quad M_y = M\sin\theta$, we get

$$y = \underbrace{\left(\frac{I_z}{I_y}\tan\theta\right)}_{a} z,$$

representing a line $y(z)$ with slope a. Letting ϕ be the angle between the N.A. and the z-axis gives

$$\tan\phi = \frac{I_z}{I_y}\tan\theta.$$